Climate change risk, investor sentiment, and the performance of new entrant firms

ABSTRACT

We explore how climate change risk affects the performance of new entrant firms seeking external capital by using a sample of Initial Public Offerings (IPO) from 2000 to 2020. We find climate change risk negatively affects underpricing and the long-term performance of the IPO firms. We further investigate the moderating effect of investor sentiment on the relationship between climate change risk and IPO long-term performance. We find that the negative effect of climate change risk on IPO performance is stronger for firms going public when investors are pessimistic. Exploring the channels through which climate change risk affects IPO performance, the results show that the effect of climate change risk on IPO underpricing is channeled through the IPO volume, while long-term underperformance is channeled through growth opportunities. Overall, our results are robust to various model specifications, firm-level measures of climate change risk, CEO traