The Salience of Climate Change and Green Patents Review: Evidence from Climatic Disasters[†]

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Abstract

This paper investigates the causal impact of patent examiners' beliefs about climate change on their patent review behavior and outcomes. Using a large sample of U.S. patent examiners from diverse geographic locations between 2012 to 2020, we leverage climatic natural disasters as shocks to examiners' beliefs about climate change. We find that, following a local climatic disaster, examiners grant more green patents and the green patents granted are of higher quality. Further analysis reveals that these examiners exert greater effort in the patent review process. These effects of climatic disasters are muted for non-green patent reviews. Moreover, the higher quality of green patents granted after natural disasters leads to reduced future greenhouse gas emissions by the associated companies.

Keywords: patent examiner, climate change, climatic disaster, green patents, patent quality, greenhouse gas emission

JEL Classifications: G30, G41, O30, Q54, Q55

Green innovation plays a critical role in addressing the challenges posed by climate change, as it focuses on developing sustainable technologies, processes, and products that reduce environmental harm. Technological advancements, such as carbon capture technologies and biodiversity protection strategies (adaptation solutions), are widely regarded as promising solutions to climate change. Moreover, green innovation drives economic growth by opening new markets, generating green jobs, and encouraging investment in sustainable industries. Despite the importance of green innovation, there is a paucity of research on the factors driving the success of such innovation. In this paper, we attempt to fill the gap by investigating how patent examiners' beliefs about climate change influence the review process and outcome for green patent applications.

Patent examiners are gatekeepers of the innovation system, and previous studies have shown that the patent review process and outcomes can be significantly influenced by patent examiners. Factors such as examiner experience (Lemley and Sampat, 2012), career concerns (Frakes and Wasserman, 2017), leniency (Farre-Mensa, Hegde, and Ljungqvist, 2020), and busyness (Shu, Tian, and Zhan, 2022) can have substantial impact on both the approval and the quality of patents granted. It is less understood whether patent examiners have non-pecuniary beliefs and how these beliefs eventually affect their behavior during the patent review.

Measuring a patent examiner's beliefs is empirically challenging, as these beliefs are often correlated or confounded by other characteristics of patent examiners. To address this challenge, we exploit the geographical variations of examiners and the timing of climatic disasters affecting different regions. The occurrence of climatic disasters, which act as a shock to examiners' beliefs about climate change, provides a quasi-exogenous setting. [1] These events are unlikely to be related

[1] Climatic natural disasters, such as drought, hurricanes, and wildfires, are extreme consequences of climate change. Since 1980, the U.S. has experienced 377 billion-dollar climatic natural disasters, amounting to a total cost of more than $2.67 trillion.

to examiners' characteristics but are likely to capture their attention and strengthen their beliefs about climate change. Therefore, we hypothesize that experiences of climatic disasters will lead patent examiners to grant more green patents, reflecting a shift in their behavior driven by heightened awareness of environmental issues.

Using data from the Spatial Hazard and Loss Database for the United States (SHELDUS), we identify major climatic natural disasters in the U.S. Patent examiners and patent information are obtained from the official websites of the United States Patent and Trademark Office (USPTO), and PatentsView. Examiner location (county-level) as well as their compensation information are provided by FederalPay.org. We focus on a sample starting in 2012 when the USPTO officially launched a work-from-anywhere (WFA) program, creating geographical variations for examiners. For each examiner each year, we require the examiner to grant at least one patent. With this simple filtering process, our sample contains 58,161 examiner-year observations from 8,408 unique examiners. According to the Cooperative Patent Classification (CPC) classification, our sample examiners grant 293,927 green patents and 3,461,365 non-green patents during the sample period.

We begin our investigation by examining whether the experience of a climatic natural disaster affects patent examiners' review process of green innovation. For each examiner each year, we first calculate the share of granted green patents in her granted patent portfolio. Compared to examiners with no experience of climatic disaster, examiners who experienced a climatic disaster grant more green patents in the year following the disaster. Specifically, an examiner with climatic disaster experience increases green patent granting by approximately 10% in her portfolio. It is unlikely that the growing interest in green technologies drives our documented results as we compare the examiners with and without experiencing a climatic disaster in the same year. As the USPTO randomly assigns patent applications to examiners, our documented patterns are also

immune to changes in corporate innovation strategies, for example, firms invest more in green technology and apply for more green patents. We further classify green patents into two categories, i.e., mitigation and adaption. Though examiners with disaster experience increase the granting for both categories, they grant more climate-change-mitigation green patents as a response to climatic disasters.

Our documented findings are robust in several dimensions. First, we define green patents and non-green patents using an alternative classification and find coherent results that climatic disasters lead examiners to approve more green patents in their granted patent portfolio. Second, in the year before climatic disasters, we match examiners in the same art unit and pay level to mitigate any possible heterogeneity in the technological field or preferences. Our results remain quantitatively the same. Last, we exclude patent applicant firms that are in the same state as the examiner to rule out the possibility that geographic proximity facilitates information spillover between examiners and applicant firms.

We further decompose green patent grants into two components, i.e., the approval rate of green patent applications and the number of green patent applications. An increased share of granted green patents could result from examiners changing their beliefs and granting more green patents or simply from receiving a higher number of green patent applications. If climatic disasters change patent examiners' preferences for green patents, our results are expected to be driven by an increased green patent approval rate. We find corroborating evidence for such conjecture. Moreover, consistent with the random assignment of patent applications to examiners by the USPTO and the unexpected occurrence of climatic disasters, there is no significant difference in the number of green patent applications between examiners with and without disaster experience.

As a placebo test, we find insignificant changes in approval rates of non-green and all patents, indicating that climatic disasters only change examiners' preference for green patents. When we replace climatic disasters with other natural disasters, such as tsunamis/seiches, we find no evidence that examiners change their behavior for green patent granting. These placebo tests highlight that salient climatic disasters shape examiners' beliefs about climate change and further strengthen their preference for green innovation.

To further understand examiners' patent granting behavior, we investigate the quality of green patents granted conditional on whether examiners have experienced climatic disasters or not. While climatic disasters appear to enhance examiners' preference for green innovation, resulting in a higher volume of green patents granted, the mechanisms through which these events influence examiners' attention and effort allocation remain unclear. On the one hand, examiners operate under significant time constraints and face cognitive limitations (Shu, Tian, and Zhan, 2022). As a result, an increased leniency toward granting green patents may lead to a potential compromise in the quality of these patents. On the other hand, exposure to climatic disasters may motivate examiners to allocate greater attention and effort to the evaluation of green innovations, thereby potentially improving the quality of granted green patents.

To assess patent quality, we employ the measure of truncated citations (Hall, Jaffe, and Trajtenberg, 2001) and calculate the average quality of green patents granted by each examiner in a given year. Our empirical investigation reveals that examiners' climatic disaster experience increases green patent granting without compromising the quality of innovation. Specifically, examiners with climatic disaster experience grant green patents that receive 3.5% more citations in the future compared to those granted by examiners without such experience. When we extend our analysis to non-green patents, we find no significant impact of climatic disaster experience on

the quality of innovation. This contrast supports the hypothesis that examiners' beliefs regarding climate change, as well as their efforts in evaluating green patents, are influenced by salient climate-related events.

We now present direct evidence that examiners affected by climatic disasters are more inclined to take proactive measures against climate change and exert greater effort in the green patent review process. First, to assess examiners' beliefs regarding climate change, we analyze their political donations, particularly to the Democratic Party. This is based on the observation that, compared to the Republican Party, Democratic politicians are more likely to prioritize climate action as part of their political agenda. Higher donations to the Democratic Party by examiners may therefore indicate a strengthened belief in the urgency of addressing climate change. Using donation data collected from the Federal Election Commission (FEC) database and the Database on Ideology, Money in Politics, and Elections (DIME), we find that examiners significantly increase their contributions to the Democratic Party following exposure to climatic disasters.

Second, we measure examiners' effort during the patent review process by examining the number of claims and backward citations requested by the examiner. Each claim in a patent application must be meticulously reviewed and verified to ensure it meets the legal and technical standards required for patent issuance. Consequently, a higher number of claims in a patent application demands greater effort and time from the examiner. Additionally, examiners may require applicants to cite more prior art in the patent filing, which further increases the examiner's workload. Consistent with the hypothesis that examiners exert more effort after experiencing climatic disasters, we find that green patents granted by these examiners contain a higher number of claims and include more backward citations requested by the examiner.

We further find that the impact of climatic disasters on examiners' green patent granting is amplified by 1) examiner compensation, tenure, and political ideology, 2) the level of attention to the climatic disaster or climate change, and 3) the severity of the climatic disaster. These findings align with the hypothesis that experiencing climatic disasters influences the green patent review process by reshaping examiners' beliefs about climate change. To reinforce this conclusion, we employ extreme hot weather events as an additional exogenous shock to examiners' beliefs regarding climate change. This alternative measure yields similar effects, demonstrating an increase in both the volume and quality of green patents granted.

Finally, we investigate the real effects of increased green patent granting by examiners who have experienced climatic disasters, focusing on corporate emissions. To measure the impact of these examiners, we calculate the ratio of the number of green patents granted by disaster-affected examiners to a firm's total number of green patents. Consistent with the higher quality of green patents granted by these examiners, we find that firms with a greater proportion of green patents granted by disaster-affected examiners exhibit a more significant reduction in their carbon emission intensity. This evidence highlights that the influence of climatic disasters extends beyond shaping examiners' beliefs and patent review processes; it also generates non-negligible effects on corporate behavior, tangible benefits for social welfare, and the transition to a green economy.

Our study contributes to the nascent research on corporate green innovation. While prior literature has primarily explored the determinants of green patents and identified various influencing factors, significant gaps remain. For instance, Chu, Liu, and Tian (2021) demonstrate that firms increase both environmental innovation input and output in response to nearby environmental spills. Contrary to conventional expectations, Cohen, Gurun, and Nguyen (2024) reveal that oil, gas, and energy-producing firms generate a higher volume of green patents with

notably superior quality. Despite these insights, the role of patent examiners—key gatekeepers of technological progress—has been largely overlooked. Our study fills this gap by demonstrating that examiners' beliefs about climate change have a causal effect on both the volume and quality of green patents.

Furthermore, existing studies on green innovation present mixed findings on the impact of corporate green innovation on emissions, as evidenced by Bolton, Kacperczyk, and Wiedemann (2023), Hege, Pouget, and Zhang (2024), and Cheng, Lin, and Yang (2024). Our findings shed new light on this debate by showing that patent examiners who dedicate additional attention and effort to the green innovation review process enhance the value of granted patents, leading to a reduction in corporate carbon emissions. Our findings underscore the critical role of examiners in driving environmentally beneficial innovation.

Our study extends the growing research on patent examiners. Prior literature has highlighted the significant role of patent examiners in shaping patent approval and quality. For instance, examiner characteristics such as experience (Lemley and Sampat, 2012), promotion incentives (Frakes and Wasserman, 2017), leniency (Farre-Mensa, Hegde, and Ljungqvist, 2020), and busyness (Shu, Tian, and Zhan, 2022) have been shown to significantly influence the patent review process and the outcomes of patent applications. Additionally, external factors such as USPTO policies (Choudhury, Foroughi, and Larson, 2021; Baek, 2023) and weather variations (Kovács, 2017) have been documented to alter examiner behavior. However, these studies have not explored how examiners' beliefs are formed or whether these beliefs influence the types of patents granted. By leveraging geographical variation among examiners and exogenous climatic disasters, we provide novel evidence that examiners' beliefs about climate change are reshaped following

exposure to salient climate-related events. This shift in belief, in turn, directly affects examiners' preferences and the level of effort they dedicate to reviewing green innovation patents.

By examining how examiners' beliefs evolve and their subsequent influence on patent review processes and corporate behavior, our study also adds to the literature on climate finance, particularly in the realm of belief formation. Prior research has demonstrated that heightened attention to climate risks significantly impacts the beliefs and actions of investors and firms. Consequently, financial markets—including equity markets (Alok, Kumar, and Wermers, 2020; Krueger, Sautner, and Starks, 2020; Bolton and Kacperczyk, 2021), bond markets (Huynh and Xia, 2023; Cao, Li, Zhan, Zhang, and Zhou, 2025), and options markets (Ilhan, Sautner, and Vilkov, 2021; Cao, Goyal, Zhan, and Zhang, 2025)—have increasingly priced in these risks. Theoretically, Hong, Wang, and Yang (2023) show that major climatic disasters alter households' perceived risks and their willingness to adopt mitigation strategies. Similarly, through experimental methods, Bernard, Tzamourani, and Weber (2023) find that making climate change information more salient motivates individuals to take action against it. Building on these insights, our paper leverages the exogenous occurrence of climate disasters to provide novel empirical evidence on how the salience of climate change shapes individual beliefs and professional behavior from the perspective of patent examiners.

1. DATA AND SAMPLE

In this section, we describe the datasets used in our study, including climatic natural disaster data, patent data, and patent examiner data, as well as the sample construction.

1.1 Climatic Natural Disaster Data

We collect county-level information on natural disaster events in the U.S. from the Spatial Hazard and Loss Database for the United States (SHELDUS database) maintained by Arizona

State University. The SHELDUS database defines disaster areas as countries directly impacted by natural disasters, providing information on the type of natural disaster events (18 types), the name of affected counties, county-level dollar damages caused by each type of event, the number of injuries or fatalities caused by each type of event, the duration of each type of event, and the date of the event. Following existing literature (e.g., Alok, Kumar, and Wermers, 2020) and analysis with ChatGPT, we classify natural disasters into two categories: those strongly linked to climate change, referred to as *climatic natural disasters*, and those that are not. Appendix B provides supporting evidence and explanations for our classification of these events, including their connection to climate change.

Following previous studies (Barrot and Sauvagnat, 2016; Huynh and Xia, 2023), we select disasters with total estimated damages exceeding $10 million in a county (in 2020 constant dollars) and durations of less than 30 days. We also require that the total number of injuries and fatalities caused by the disaster in a county be greater than zero, ensuring that the examiner can more directly sense the disaster's severity and impact. Panel A of Table 1 reports summary statistics for climatic natural disasters that occurred between 2011 and 2019 in our sample.[2] There are six types of climatic disasters, including flooding, hurricane, tornado, wildfire, wind, and hail. The average damages caused by each disaster range from 390 million to 3.64 billion U.S. dollars, with durations spanning from 1 day to 14 days. Among all disaster types, flooding is the most frequent, followed by hurricanes. Hurricanes result in the highest monetary damages, while wildfires have the longest durations.

[2] To align with our examiner location data, we start the sample period from 2011.

1.2 Examiner and Patent Data

We obtain data on all issued utility patents and patent examiners from the U.S. Patent & Trademark Office (USPTO) and PatentsView.[3] Each patent has a patent ID, an examiner's full name, and an issue date. All patents are randomly assigned to an examiner, and the detailed examination process for patent applications is outlined in Shu, Tian, and Zhan (2022). We then use the examiners' names from the USPTO database to link the examiner to their location and pay information from FederalPay.org, a public resource for U.S. government employee data.[4]

In December 2010, President Obama signed the Telework Enhancement Act, which established standard rules and regulations for remote work at federal government agencies. In response, the USPTO officially launched the Telework Enhancement Act Pilot Program (TEAPP) in early 2012. This program introduced a work-from-anywhere (WFA) arrangement, allowing employees to live and work anywhere in the contiguous United States. The TEAPP program is the first program that allows examiners to work far away from the headquarters. Notably, the USPTO does not adjust wages for employees participating in the WFA program. To ensure that our inventor sample has a diverse and extensive geographical distribution, we start our sample period in 2012, aligning with the introduction of the WFA program. Figure 1 illustrates the geographic distribution of patent examiners in 2020, showing that patent examiners are dispersed across multiple counties rather than being concentrated near the USPTO headquarters. This geographic variation provides a unique opportunity to investigate the impact of climate change on examiners' beliefs and decisions.

To classify patents as green or non-green, we utilize the Cooperative Patent Classification

[3] The data websites are https://www.uspto.gov/ip-policy/economic-research/research-datasets/patent-examination-research-dataset-public-pair and https://patentsview.org/.
[4] See https://www.federalpay.org/employees/patent-and-trademark-office.

(CPC) codes for all issued patents from the USPTO. Specifically, we focus on the CPC Y02 category, which is jointly defined by the USPTO and EPO. The Y02 category is specifically designed to identify climate-related technologies, which include technologies or applications for mitigation or adaptation against climate change.[5] Building on the Organization for Economic Co-operation and Development new method (hereafter OECD 2023) proposed by Dussaux, Agnelli, and Es-Sadki (2023), as well as insights from previous studies (e.g., Calel, 2020), we classify patents under the CPC Y02 category as green patents.

1.3 Summary Statistics

Our final sample consists of 8,408 unique examiners from 2012 to 2020. To establish the link between examiner location and climatic natural disasters, we use county-level location data. We construct an examiner-year level preference measure for green patents, referred to as the *Green Patent Ratio*, which is defined as the proportion of green patents relative to all patents granted by each examiner in a given year. Meanwhile, we construct an examiner-year level disaster measure, labeled $Disaster_{Climatic}$, which is a dummy variable equal to one if an examiner experienced a climatic disaster in the previous year and zero otherwise. Summary statistics for the main variables are presented in Panel B of Table 1. There are 58,161 examiner-year observations. The mean values of $Disaster_{Climatic}$ and *Green Patent Ratio* are 0.01 and 0.08, respectively, with standard deviations of 0.08 and 0.16. All continuous variables that are not constrained between 0 and 1 are winsorized at the 1% and 99% levels. Detailed variable definitions are provided in Appendix A.

[5] CPC Y02 includes technologies for adaptation to climate change (Y02A); climate change mitigation technologies related to buildings (Y02B); capture, storage, sequestration, or disposal of greenhouse gases (Y02C); climate change mitigation technologies in information and communication technologies (Y02D); reduction of greenhouse gas emissions related to energy generation, transmission, or distribution (Y02E); climate change mitigation technologies in the production or processing of goods (Y02P); climate change mitigation technologies related to transportation (Y02T); and climate change mitigation technologies related to wastewater treatment or waste management (Y02W).

2. CLIMATIC DISASTER EXPERIENCE AND GREEN PATENT REVIEW

In this section, we examine the impact of climatic disaster experience on examiners' beliefs regarding climate change, as evidenced by their green patent review outcomes.

2.1 Climatic Disaster Experience and Green Patent Grant Rate

2.1.1 Baseline Results

We analyze whether an examiner's experience of climatic disasters influences the proportion of green patents they grant. We estimate the following OLS regression:

$$Green\ Patent\ Ratio_{i,t} = \beta_0 + \beta_1 Disaster_{Climatic\ i,t-1} + FEs + \varepsilon_{it} \quad (1)$$

where the dependent variable, $Green\ Patent\ Ratio_{i,t}$, is defined as the percentage of green patents granted in all granted patents for examiner *i* during year *t*, representing examiners' preference for green patents. The independent variable, $Disaster_{Climatic\ i,t-1}$, is a dummy variable equal to one if examiner *i* experiences a climatic disaster in year *t-1*, and zero otherwise. To account for unobserved heterogeneity, we include examiner and year fixed effects in our model, and standard errors are double-clustered at the county and year levels. If an examiner's exposure to climatic disaster significantly increases her preference for granting more green patents, we expect the coefficient estimate of $Disaster_{Climatic}$ to be significantly positive.

Panel A of Table 2 shows that, consistent with our prediction, climatic disasters positively affect examiners' preference for granting green patents. This effect is consistent across various specifications that modify fixed effects and clustering methods. For example, the coefficient in column (1) is 0.0079 and statistically significant at the 0.01 level. This coefficient is also economically significant, suggesting that after examiners experienced climatic natural disasters, the magnitude of the Green Patent Ratio will increase by 9.9% relative to the mean (0.0079/0.08). Figure 2 illustrates the dynamic effects of climatic disasters on examiner decisions, showing a

significant impact only in the year following the occurrence of climatic disasters. In contrast, the coefficients for the years preceding the disasters and for the years after the first year post-disaster are statistically insignificant. This finding indicates that the impact of climatic disasters on examiners' beliefs is concentrated in the first year post-disaster.[6]

2.1.2 Green Patent Approval Rate vs. Number of Green Patent Applications

While our finding of an increase in green patents granted is consistent with examiners changing their beliefs following climatic disaster experience, it could also be driven by a larger number of green patent applications. To investigate this alternative explanation, we decompose the outcome of green patent grants into two components: the approval rate of green patent applications and the number of green patent applications. We define $Approval\ Rate_{Green}$ as the total number of green patents issued by the examiner divided by the total number of green patent applications reviewed by that examiner in a given year. $Approval\ Rate_{Non\text{-}Green}$ and $Approval\ Rate_{All}$ are defined similarly for non-green patents and all patents, respectively. Additionally, $Application\ Ratio_{Green}$ is defined as the percentage of green patent applications among all patent applications reviewed by each examiner annually. If our conjecture that climatic disasters change examiners' preferences for green patents is correct, our results should be driven by an increased approval rate rather than the growing number of green patent applications. Furthermore, this positive relationship does not hold for non-green patents.

In Panel B of Table 2, we find that the coefficient on $Approval\ Rate_{Green}$ is significantly positive in column (1), while the coefficient on $Application\ Ratio_{Green}$ is insignificant in Column (4). Additionally, we find insignificant changes in approval rates of non-green and all patents in

[6] Some previous studies argue that the Tobit model may be more appropriate for processing censored data, as it allows for the inclusion of observations with values at the limits. (Amemiya, 1984; Jiménez, Lopez, and Saurina, 2009; De Angelis, Grullon, and Michenaud, 2017) We use the Tobit model to conduct a robustness test and observe similar results in Panel A of Table C1 in Appendix C.

columns (2) and (3), indicating that climatic disasters change examiners' preference for green patents rather than non-green patents. These results show that the observed increase in green patents is not driven by a surge in the overall number of green patent applications but rather by examiners' selective granting preference specifically towards green patents.

2.1.3 Specific Categories of Green Patents

To further analyze the impact of climate disasters on the granting of green patents, we categorize green patents into two segments: technologies for climate change adaptation and technologies for climate change mitigation. Climate change adaptation encompasses technologies that help adapt to the adverse effects of climate change, such as controlling or monitoring floods or hurricanes. On the other hand, climate change mitigation includes technologies for climate change mitigation in many areas, such as the capture and disposal of greenhouse gases and the use of non-fossil fuels in aviation.

We run regressions on these two subsamples, with the results shown in Panel C of Table 2. The positive and significant coefficients in both columns suggest that green patents related to climate change adaptation and mitigation increase after examiners experience climate disasters. However, the effect is stronger for mitigation patents than adaptation patents. This indicates a greater boost in granting technologies aimed at mitigating climate change. The trend suggests that examiners may prioritize mitigation technologies, which address the root causes of climate change and offer long-term solutions, over adaptation technologies, which are often seen as reactive measures managing the consequences rather than preventing the problem.

2.2 Robustness Tests and Alternative Explanations

2.2.1 Alternative Definitions of Green Patents and Climatic Disasters

To ensure the robustness of our baseline results, we first use an alternative classification of green patents following Cohen, Gurun, and Nguyen (2024). [7] Given the partial overlap between the OECD 2015 and the OECD 2023 (CPC Y02) classifications, we classify green patents into three categories. The first category is based on the OECD 2015 framework (*Green Patent Ratio*$_{OECD15}$). The second category includes green patents that fall within the intersection of the OECD 2015 and OECD 2023 classifications (*Green Patent Ratio*$_{OECD15\&23}$). The third category consists of green patents identified using the union of the OECD 2015 and OECD 2023 classifications (*Green Patent Ratio*$_{OECD15or23}$). Additionally, green patents unrelated to climate change are classified under the OECD 2015 framework but not labeled under the OECD 2023 classification (*Green Patent Ratio*$_{OECD15|23}$). The results are shown in Panel A of Table 3. The effect is most pronounced in column (3), where all Y02 tags are included as green patents, while the coefficient in column (4) is insignificant. The results indicate that the increase in green patents is primarily driven by those classified as climate-related rather than other green patents under the OECD 2015 classifications.

We also conduct a robustness test that excludes two less frequent disaster types, wind and hail, which occurred only a few times in our sample and, therefore, may be less relevant to shaping the beliefs about climate change. Panel B of Table C1 in Appendix C shows that our results hold with this alternative classification of climatic disasters.

[7] Hascic and Migotto (2015) provide a detailed description of OECD's algorithm that identifies patents incorporating environmental technologies related to pollution, water scarcity, and climate change mitigation. This method identifies green patents using the International Patent Classification (IPC) system, as defined in the 2015 version of the Organization for Economic Co-operation and Development's (OECD) classification (hereafter OECD 2015), rather than climate-related green patents in our paper.

2.2.2 Matched sample

In this subsection, we match pair examiners with similar characteristics using two methods. The first method matches examiners within the same art units each year, while the second method matches examiners within the same art units but considers a General Schedule (GS) pay level gap of no more than one.[8] For the "1:m" matching method, each affected examiner is paired with any number of unaffected examiners sharing similar characteristics, thereby allowing multiple matches for each affected examiner. The "1:1" method refines this approach by selecting the most similar examiner from the "1:m" pool, based on the closest GS level for the first method and an equal GS level for the second. Panel B of Table 3 presents the results. The coefficients in all columns are statistically significant and positive, showing the positive relation between climatic disasters and examiners' preferences toward green patents. Using the matching method can help us mitigate potential biases and ensure that our comparisons are made between examiners with comparable attributes, providing more robust evidence of the impact of climatic disasters on the granting of green patents.

2.2.3 Excluding Local Firms

The proximity of patent firms to examiners' locations may increase the chance of success in patent applications, either due to an information advantage or familiarity (Jia and Tian, 2018). To ensure robustness, we exclude patents where the patent company is located in the same state as the examiners from the main sample.[9] The results in Panel C of Table 3 remain consistent with our

[8] The General Schedule (GS) is the primary pay scale used for United States federal employees. The grade level assigned to a position determines the corresponding pay level for that job.

[9] We also conduct another robust test that excluding patents owned by companies located in counties that are within a 50-mile distance from the examiner's county, where the results hold. County distances are great-circle distances calculated using the Haversine formula based on internal points in the geographic area: https://www.nber.org/research/data/county-distance-database

baseline findings, suggesting that our results are not driven by geographical proximity.[10]

2.2.4 Placebo Analysis

In the baseline regression, we focused on natural disasters strongly linked to climate change, such as hurricanes and wildfires, as examples of climatic disasters. These disasters are chosen due to their strong link to climate change. In this section, we conduct a placebo test by analyzing natural disasters unrelated or weakly related to climate change. The goal is to determine whether such events similarly influence examiners' behavior. We combined insights from an extensive literature review with ChatGPT analysis to differentiate between climate-related and non-climate-related disasters. Details are introduced in Appendix B. This careful categorization ensures the robustness of our analysis. The placebo test results in Panel D of Table 3 show that natural disasters unrelated to climate change do not affect examiners' behavior in the same way as climate-related disasters. This highlights the unique impact of climate change-related events on examiner decision-making, further reinforcing the link between climate change and belief change among patent examiners.

2.3 Climatic Disaster Experience and Green Patent Quality

Building on our finding that examiners grant more green patents after experiencing climatic disasters, we turn to examining the quality of these patents. One possibility is that climatic disaster experiences lead examiners to approve green patents more easily without thorough evaluation. If this is the case, we would expect the quality of green patents to either decline or show no significant change. However, if climatic disasters reshape and inspire examiners to take a more active role in promoting green innovation, they may increase the effort invested in reviewing green patent applications. This increase in effort could lead to more rigorous evaluations, ultimately improving

[10] We also conduct a robustness test by dropping the examiners who are located in the headquarters of the USPTO, and the results hold in the untabulated analysis.

the quality of granted green patents.

We estimate the regression in Equation (1), replacing the independent variable with *Patent Quality*$_{Green}$, which is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of green patents for each examiner in a given year. In Column (1) of Table 4, we observe that the coefficient on *Disaster*$_{Climatic}$ is significantly positive at the 1% level, indicating that the quality of green patents granted significantly increases following the examiner's climatic disaster experience.[11] Specifically, the coefficient suggests that *Patent Quality*$_{Green}$ increases by 0.0157 following the disaster experience, which represents a 3.5% increase relative to the mean (0.0157/0.45).

For a comparison, we examine the quality of non-green patents by estimating a regression of *Patent Quality*$_{Non\text{-}green}$, which is defined similarly as *Patent Quality*$_{Green}$ but for the examiner's non-green patents. The coefficient of *Disaster*$_{Climatic}$ is insignificant, indicating that climatic disaster experience does not affect the quality of non-green patents experience. Additionally, the coefficient is also insignificant in the regression of *Patent Quality*$_{All}$, which is calculated using all patents granted by the examiner (Column 3), as the non-green patents account for the majority of the patents granted. The findings in Table 4 support the hypothesis that climatic disasters lead examines to exert more effect and conduct more rigorous evaluations of green patent applications, resulting in higher quality patents being granted.

3. MECHANISM AND CROSS-SECTIONAL EVIDENCE

We posit that examiners' experiences with climatic disasters influence their beliefs about climate change, prompting them to grant more green patents, which are also of higher quality. In

[11] In Table C2 of Appendix C, we conduct robustness tests using the raw citation measures (instead of the truncation-adjusted measures) under a Poisson regression model, and our results remain unchanged.

this section, we further investigate the underlying mechanisms.

3.1 Climatic Disaster Experience and Examiners' Beliefs about Climate Change

We first examine the effect of climatic disasters on examiners' beliefs about climate change, using their political donations as a proxy. If exposure to climatic disasters strengthens examiners' beliefs in climate change, we expect an increased tendency to donate to the Democratic Party, which places greater emphasis on climate change-related issues and advocates for ESG initiatives, such as environmental protection (Di Giuli and Kostovetsky, 2014; Bernstein, Billings, Gustafson, and Lewis, 2022).

We collect examiners' donation data from two sources. First, we use the Federal Election Commission (FEC) database following prior studies (e.g., Di Giuli and Kostovetsky, 2014; Addoum and Kumar, 2016; Babenko, Fedaseyeu, and Zhang, 2020; Bizjak, Kalpathy, Mihov, and Ren, 2022). The FEC database provides detailed records of political contributions to federal candidates and political parties since 1979, including the donor's name, address, occupation, and contribution amount. Second, we supplement missing data with the Database on Ideology, Money in Politics, and Elections (DIME) from Harvard University (Bonica, 2024), which includes over 130 million contributions to local, state, and federal elections. To identify political donation records linked to examiners, we match examiners' names and institutional affiliations within the FEC database and use the DIME database to fill any gaps in the records. We obtain a final sample of 514 observations of examiners' donations.

Table 5 presents the regressions of examiners' political donations on climatic disaster experience. The results reveal a significant increase in examiners' donations to the Democratic Party following climatic disaster experience. For example, the coefficient in column (2) indicates that examiners' donations to democratic party increase by 44.5% following climatic disasters in

their counties. This finding provides evidence that climatic disaster experiences may lead to a possible ideological shift among examiners toward climate change.

3.2 Climatic Disaster Experience and Examiner Efforts

Our previous finding of an increase in green patent quality following climatic disasters suggests that examiners devote more effort to evaluating green patents after experiencing climatic disasters. In this subsection, we use several measures to directly evaluate the level of effort exerted by examiners.

Our first measure uses the number of claims following Harhoff and Wagner (2009). A larger number of claims requires more examination time because claims define the boundaries of a patent and must be thoroughly reviewed and validated by the examiner. We define $Claims_{Green}$ as the average number of claims in green patents reviewed by each examiner annually. We also define $Claims_{Non\text{-}green}$ and $Claims_{All}$ similarly for non-green patents and all patents granted by the examiner, respectively.

Our second proxy for examiner effort is the total number of patent references (backward citations) made by examiners during the examination process. Examiners may require applicants to cite more prior art in the patent filing, which further increases the examiner's workload. Each reference represents prior art that must be identified and validated by the examiner, with a higher number of references indicating more meticulous effort. We define $References_{Green}$ as the average number of references to green patents cited by an examiner annually. Similarly, $References_{Non\text{-}green}$ and $References_{All}$ represent the averages for non-green and all patents, respectively.

To construct the first two measures, we focus on a sample of patents granted in the year following the disasters and without prior rejections before the disaster. This filter ensures that the examiner's first actions on these patents occur after the disasters. If the examiner had issued non-

final rejection actions before the disaster occur, we would not be able to accurately measure the increase in the examiner's effort caused by the disaster.[12]

The third measure of examiner effort is based on the rejection data. Specifically, we examine whether examiners become more meticulous in rejecting green patent applications after a disaster. *Rejection Effort*$_{Green}$ represents the proportion of green rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner annually.[13] We also define *Rejection Effort*$_{Non\text{-}green}$ and *Rejection Effort*$_{All}$ are defined similarly for non-green and all rejections.

Table 6 presents the regressions of examiner effort measures on climatic disaster experience. Panels A and B report the results for the first two measures of examiner effort. In column (1) of both panels, where the independent variable is examiner effort for green patent reviews, the coefficient on *Disaster*$_{Climatic}$ is significantly positive. In contrast, in columns (2) and (3), which focus on examiner effort for non-green patents and all patents, the coefficients on *Disaster* $_{Climatic}$ are statistically insignificant. Panel C reports the results on the examiner rejection effort, where we observe that examiners become more meticulous in deciding whether to reject green patent applications after experiencing a climatic disaster.

Overall, these results suggest that climatic disasters lead to examiners' greater effort and scrutiny in reviewing green applications. This increased effort is not observed for non-green

[12] We also use this sample to run the baseline regression, and the results remain robust (see Table C3 in Appendix C).
[13] The USPTO provides several grounds for rejection, such as 101 rejections (subject matter eligibility, statutory double patenting, utility, etc.), 102 rejections (lack of novelty), 103 rejections (obviousness), and 112 rejections (written description, indefiniteness, etc.). Frakes and Wasserman (2017) show that rejections based on 102 or 103 grounds are more time-consuming than non-art-based rejections under 101 or 112 grounds. This is because either 102 or 103 rejections require the examiner to conduct a prior art search and compare the claimed invention with the prior art before making an assessment.

patents, highlighting the specific influence of climatic disasters on examiners' prioritization of environmental innovation.

3.3 Cross-Sectional Analyses

3.3.1 Examiner Characteristics

More experienced examiners are often seasoned professionals, likely to be older and, in some cases, parents. This demographic, shaped by their life experiences and responsibilities, tends to exhibit a greater concern for environmental development and the survival of the environment for future generations (e.g., Lemley and Sampat, 2012; Cronqvist and Yu, 2017; Bernard, Tzamourani, and Weber, 2023). At the same time, regions governed by the Democratic Party or states that have joined the U.S. Climate Alliance are known to prioritize climate issues, as reflected in their policies and voting patterns. These regions often foster an environment that emphasizes climate action, which may influence examiners working there to align with such views or be affected by local policies. Based on these observations, we hypothesize that the impact of climatic disasters is more pronounced among senior examiners and examiners who support the Democratic Party, which prioritizes climate issues, compared to their counterparts.

To measure examiners' experience, we use two proxy variables: $Compensation_{High}$, a dummy variable equal to one if the examiner's General Schedule (GS) pay level in the previous year is higher than or equal to the median, and zero otherwise. $Tenure_{Long}$ is a dummy variable that equals one if the examiner's number of work years in the previous year is higher than or equal to the median, and zero otherwise.[14] Besides, to measure examiners' political ideology toward climate change, we define $County_{Dem}$ as a dummy variable equal to one if the examiner's county in the

[14] We identify the examiner's first year of work using the complete patent database provided by the USPTO, rather than limiting it to our sample. The first year an examiner appears in the patent database is regarded as their starting year as a patent examiner.

previous year was governed by the Democratic Party, and $Alliance_{Climate}$ as a dummy variable equal to one if the examiner's state has joined the U.S. Climate Alliance in the previous year.

We repeat the baseline regression analyses with interactions of *Disaster* and the above examiner characteristics. In Panel A of Table 7, the coefficients of interaction terms are significantly positive for the interactions of $Compensation_{High}$ (column (1)) and $Tenure_{Long}$ (column (2)). These results imply that, consistent with our predictions, senior examiners appear more responsive to climatic disasters. The results in columns (3) and (4) suggest that examiners who may support the Democratic Party tend to grant more green patents.

3.3.2 Examiner Attention

Our second cross-sectional analysis is motivated by the prediction that the impact of climatic disasters on green patent granting is stronger among examiners with heightened attention to climate change. To proxy for the level of examiners' attention towards climate change, we use both year-level and state-year-level Google Search Volume Index (SVI) data from Google Trends for the term "climate change".[15] Prior studies, such as Da, Engelberg, and Gao (2011), have shown that the SVI can effectively proxy for attention. This index measures search volumes on a scale from 0 to 100, where a higher score represents higher attention. We therefore define $Attention_{High}$ as a dummy variable that equals one if the SVI in the previous year is higher than the median and zero otherwise. Similarly, we define $Attention_{HighState}$ as a dummy variable that equals one if the SVI of the examiner's state in the previous year is higher than the median of all the states this year, and zero otherwise.

Panel B of Table 7 presents the regression results that include interactions of $Disaster_{\text{Climatic}}$ and attention measures. We find that, consistent with our prediction, the coefficients of the

[15] Google search volume can be obtained from Google Trends (https://trends.google.com/trends/?geo=US). We also consider the search volume of "climate natural disaster" and "natural disaster" and the results are similar.

interaction terms are significantly positive, suggesting that examiners who demonstrate a higher level of attention to climate change are more responsive to climatic disasters.

3.3.3 Damage Caused by Disasters

When examiners face more severe degrees of climatic disasters, the impact on their behavior can become more pronounced. This is because more severe disasters tend to bring direct shocks and heightened awareness of the urgent need to address environmental challenges. consequently, we predict that examiners who experience severe effects of climatic disasters may undergo a more significant shift in their green patent granting. To investigate this conjecture, we examine four aspects of damage caused by climatic disasters. Specifically, we define $Loss_{Large}$ as a dummy variable which equals one if the monetary loss of a disaster is above the median, and zero otherwise. Similarly, we construct dummy variables based on the duration of a disaster ($Duration_{Long}$), the fatality caused by the disasters (*Fatality*), and whether the examiner experiences climatic disasters two years in a row ($Year_{Consecutive}$). The results in Panel C support our prediction, as the interaction terms of disaster damage have positive and statistically significant coefficients. These results indicate that the impact of climatic disasters on examiners is significantly stronger in the face of more severe disasters.

4. REAL EFFECT: FIRM GREENHOUSE GAS EMISSIONS

Our findings show that, after experiencing climatic disasters, examiners approve green patents of higher quality. In this section, we investigate whether this increase in the quality of green patents translates into a more effective reduction in corporate greenhouse gas emissions.

We first match the patents from our sample to U.S. publicly listed firms using the linkage file developed by Kogan, Papanikolaou, Seru, and Stoffman (2017). Greenhouse gas emission data is obtained from the Trucost database. We conduct firm-level regression analysis where the

dependent variable is *Log(GHG Emission)*, which represents the natural log of the total greenhouse gas (GHG) emission intensity, including Scope 1, Scope 2, and Scope 3 emissions, as provided by the Trucost database. This measure captures a firms' greenhouse gas emissions over the three years following the granting of green patents. The key independent variable is $Green\ Ratio_{ExaminerDisaster}$, defined as the percentage of green patents granted by examiners who experienced a climatic disaster in the previous year for each firm. We require sample firms to have at least one green patent in the measurement year to calculate this measure. We control for firm characteristics, including book-to-market, natural log of total assets, leverage, cash holding, dividends, R&D intensity, and Return. Our regression sample includes 493 public firms and 1,987 firm-years from 2012 to 2020. Summary statistics for firm-year level variables are shown in Table 8 Panel A. A negative coefficient on $Green\ Ratio_{ExaminerDisaster}$ would indicate that firms receiving a higher proportion of green patents from event examiners see a reduction in future GHG emissions.

Panel B of Table 8 presents the regression results. Consistent with our prediction, we find significantly negative coefficients for $Green\ Ratio_{ExaminerDisaster}$, suggesting that high-quality green patents granted by disaster-affected examiners help reduce the innovating firms' greenhouse gas emissions.[16] This result highlights that green patents granted by disaster-affected examiners are not only of higher quality but also more effective in addressing climate change.

5. EXPERIENCE OF EXTREME TEMPERATURE AND GREEN PATENT REVIEW

In this section, we examine whether other climate-related phenomena, such as extreme heat, have a similar impact on examiners' beliefs and patent review efforts. Extreme heat, a growing consequence of climate change, is known to affect human behavior, decision-making, and

[16] Unlike prior studies that argue green patents do not necessarily lower firms' carbon emissions (Bolton, Kacperczyk, and Wiedemann, 2023; Hege, Pouget, and Zhang, 2024), our findings focus on the effect of patent quality, conditional on firms having green patents, rather than examining green patents in general.

productivity. By analyzing whether extreme heat influences examiners' decisions—such as increasing the approval rate or quality of green patents—we aim to broaden our understanding of how various climatic factors shape examiner behavior.

Following Addoum, Ng, and Ortiz-Bobea (2020, 2023), we use daily temperature data from the PRISM Climate Group, the official climatological database of the U.S. Department of Agriculture. The PRISM dataset provides daily mean, minimum, and maximum temperatures for grid cells across the continental United States. We first define a day with extremely hot (cold) weather as one where the maximum (minimum) temperature in the examiner's county exceeds (falls below) the 90^{th} percentile (10^{th} percentile) across all counties. We then construct three variables. *Extreme Temperature*$_{Heat}$ is a dummy variable that equals one if the total number of extremely hot days in a year exceeds the median of all counties for that year, and zero otherwise. *Extreme Temperature* is a dummy variable that equals one if the combined total of extremely hot and extremely cold days exceeds the median of all counties for that year, and zero otherwise. *Extreme Temperature*$_{Cold}$ is a dummy variable that equals one if the total number of extremely cold days in a year exceeds the median of all counties for that year, and zero otherwise.

Panel A of Table 9 presents the regressions of the *Green Patent Ratio* on the measures of extreme temperature experience. The coefficients for *Extreme Temperature*$_{Heat}$ and *Extreme Temperature* in columns (1) and (2) are significantly positive, while the coefficient for *Extreme Temperature*$_{Cold}$ in column (3) is insignificant. These results suggest that exposure to extreme heat increases the likelihood of examiners granting more green patents. However, this relationship does not hold for extreme cold, probably because extremely hot weather is more directly associated with the issues of global warming than extremely cold weather.

In Panel B of Table 9, we explore whether exposure to extreme heat affects the quality of granted green patents. We find that the coefficient for *Extreme Temperature*$_{Heat}$ in column (1) is significantly positive, suggesting that examiners exposed to extremely hot weather grant higher-quality green patents. Column (2) shows that this effect does not extend to the quality of non-green patents, further supporting the mechanism of climate-related beliefs. Overall, the results in Table 9 validate our previous findings based on climatic disasters and provide a deeper understanding of how climate change experience shapes green patent review.

6. CONCLUSION

This paper identifies the causal impact of patent examiners' beliefs about climate change on the review and grant of green patents. By leveraging geographical variation in examiners' workplaces and the occurrence of climatic disasters, we create an exogenous shift in examiners' beliefs about climate change. Our findings reveal that examiners who have experienced climatic disasters tend to grant more green patents in the subsequent year. These results are robust to alternative classifications of green innovation and different matching methods. The increase in green patent grants by examiners exposed to climatic disasters is driven by a higher approval rate rather than an increase in green patent filings. Importantly, we find no effect of climatic disasters on non-green patent approval rates and no effect of non-climatic disasters on green patent review outcomes, highlighting the specific role of examiners' beliefs about climate change in shaping green innovation. Additional evidence that examiners exposed to climatic disasters donate more to the Democratic Party further supports the notion of a belief change.

We further investigate the quality of green patents granted by examiners with climatic-disaster experience. Consistent with heightened attention to climate change and greater efforts by these examiners, we find that green patents granted by examiners with climatic-disaster experience

are of higher quality. This higher quality is likely driven by examiners' efforts, as proxied by the number of claims and references cited. Aligned with the higher quality finding, we document that firms with more green patents granted by examiners exposed to climatic disasters experience a decline in future carbon intensity. Thus, examiners' belief changes and subsequent professional behavior have real-world impacts on innovating firms and social welfare.

Overall, our study provides novel evidence on the determinants and consequences of corporate green innovation, highlighting the role of patent examiners' beliefs in shaping innovation outcomes. Our findings contribute to the growing literature on climate finance, which examines how various economic agents respond to climate change and associated risks. Additionally, our research underscores the policy relevance of salient information about climate change, demonstrating its potential to drive meaningful changes in individual behavior and decision-making processes.

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Figure 1
Examiner Distribution across U.S. Counties

This figure presents an overview of patent examiner distribution in 2020. No. of examiners represents the number of examiners in each county.

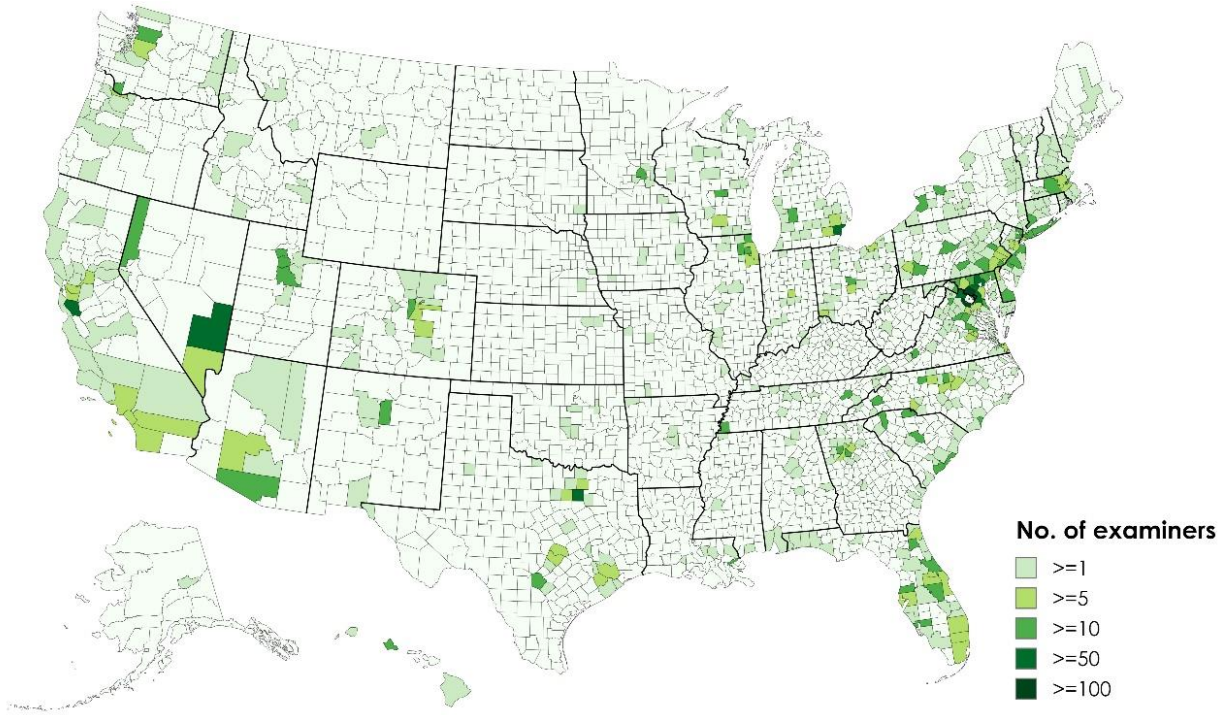


Figure 2.
Parallel Trend

This figure shows the dynamic effects of climatic disasters on examiner decisions. Year 0 is the year in which the disasters occurred. Examiner and year fixed effects are included, and standard errors are double-clustered at the county and year levels. The sample period is from 2012 to 2020. Capped spikes indicate statistical significance at the 10% level.

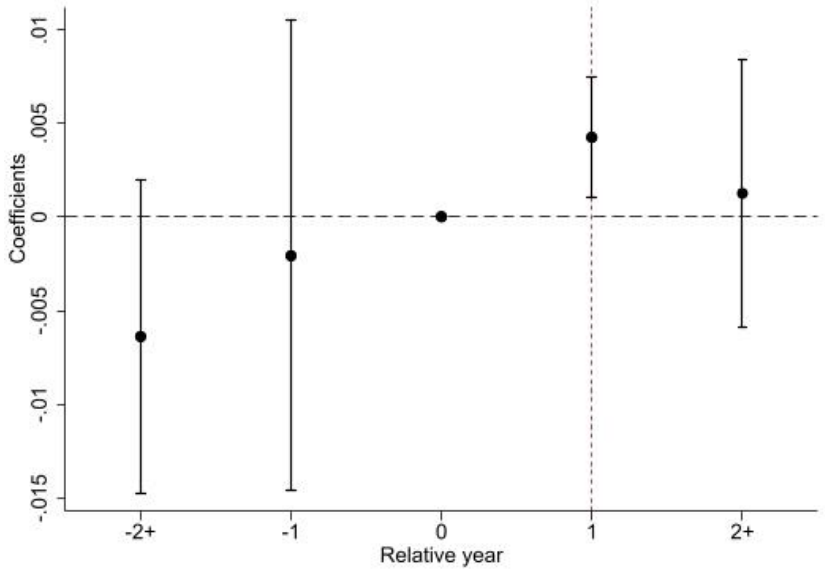


Table 1
Summary Statistics

This table shows summary statistics in our sample. Panel A reports summary statistics for climatic natural disasters in the U.S. that affected patent examiners in our sample. Reported damages are in $ 10 million adjusted to 2020 dollars. Panel B reports the summary statistics of examiner-year level variables from 2012 to 2020. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. *Green Patent Ratio* is defined as the percentage of green patents granted out of all granted patents for each examiner in a given year. $ApprovalRate_{Green}$ is defined as the total number of green patents issued by the examiner divided by the total number of green applications received by the examiner in a given year. $ApprovalRate_{Non\text{-}green}$ is defined as the total number of non-green patents issued by the examiner divided by the total number of non-green applications received by the examiner in a given year. $Approval\ Rate_{All}$ is defined as the total number of all patents issued by the examiner divided by the total number of all applications reviewed by the examiner in a given year. $Application\ Ratio_{Green}$ is defined as the percentage of green patent applications in all patent applications received by each examiner in a given year. $Green\ Patent\ Ratio_{Adaptation}$ is the percentage of green patents related to technologies for adaptation to climate change in all granted patents for each examiner each year. $Green\ Patent\ Ratio_{Mitigation}$ is the percentage of green patents related to technologies for climate change mitigation in all granted patents for each examiner each year. $Patent\ Quality_{Green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of green patents for each examiner in a given year. $Patent\ Quality_{Non\text{-}green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of non-green patents for each examiner in a given year. $Patent\ Quality_{All}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of all patents for each examiner in a given year. $Donation_{Democratic}$ *(USD)* is the total annual dollar amount of donations contributed to the Democratic Party by each examiner. $Log(Donation_{Democratic})$ is the logarithm of the total annual dollar amount of donations to the Democratic Party for each examiner. $Claims_{Green}$ is defined as the average number of claims from green patents reviewed by each examiner in a given year. $Claims_{Non\text{-}green}$ is defined as the average number of claims from non-green patents reviewed by each examiner in a given year. $Claims_{All}$ is defined as the average number of claims from all patents reviewed by each examiner in a given year. $References_{Green}$ is the average number of references to green patents cited by each examiner each year. $References_{Non\text{-}green}$ is the average number of references to non-green patents cited by each examiner each year. $References_{All}$ is the average number of references to green patents cited by each examiner each year. $Rejection\ Effort_{Green}$ represents the proportion of green rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year. $Rejection\ Effort_{Non\text{-}green}$ represents the proportion of non-green rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year. $Rejection\ Effort_{All}$ represents the proportion of all rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year. $Extreme\ Temperature_{Heat}$ is a dummy variable that equals one if the total number of extremely hot days in a year exceeds the median of all counties for that year, and zero otherwise. *Extreme Temperature* is a dummy variable that equals one if the combined total of extremely hot and extremely cold days exceeds the median of all counties for that year, and zero otherwise. $Extreme\ Temperature_{Cold}$ is a dummy variable that equals one if the total number of extremely cold days in

a year exceeds the median of all counties for that year, and zero otherwise. All continuous variables that are not constrained between 0 and 1 are winsorized at 1% and 99% level. Detailed variable definitions are provided in Appendix A.

Panel A: Summary Statistics for Climatic Natural Disasters

Disasters	Average Damage ($ 10M)	Average Duration (Days)	Average Injuries & Fatalities	No. of Disasters
Flooding	245.08	2.96	6.87	23
Hurricane/Tropical Storm	264.97	2.87	4.20	15
Tornado	39.02	1.00	109.80	10
Wildfire	160.33	14.33	10.03	6
Wind	105.61	1.50	1.50	2
Hail	130.38	1.00	1.00	1

Panel B: Summary Statistics for Patent Examiners

Variable	Obs	Mean	STD	P1	P25	Med	P75	P99
Examiner-year panel								
No. of Patents	58,161	43.02	26.17	1.00	23.00	40.00	59.00	114.00
No. of Green Patents	58,161	3.79	7.99	0.00	0.00	1.00	4.00	41.00
$\text{Disaster}_{\text{Climatic}}$	58,161	0.01	0.08	0.00	0.00	0.00	0.00	0.00
Green Patent Ratio	58,161	0.08	0.16	0.00	0.00	0.03	0.09	0.96
$\text{Approval Rate}_{\text{Green}}$	39,754	0.80	0.79	0.00	0.29	0.67	1.00	4.00
$\text{Approval Rate}_{\text{Non-green}}$	57,700	0.85	0.77	0.08	0.59	0.80	1.00	2.83
$\text{Approval Rate}_{\text{All}}$	57,969	0.85	0.72	0.10	0.59	0.80	0.98	2.78
$\text{Application Ratio}_{\text{Green}}$	57,969	0.09	0.16	0.00	0.00	0.03	0.09	0.93
$\text{Green Patent Ratio}_{\text{Adaptation}}$	58,161	0.01	0.03	0.00	0.00	0.00	0.00	0.15
$\text{Green Patent Ratio}_{\text{Mitigation}}$	58,161	0.08	0.16	0.00	0.00	0.02	0.08	0.96
$\text{Patent Quality}_{\text{Green}}$	35,450	0.30	0.32	0.00	0.00	0.22	0.48	1.42
$\text{Patent Quality}_{\text{Non-green}}$	57,735	0.32	0.21	0.00	0.15	0.32	0.47	0.89
$\text{Patent Quality}_{\text{All}}$	58,161	0.33	0.21	0.00	0.16	0.33	0.48	0.88
$\text{Donation}_{\text{Democratic}}$ (USD)	514	311.28	598.53	0.00	38.50	120.50	300.00	3000.00
$\text{Log(Donation}_{\text{Democratic}}\text{)}$	458	4.98	1.37	1.61	4.13	5.02	5.77	8.02
$\text{Claims}_{\text{Green}}$	22,345	16.16	6.66	3.00	12.00	16.00	20.00	42.00
$\text{Claims}_{\text{Non-green}}$	54,701	16.40	4.11	6.00	13.86	16.29	18.73	30.43
$\text{Claims}_{\text{All}}$	55,459	16.39	4.03	6.00	13.88	16.25	18.67	30.08
$\text{References}_{\text{Green}}$	22,345	2.86	4.02	0.00	0.33	1.50	3.67	23.00
$\text{References}_{\text{Non-green}}$	54,701	3.28	3.86	0.00	0.82	2.00	4.22	21.25
$\text{References}_{\text{All}}$	55,459	3.25	3.82	0.00	0.80	2.00	4.16	21.20
$\text{Rejection Effort}_{\text{Green}}$	44,117	0.88	0.24	0.00	0.86	1.00	1.00	1.00
$\text{Rejection Effort}_{\text{Non-green}}$	62,630	0.87	0.16	0.23	0.82	0.92	0.98	1.00
$\text{Rejection Effort}_{\text{All}}$	62,955	0.87	0.16	0.25	0.83	0.92	0.97	1.00
$\text{Extreme Temperature}_{\text{Heat}}$	58,141	0.63	0.48	0.00	0.00	1.00	1.00	1.00
Extreme Temperature	58,141	0.12	0.32	0.00	0.00	0.00	0.00	1.00
$\text{Extreme Temperature}_{\text{Cold}}$	58,141	0.13	0.34	0.00	0.00	0.00	0.00	1.00

Table 2
Climatic Disaster Experience and Green Patent Review

This table presents examiner-year level regressions of examiners' preferences for green patents on climatic disaster exposures. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. Panel A shows the baseline results. *Green Patent Ratio* is defined as the percentage of green patents granted out of all granted patents for each examiner in a given year. Panel B presents the results of climatic disasters on examiners' approval rate. $Approval\ Rate_{Green}$ is defined as the total number of green patents issued by the examiner divided by the total number of green applications received by the examiner in a given year. $Approval\ Rate_{Non\text{-}green}$ is defined as the total number of non-green patents issued by the examiner divided by the total number of non-green applications received by the examiner in a given year. $Approval\ Rate_{All}$ is defined as the total number of all patents issued by the examiner divided by the total number of all applications reviewed by the examiner in a given year. $Application\ Ratio_{Green}$ is defined as the percentage of green patent applications in all patent applications received by each examiner in a given year. Panel C shows the impact on different green patent categories. $Green\ Patent\ Ratio_{Adaptation}$ is the percentage of green patents related to technologies for adaptation to climate change in all granted patents for each examiner each year. $Green\ Patent\ Ratio_{Mitigation}$ is the percentage of green patents related to technologies for climate change mitigation in all granted patents for each examiner each year. The baseline model includes examiner and year fixed effects. Standard errors are double-clustered at the county and year levels, and reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Green Patent Ratio

	Dependent Variable: Green Patent Ratio			
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0079^{***}	0.0079^{***}	0.0121^{***}	0.0077^{***}
	(0.0020)	(0.0024)	(0.0035)	(0.0025)
Examiner FE	Yes	Yes	No	Yes
County FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	County, Year	County	County, Year	County, Year
# Obs.	58,161	58,161	58,161	58,161
Adj. R^2	0.852	0.852	0.043	0.852

Panel B: Green Patent Approval Rate vs. Number of Green Patent Applications

	Approval $Rate_{Green}$	Approval $Rate_{Non\text{-}green}$	Approval $Rate_{All}$	Application $Ratio_{Green}$
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.1290**	-0.0079	0.0023	0.0043
	(0.0645)	(0.0129)	(0.0156)	(0.0042)
Examiner FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs.	39,754	57,700	57,769	57,769
Adj. R^2	0.070	0.270	0.287	0.889

Panel C: Climate Change Adaptation Patents vs. Mitigation Patents

	Green Patent $Ratio_{Adaptation}$	Green Patent $Ratio_{Mitigation}$
	(1)	(2)
$Disaster_{Climatic}$	0.0014*	0.0062***
	(0.0008)	(0.0014)
Examiner FE	Yes	Yes
Year FE	Yes	Yes
# Obs.	58,161	58,161
Adj. R^2	0.547	0.864

Table 3
Robustness and Placebo Tests

This table shows the results of robustness and placebo tests. Panel A presents examiner-year level regressions of examiners' preferences for green patents on climatic disaster exposures, based on an alternative green patent classification. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. *Green Patent* $Ratio_{OECD15}$ is the percentage of green patents identified by the OECD 2015 classification in all granted patents for each examiner each year. *Green Patent* $Ratio_{OECD15\&23}$ is the percentage of green patents identified by the intersection of both OECD 2015 and OECD 2023 classifications in all granted patents for each examiner each year. *Green Patent* $Ratio_{OECD15or23}$ is the percentage of green patents identified by the union of OECD 2015 and 2023 classifications in all granted patents for each examiner each year. *Green Patent* $Ratio_{OECD15|23}$ is the percentage of green patents that fall within the OECD 2015 classification but do not include the OECD 2023 classification in all granted patents for each examiner each year, where these green patents are all non-climate-change related. Panel B presents examiner-year level regressions of examiners' preferences for green patents on climatic disaster exposures using matched samples. *Green Patent Ratio* is defined as the percentage of green patents granted in all granted patents for each examiner in a given year. Columns (1) and (2) use a sample with matched examiners of the same art units. Columns (3) and (4) use a sample with matched examiners of the same art units and a General Schedule (GS) pay level gap of no more than 1. In Panel C, we exclude patents filed by companies located in the same state as the examiners. Panel D presents examiner-year level regressions of examiners' preferences for green patents on non-climatic disaster exposures. $Disaster_{Non\text{-}climatic}$ is a dummy variable that equals one if the examiner experiences non-climatic disasters in the previous year and zero otherwise. The baseline model includes examiner and year fixed effects. Standard errors are double-clustered at the county and year levels, and reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Alternative Definitions of Green Patents

	Climate-related Green Patents			Non-climate Related Green Patents
	Green Patent $Ratio_{OECD15}$	Green Patent $Ratio_{OECD15\&23}$	Green Patent $Ratio_{OECD15or23}$	Green Patent $Ratio_{OECD15\|23}$
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0038***	0.0044**	0.0074***	-0.0006
	(0.0011)	(0.0018)	(0.0018)	(0.0010)
Examiner FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs.	58,161	58,161	58,161	58,161
Adj. R^2	0.888	0.875	0.868	0.819

Panel B: Matched Sample

	Dependent Variable: Green Patent Ratio			
	Art unit matching		Art unit + Pay matching	
	1:m	1:1	1:m	1:1
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0076***	0.0077***	0.0096***	0.0100***
	(0.0016)	(0.0015)	(0.0024)	(0.0023)
Examiner FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs.	9,402	3,128	6,241	2,358
Adj. R^2	0.827	0.865	0.785	0.766

Panel C: Excluding Firms in the Same State

	Dependent Variable: Green Patent Ratio			
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0081***	0.0081***	0.0120***	0.0078***
	(0.0017)	(0.0025)	(0.0033)	(0.0023)
Examiner FE	Yes	Yes	No	Yes
County FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	County, Year	County	County, Year	County, Year
# Obs.	58,142	58,142	58,142	58,142
Adj. R^2	0.851	0.851	0.043	0.852

Panel D: Placebo Test

	Dependent Variable: Green Patent Ratio			
	(1)	(2)	(3)	(4)
$Disaster_{Non\text{-}climatic}$	0.0003	0.0003	-0.0023	0.0003
	(0.0017)	(0.0019)	(0.0049)	(0.0013)
Examiner FE	Yes	Yes	No	Yes
County FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	County, Year	County	County, Year	County, Year
# Obs.	58,161	58,161	58,161	58,161
Adj. R^2	0.852	0.852	0.043	0.852

Table 4
Climatic Disaster Experience and Green Patent Quality

This table presents examiner-year level regressions of green patent quality on climatic disaster exposures. *Patent Quality*$_{Green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of green patents for each examiner in a given year. *Patent Quality*$_{Non\text{-}green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of non-green patents for each examiner in a given year. *Patent Quality*$_{All}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of all patents for each examiner in a given year. *Disaster*$_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. Examiner and year fixed effects are included. Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Patent Quality$_{Green}$	Patent Quality$_{Non\text{-}green}$	Patent Quality$_{All}$
	(1)	(2)	(3)
Disaster$_{Climatic}$	0.0222**	-0.0034	-0.0013
	(0.0111)	(0.0061)	(0.0060)
Examiner FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	35,450	57,735	58,161
Adj. R^2	0.322	0.661	0.677

Table 5
Climatic Disaster Experience and Examiners' Political Donations

This table presents examiner-year level regressions of examiners' political donations on climatic disaster exposures. $Donation_{Democratic}(USD)$ is the total annual dollar amount of donations contributed to the Democratic Party by each examiner. $Log(Donation_{Democratic})$ is the logarithm of the total annual dollar amount of donations to the Democratic Party for each examiner. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. Examiner and year fixed effects are included. Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$Donation_{Democratic}$(USD)	$Log(Donation_{Democratic})$
	(1)	(2)
$Disaster_{Climatic}$	204.8644***	0.4456***
	(52.1659)	(0.1156)
Control	Yes	Yes
Examiner FE	Yes	Yes
Year FE	Yes	Yes
# Obs.	514	458
Adj. R^2	0.238	0.495

Table 6
Climatic Disaster Experience and Examiners' Effort

This table presents examiner-year level regressions of examiners' efforts for green patents on climatic disaster exposures. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. In Panel A, we focus on the data related to patent claims. $Claims_{Green}$ is defined as the average number of claims from green patents reviewed by each examiner in a given year. $Claims_{Non\text{-}green}$ is defined as the average number of claims from non-green patents reviewed by each examiner in a given year. $Claims_{All}$ is defined as the average number of claims from all patents reviewed by each examiner in a given year. In Panel B, we focus on the data related to patent references. $References_{Green}$ is the average number of references to green patents cited by each examiner each year. $References_{Non\text{-}green}$ is the average number of references to non-green patents cited by each examiner each year. $References_{All}$ is the average number of references to green patents cited by each examiner each year. In panel C, we focus on the sample with all the rejection applications. $Rejection\ Effort_{Green}$ represents the proportion of green rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year. $Rejection\ Effort_{Non\text{-}green}$ represents the proportion of non-green rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year. $Rejection\ Effort_{All}$ represents the proportion of all rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year. Examiner and year fixed effects are included. Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Claims of Patents Reviewed by Examiners

	$Claims_{Green}$	$Claims_{Non\text{-}green}$	$Claims_{All}$
	(1)	(2)	(3)
$Disaster_{Climatic}$	1.1476***	0.0292	0.2098
	(0.3576)	(0.1628)	(0.1809)
Examiner FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	22,345	54,701	55,459
Adj. R^2	0.176	0.320	0.330

Panel B: References Cited by Examiners in the Review Process

	$References_{Green}$	$References_{Non\text{-}green}$	$References_{All}$
	(1)	(2)	(3)
$Disaster_{Climatic}$	0.3124**	-0.0990	-0.0294
	(0.1414)	(0.0762)	(0.0400)
Examiner FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	22,345	54,701	55,459
Adj. R^2	0.584	0.744	0.749

Panel C: Examiners' Rejection Effort

	Rejection $Effort_{Green}$	Rejection $Effort_{Non\text{-}green}$	Rejection $Effort_{All}$
	(1)	(2)	(3)
$Disaster_{Climatic}$	0.0296**	0.0033	0.0036
	(0.0142)	(0.0068)	(0.0065)
Examiner FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	44,117	62,630	62,955
Adj. R^2	0.329	0.649	0.659

Table 7

Climatic Disaster Experience and Green Patent Review: Cross-Sectional Analyses

This table presents the results from the cross-sectional analysis. *Green Patent Ratio* is defined as the percentage of green patents granted in all granted patents for each examiner in a given year. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. Panel A is based on the role of examiners' characteristics. $Compensation_{High}$ is a dummy variable that equals one if the examiners' pay level in the previous year is no lower than the median pay level and zero otherwise. $Disaster_{Climatic} \times Compensation_{High}$ is an interaction term between $Disaster_{Climatic}$ and $Compensation_{High}$. $Tenure_{Long}$ is a dummy variable that equals one if the number of years of the examiner year in the previous year is no less than the median work and zero otherwise. $Disaster_{Climatic} \times Tenure_{Long}$ is an interaction term between $Disaster_{Climatic}$ and $Tenure_{Long}$. $County_{Dem}$ is a dummy variable that equals one if the county where the examiner is located is governed by the Democratic Party in the previous year, and zero otherwise. $Disaster_{Climatic} \times County_{Dem}$ is an interaction term between $Disaster_{Climatic}$ and $County_{Dem}$. $Alliance_{Climate}$ is a dummy variable that equals one if the state where the examiner is located has joined the United States Climate Alliance in the previous year, and zero otherwise. $Disaster_{Climatic} \times Alliance_{Climate}$ is an interaction term between $Disaster_{Climatic}$ and $Alliance_{Climate}$. Panel B is based on the role of examiners' attention. $Attention_{High}$ is a dummy variable that equals one if the total Google search volume in the previous year is higher than the median and zero otherwise. $Disaster_{Climatic} \times Attention_{High}$ is an interaction term between $Disaster_{Climatic}$ and $Attention_{High}$. $Attention_{High\ State}$ is a dummy variable that equals one if the state's Google search volume in the previous year is higher than the median of all states for that year and zero otherwise. $Disaster_{Climatic} \times Attention_{HighState}$ is an interaction term between $Disaster_{Climatic}$ and $Attention_{HighState}$. Panel C is based on the role of disaster severity. $Loss_{Large}$ is a dummy variable that equals one if the monetary loss of a disaster is above the median and zero otherwise. $Disaster_{Climatic} \times Loss_{Large}$ is an interaction term between $Disaster_{Climatic}$ and $Loss_{Large}$. $Duration_{Long}$ is a dummy variable that equals one if the total duration of the corresponding disasters is higher than the median and zero otherwise. $Disaster_{Climatic} \times Duration_{Long}$ is an interaction term between $Disaster_{Climatic}$ and $Duration_{Long}$. *Fatality* is a dummy variable that equals one if the corresponding disasters have caused the fatality and zero otherwise. $Disaster_{Climatic} \times Fatality$ is an interaction term between $Disaster_{Climatic}$ and *Fatality*. $Year_{Consecutive}$ is a dummy variable that equals one if the examiners experience climatic disasters in the previous two consecutive years and zero otherwise. $Disaster_{Climatic} \times Year_{Consecutive}$ is an interaction term between $Disaster_{Climatic}$ and $Year_{Consecutive}$. Examiner and year fixed effects are included. Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Examiner Characteristics

	Dependent Variable: Green Patent Ratio			
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0023	0.0033	0.0048**	0.0067***
	(0.0022)	(0.0028)	(0.0022)	(0.0017)
$Compensation_{High}$	0.0012			
	(0.0014)			
$Disaster_{Climatic} \times Compensation_{High}$	0.0092***			
	(0.0027)			
$Tenure_{Long}$		0.0017***		
		(0.0005)		
$Disaster_{Climatic} \times Tenure_{Long}$		0.0098***		
		(0.0035)		
$County_{Dem}$			0.0001	
			(0.0001)	
$Disaster_{Climatic} \times County_{Dem}$			0.0021**	
			(0.0009)	
$Alliance_{Climate}$				-0.0013
				(0.0009)
$Disaster_{Climatic} \times Alliance_{Climate}$				0.0101***
				(0.0028)
Examiner FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs.	58,161	58,161	58,161	58,161
Adj. R^2	0.852	0.852	0.852	0.852

Panel B: Attention to Climate Change

	Dependent Variable: Green Patent Ratio	
	(1)	(2)
$Disaster_{Climatic}$	0.0015	0.0071***
	(0.0013)	(0.0017)
$Disaster_{Climatic} \times Attention_{High}$	0.0086***	
	(0.0017)	
$Attention_{HighState}$		-0.0004
		(0.0009)
$Disaster_{Climatic} \times Attention_{HighState}$		0.0048**
		(0.0021)
Examiner FE	Yes	Yes
Year FE	Yes	Yes
# Obs.	58,161	58,161
Adj. R^2	0.852	0.852

Panel C: Severity of Climate Disaster

	Dependent Variable: Green Patent Ratio			
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0051***	0.0058***	-0.0015	0.0069***
	(0.0008)	(0.0022)	(0.0044)	(0.0015)
$Disaster_{Climatic} \times Loss_{Large}$	0.0074*			
	(0.0039)			
$Disaster_{Climatic} \times Duration_{Long}$		0.0090**		
		(0.0057)		
$Disaster_{Climatic} \times Fatality$			0.0115**	
			(0.0052)	
$Disaster_{Climatic} \times Year_{Consecutive}$				0.0108**
				(0.0051)
Examiner FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs.	58,161	58,161	58,161	54,815
Adj. R^2	0.852	0.852	0.852	0.857

Table 8
Green Patents, Climatic Disaster, and Corporate Greenhouse Gas Emission

Panel A shows the statistics for firm-year level variables in our sample. *Log(GHG Emission*) is the logarithm of the sum of Scope 1 greenhouse gas intensity, Scope 2 greenhouse gas intensity, and Scope 3 greenhouse gas intensity provided by the Trucost database in the following three years. *Green Ratio*$_{ExaminerDisaster}$ is the percentage of green patents granted by examiners who experienced the disaster in the previous year for each firm. *Disaster*$_{Firm}$ is a dummy variable that equals one if the county where the firm's headquarters is located experienced a climatic disaster in the previous year, and zero otherwise. *Book-to-market* is the difference between common equity and preferred stock capital divided by the equity market value at the end of the previous year. *Return* is the annual return calculated by accumulating the monthly return in the previous year. *Log(Assets)* is the logarithm of total assets at the end of the previous year. *Div/Inc* is dividends divided by net income at the end of the previous year. *Leverage* is long-term debt plus current liabilities divided by total assets in US dollars (millions) at the end of the previous year. *Cash Holding* is the ratio of current assets over total assets at the end of the previous year. *RD Intensity* is the R&D expense scaled by total assets at the end of the previous year. The sample period is from 2012 to 2020. All continuous variables that are not constrained between 0 and 1 are winsorized at 1% and 99% level. Panel B presents firm-year level regressions of greenhouse gas emissions on selected green patents by event examiners. We control firm-level variables, including *Book-to-market*, *Log(Assets)*, *Leverage*, *Cash Holding*, *Div/Inc, RD Intensity*, and *Return*. Firm, county, and year fixed effects are included in columns (1) and (2), while industry, county, and year fixed effects are included in columns (3) and (4). Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Detailed variable definitions are provided in Appendix A.

Panel A: Summary Statistics for Firms

Variable	Obs	Mean	STD	P1	P25	Med	P75	P99
Firm-year panel								
Log(GHG Emission)	1,987	6.46	0.90	4.72	5.89	6.44	6.97	9.40
Green Ratio$_{ExaminerDisaster}$	1,987	0.01	0.06	0.00	0.00	0.00	0.00	0.14
Book-to-market	1,987	0.36	0.36	-0.30	0.17	0.30	0.46	1.46
Returns	1,987	0.17	0.58	-0.67	-0.09	0.13	0.34	2.05
Log(Assets)	1,987	8.68	2.11	3.89	7.34	8.62	10.19	12.87
Div/Inc	1,987	0.44	5.46	-1.50	0.00	0.15	0.39	3.14
Leverage	1,987	0.25	0.20	0.00	0.12	0.23	0.35	0.98
Cash Holding	1,987	0.24	0.22	0.00	0.08	0.16	0.32	0.93
RD Intensity	1,987	0.09	0.18	0.00	0.02	0.05	0.10	0.61
Disaster$_{Firm}$	1,987	0.03	0.18	0.00	0.00	0.00	0.00	1.00

Panel B: Corporate Greenhouse Gas Emission

	Dependent Variable: Log(GHG Emission)			
	(1)	(2)	(3)	(4)
Green Ratio$_{ExaminerDisaster}$	-0.4461***	-0.4402***	-0.8568***	-0.8499***
	(0.1422)	(0.1480)	(0.2137)	(0.2122)
Disaster$_{Firm}$		-0.0147		-0.0172
		(0.0197)		(0.0364)
Control	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	No	No
Industry FE	No	No	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs.	1,987	1,987	1,987	1,987
Adj. R^2	0.978	0.978	0.821	0.821

Table 9
Extreme Temperature Experience and Green Patent Review

This table presents examiner-year level regressions for green patents on extreme temperature exposures. Panel A shows the regressions of *Green Patent Ratio* on the measures of extreme temperature experience, while Panel B shows the regressions of *Patent Quality* on the measures of extreme temperature experience. *Green Patent Ratio* is defined as the percentage of green patents granted out of all granted patents for each examiner in a given year. *Extreme Temperature*$_{Heat}$ is a dummy variable that equals one if the total number of extremely hot days in a year exceeds the median of all counties for that year, and zero otherwise. *Extreme Temperature* is a dummy variable that equals one if the combined total of extremely hot and extremely cold days exceeds the median of all counties for that year, and zero otherwise. *Extreme Temperature*$_{Cold}$ is a dummy variable that equals one if the total number of extremely cold days in a year exceeds the median of all counties for that year, and zero otherwise. *Patent Quality*$_{Green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of green patents for each examiner in a given year. *Patent Quality*$_{Non\text{-}green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of non-green patents for each examiner in a given year. *Patent Quality*$_{All}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of all patents for each examiner in a given year. Examiner and year fixed effects are included. Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Green Patent Ratio

	Dependent Variable: Green Patent Ratio		
	(1)	(2)	(3)
Extreme Temperature$_{Heat}$	0.0022***		
	(0.0006)		
Extreme Temperature		0.0029***	
		(0.0008)	
Extreme Temperature$_{Cold}$			-0.0011
			(0.0010)
Examiner FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	58,141	58,141	58,141
Adj. R^2	0.852	0.852	0.852

Panel B: Green Patent Quality

	$\text{Patent Quality}_{\text{Green}}$	$\text{Patent Quality}_{\text{Non-green}}$	$\text{Patent Quality}_{\text{All}}$
	(1)	(2)	(3)
$\text{Extreme Temperature}_{\text{Heat}}$	0.0138**	0.0026	0.0024
	(0.0066)	(0.0021)	(0.0020)
Examiner FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	35,436	57,715	58,141
Adj. R^2	0.322	0.660	0.677

Appendix A: Variable Definitions

Variables	Definitions
Examiner-year level	
$Disaster_{Climatic}$	$Disaster_{Climatic}$ is a dummy variable, which equals one if the examiner experiences climatic disasters in year t-1 and zero otherwise.
Green Patent Ratio	Green Patent Ratio is the percentage of green patents granted in all granted patents for each examiner in a given year.
Approval $Rate_{Green}$	Approval $Rate_{Green}$ is defined as the total number of green patents issued by the examiner divided by the total number of green applications received by the examiner in a given year.
Approval $Rate_{Non\text{-}green}$	Approval $Rate_{Non\text{-}green}$ is defined as the total number of non-green patents issued by the examiner divided by the total number of non-green applications received by the examiner in a given year.
Approval $Rate_{All}$	Approval $Rate_{All}$ is defined as the total number of all patents issued by the examiner divided by the total number of all applications reviewed by the examiner in a given year.
Application $Ratio_{Green}$	Application $Ratio_{Green}$ is defined as the percentage of green patent applications in all patent applications received by each examiner in a given year.
Green Patent $Ratio_{Adaptation}$	Green Patent $Ratio_{Adaptation}$ is the percentage of green patents related to technologies for adaptation to climate change in all granted patents for each examiner each year.
Green Patent $Ratio_{Mitigation}$	Green Patent $Ratio_{Mitigation}$ is the percentage of green patents related to technologies for climate change mitigation in all granted patents for each examiner each year.
Green Patent $Ratio_{OECD15}$	Green Patent $Ratio_{OECD15}$ is the percentage of green patents identified by the OECD 2015 classification in all granted patents for each examiner each year.
Green Patent $Ratio_{OECD15\&23}$	Green Patent $Ratio_{OECD15\&23}$ is the percentage of green patents identified by the intersection of both OECD 2015 and OECD 2023 classifications in all granted patents for each examiner each year.
Green Patent $Ratio_{OECD15or23}$	Green Patent $Ratio_{OECD15or23}$ is the percentage of green patents identified by the union of OECD 2015 and 2023 classifications in all granted patents for each examiner each year.
Green Patent $Ratio_{OECD15\|23}$	Green Patent $Ratio_{OECD15\|23}$ is the percentage of green patents that fall within the OECD 2015 classification but do not include the OECD 2023 classification in all granted patents for each examiner each year.
$Disaster_{Non\text{-}climatic}$	$Disaster_{Non\text{-}climatic}$ is a dummy variable that equals one if the examiner experiences non-climatic disasters in the previous year and zero otherwise.
Patent $Quality_{Green}$	Patent $Quality_{Green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of green patents for each examiner in a given year.
Patent $Quality_{Non\text{-}green}$	Patent $Quality_{Non\text{-}green}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of non-green patents for each examiner in a given year.
Patent $Quality_{All}$	Patent $Quality_{All}$ is defined as the logarithm of one plus the average truncated citation (Hall, Jaffe, and Trajtenberg, 2001) of all patents for each examiner in a given year.

$Donation_{Democratic}$(USD)	$Donation_{Democratic}$(USD) is the total annual dollar amount of donations contributed to the Democratic Party by each examiner.
$Log(Donation_{Democratic})$	$Log(Donation_{Democratic})$ is the logarithm of the total annual dollar amount of donations to the Democratic Party for each examiner.
$Claims_{Green}$	$Claims_{Green}$ is defined as the average number of claims from green patents reviewed by each examiner in a given year.
$Claims_{Non\text{-}green}$	$Claims_{Non\text{-}green}$ is defined as the average number of claims from non-green patents reviewed by each examiner in a given year.
$Claims_{All}$	$Claims_{All}$ is defined as the average number of claims from all patents reviewed by each examiner in a given year.
$References_{Green}$	$References_{Green}$ is the average number of references to green patents cited by each examiner each year.
$References_{Non\text{-}green}$	$References_{Non\text{-}green}$ is the average number of references to non-green patents cited by each examiner each year.
$References_{All}$	$References_{All}$ is the average number of references to green patents cited by each examiner each year.
Rejection $Effort_{Green}$	Rejection $Effort_{Green}$ represents the proportion of green rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year.
Rejection $Effort_{Non\text{-}green}$	Rejection $Effort_{Non\text{-}green}$ represents the proportion of non-green rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year.
Rejection $Effort_{All}$	Rejection $Effort_{All}$ represents the proportion of all rejections based on 102 or 103 reasons that include at least one prior art citation, relative to the total number of such rejections by each examiner each year.
$Compensation_{High}$	$Compensation_{High}$ is a dummy variable equal to one if the examiner's General Schedule (GS) pay level in the previous year is higher than or equal to the median, and zero otherwise.
$Tenure_{Long}$	$Tenure_{Long}$ is a dummy variable that equals one if the examiner's number of work years in the previous year is higher than or equal to the median, and zero otherwise.
$County_{Dem}$	$County_{Dem}$ is a dummy variable that equals one if the county where the examiner is located is governed by the Democratic Party and zero otherwise.
$Alliance_{Climate}$	$Alliance_{Climate}$ is a dummy variable that equals one if the state where the examiner is located has joined the United States Climate Alliance and zero otherwise.
$Attention_{High}$	$Attention_{High}$ is a dummy variable that equals one if the total Google search volume in one year is higher than the median and zero otherwise.
$Attention_{HighState}$	$Attention_{HighState}$ is a dummy variable that equals one if the state's Google search volume in one year is higher than the median of all states this year and zero otherwise.
$Loss_{Large}$	$Loss_{Large}$ is a dummy variable, which equals one if the monetary loss of a disaster is above the median and zero otherwise
$Duration_{Long}$	$Duration_{Long}$ is a dummy variable that equals one if the total duration of the disasters is higher than the median duration of all disasters and zero otherwise.

Fatality	Fatality is a dummy variable that equals one if the disaster has caused the fatality and zero otherwise.
$Year_{Consecutive}$	$Year_{Consecutive}$ is a dummy variable that equals one if the examiners experience climatic disasters in two consecutive years and zero otherwise.
Extreme $Temperature_{Heat}$	Extreme $Temperature_{Heat}$ is a dummy variable that equals one if the total number of days in a year when the maximum temperature in the examiner's county exceeds the 90^{th} percentile across all counties is greater than the median of all counties for that year, and zero otherwise.
Extreme Temperature	Extreme Temperature is a dummy variable that equals one if the total number of days when the maximum temperature in the examiner's county exceeds the 90^{th} percentile plus the total number of days when the minimum temperature falls below the 10^{th} percentile across all counties is greater than the median of all counties for that year, and zero otherwise.
Extreme $Temperature_{Cold}$	Extreme $Temperature_{Cold}$ is a dummy variable that equals one if the total number of days in a year when the minimum temperature in the examiner's county is below the 10^{th} percentile across all counties is greater than the median of all counties for that year, and zero otherwise.
Firm-year level	
Log(GHG Emission)	Log(GHG Emission) is the logarithm of the sum of Scope 1 greenhouse gas emission intensity, Scope 2 greenhouse gas emission intensity, and Scope 3 greenhouse gas emission intensity in the following three years.
Green $Ratio_{ExaminerDisaster}$	Green $Ratio_{ExaminerDisaster}$ is the percentage of green patents granted by examiners who experienced the disaster out of all green patents in the previous year for each firm.
$Disaster_{Firm}$	$Disaster_{Firm}$ is a dummy variable that equals one if the county where the firm's headquarters is located experienced a climatic disaster in the previous year, and zero otherwise.
Book-to-market	Book-to-market is the difference between common equity and preferred stock capital divided by the equity market value at the end of the previous year.
Return	Return is the annual return calculated by accumulating the monthly return in the previous year.
Log(Assets)	Log(Assets) is the logarithm of total assets at the end of the previous year.
Div/Inc	Div/Inc is dividends divided by net income at the end of the previous year
Leverage	Leverage is long-term debt plus current liabilities divided by total assets in US dollars (millions) at the end of the previous year.
Cash Holding	Cash Holding is the ratio of current assets over total assets at the end of the previous year.
RD Intensity	RD Intensity is the R&D expense scaled by total assets at the end of the previous year

Appendix B: Classification of Climatic Natural Disasters

This appendix provides details for our classification of climatic natural disasters. The Spatial Hazard and Loss Database for the United States (SHELDUS) includes 18 types of natural disasters. In our study, we focus on identifying natural disasters more closely linked to climate change, referred to as *climatic disasters*. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (2022) highlights extreme climate events including flooding, drought, wind, tornadoes, and storms (including thunderstorms, hail, and hurricanes/tropical storms).[17] Additionally, Alok, Kumar, and Wermers (2020) and Kim, Wang, and Wu (2022) provide broader definitions of climatic disasters based on SHELDUS, though their categorizations differ slightly.

Building on previous studies and classifications generated with the assistance of ChatGPT, we identify 10 climate-related disaster types: drought, flooding, coastal, heat, hurricane/tropical storm, severe thunderstorm, wildfire, wind, tornado, and hail. We exclude the remaining 8 disaster types: fog, avalanche, landslide, lightning, winter weather, earthquake, tsunamis/seiche, and volcanic, as these are either not directly linked to climate change or are geologically driven. Figure B1 presents ChatGPT's classification process, while Table B1 draws on existing scientific research to detail the relationships between the six selected climatic disaster types in our final sample and climate change, providing a solid foundation for our classification and analysis. Overall, these references collectively support our classification of events in the sample as climatic natural disasters and establish their connection to climate change. This ensures that our analysis is grounded in established scientific and empirical research, thereby strengthening the validity of our findings.

[17] See https://www.ipcc.ch/report/ar6/wg2/.

Figure B1
Climatic Disasters Classified by ChatGPT

This figure demonstrates how ChatGPT classifies climatic disasters that are highly related to climate change.

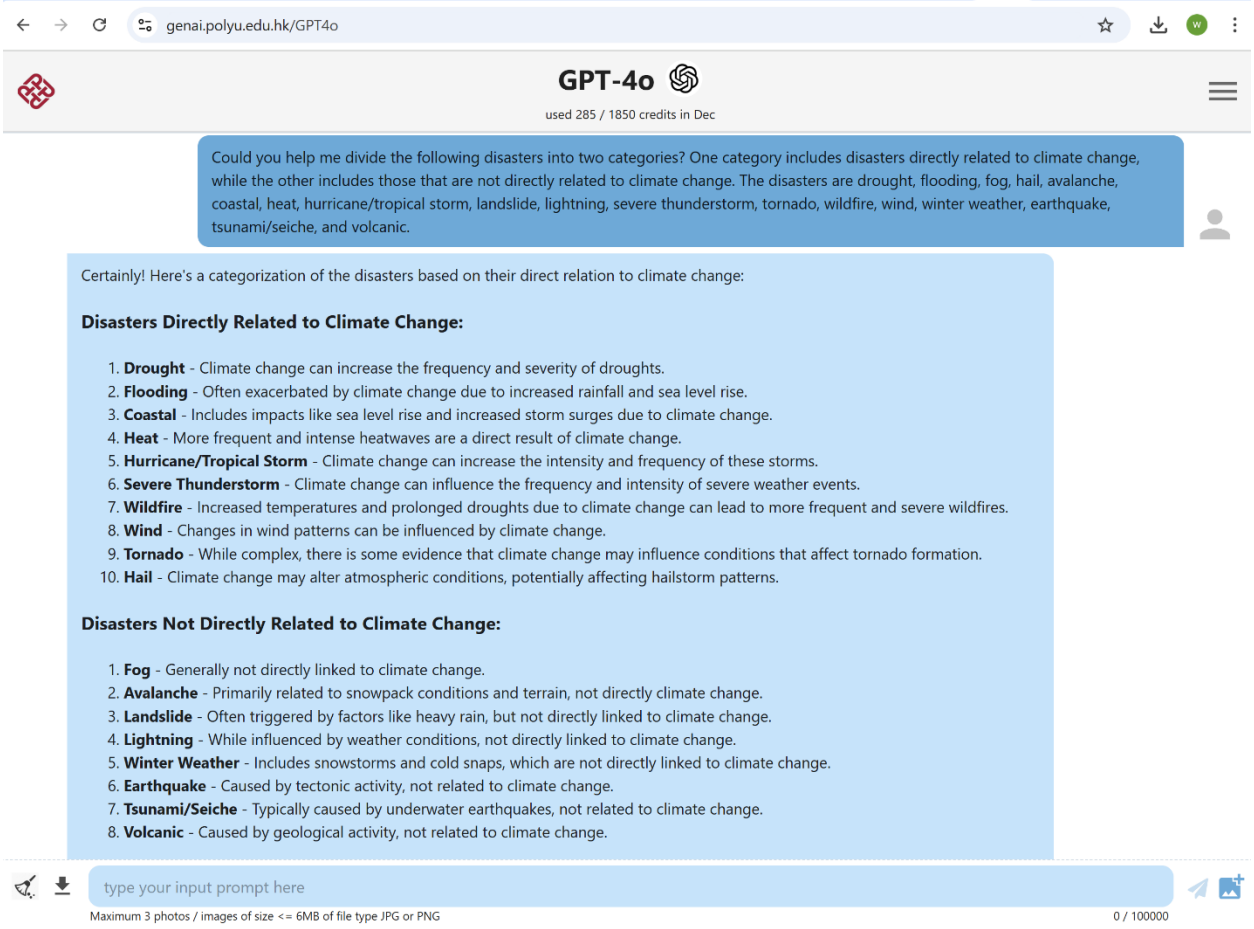


Table B1
Supporting Evidence for Climatic Natural Disasters

Disasters	Relation to Climate Change
Flooding	Climate change increases flooding by raising the frequency and intensity of heavy precipitation and altering temperatures across the region. (Mallakpour and Villarini, 2015; Alifu, Hirabayashi, Imada, and Shiogama, 2022)
Hurricane/ Tropical Storm	Climate changes, such as higher sea-surface temperatures, increased atmospheric moisture, and changes in large-scale circulation, can influence factors like intensity, size, landfall angle, translation speed, and sea level, thereby contributing to hurricanes and tropical storms. (Hassanzadeh et al., 2020; Strauss et al., 2021)
Tornado	Climate change plays a significant role in modulating the annual frequency of tornadoes. In a warming climate, the frequency of environments favorable to tornadoes is expected to increase, particularly in spring, due to a rise in high wind shear values in the lowest 1 km of the atmosphere. (Brooks, Carbin, and Marsh, 2014; Nouri, Devineni, Were, and Khanbilvardi, 2021)
Wildfire	Climate changes, such as increased global temperatures, accelerate the water cycle, leading to more intense rainfall events, more severe and widespread droughts, regional humidity variations, and sea surface temperature fluctuations, which in turn increase wildfire. For example, these changes dry out vegetation, making it more flammable, and create conditions that are more favorable for wildfires, thereby increasing their frequency and severity. (Jolly et al., 2015; Gutierrez et al, 2021.)
Wind	Climate change can influence wind-related natural disasters by altering variables directly linked to wind generation and propagation. For instance, increasing greenhouse gas concentrations can intensify winds that promote upwelling. This intensification is more noticeable at higher latitudes, consistent with the warming patterns associated with climate change, leading to more severe wind events. (Sydeman et al., 2014; Lobeto, Menendez, and Losada, 2021)
Hail	Climate change, such as global warming, affects low-level moisture, convective instability, microphysical processes, and vertical wind shear. These changes create conditions that increase the frequency and severity of hail by enhancing the atmospheric environment necessary for hail formation and growth. (Allen, 2017; Raupach et al., 2021)

Appendix B References

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Appendix C: Additional Results

Table C1
Climatic Disaster Experience and Green Patent Review: Additional Tests

This table presents examiner-year level regressions of examiners' preferences for green patents on climatic disaster exposures. *Green Patent Ratio* is the percentage of green patents granted out of all granted patents for each examiner in a given year. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. In panel A, we run the regression using the Tobit model, including county and year fixed effects. In panel B, we exclude certain climate disasters, such as hail and wind events, as they may be less directly associated with climate change compared to other disasters in our sample. The baseline model includes examiner and year fixed effects. Standard errors are double-clustered at the county and year levels for the baseline model, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Tobit Model

	Dependent Variable: Green Patent Ratio	
	(1)	(2)
$Disaster_{Climatic}$	0.0202^{***}	0.0202^{***}
	(0.0071)	(0.0074)
County FE	Yes	Yes
Year FE	Yes	Yes
Cluster	County, Year	County
# Obs.	58,161	58,161
Pseudo R^2	0.112	0.112

Panel B: Alternative Definition of Climatic Disasters

	Dependent Variable: Green Patent Ratio			
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0084^{***}	0.0084^{***}	0.0126^{***}	0.0082^{***}
	(0.0019)	(0.0024)	(0.0034)	(0.0023)
Examiner FE	Yes	Yes	No	Yes
County FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	County, Year	County	County, Year	County, Year
# Obs.	58,161	58,161	58,161	58,161
Adj. R^2	0.852	0.852	0.043	0.852

Table C2

Climatic Disaster Experience and Green Patent Quality: Poisson Regressions

This table presents examiner-year level Poisson regressions of green patent quality on climatic disaster exposures. *Patent Citation*$_{Green}$ is the average number of citations received by green patents for each examiner in a given year. *Patent Citation*$_{Non\text{-}green}$ is the average number of citations received by non-green patents for each examiner in a given year. *Patent Citation*$_{All}$ is the average number of citations received by all patents for each examiner in a given year. *Disaster*$_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. Examiner and year fixed effects are included. Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Patent Citation$_{Green}$	Patent Citation$_{Non\text{-}green}$	Patent Citation$_{All}$
	(1)	(2)	(3)
Disaster$_{Climatic}$	0.1961***	0.0032	0.0231
	(0.0723)	(0.0501)	(0.0459)
Examiner FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	35,450	57,735	58,161
Pseudo R^2	0.471	0.499	0.500

Table C3

Climatic Disaster Experience and Green Patent Review: Patents without Prior Rejections

This table presents examiner-year level regressions of examiners' preferences for green patents on climatic disaster exposures. *Green Patent Ratio* is the percentage of green patents granted out of all granted patents for each examiner in a given year. $Disaster_{Climatic}$ is a dummy variable that equals one if the examiner experiences climatic disasters in the previous year and zero otherwise. Here we use the same sample in Table 5. The baseline model includes examiner and year fixed effects. Standard errors are double-clustered at the county and year levels, and are reported in parentheses. The sample period is from 2012 to 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: Green Patent Ratio			
	(1)	(2)	(3)	(4)
$Disaster_{Climatic}$	0.0091^{***}	0.0091^{***}	0.0141^{***}	0.0088^{***}
	(0.0022)	(0.0029)	(0.0026)	(0.0026)
Examiner FE	Yes	Yes	No	Yes
County FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	County, Year	County	County, Year	County, Year
# Obs.	55,682	55,682	55,682	55,682
Adj. R^2	0.874	0.874	0.044	0.874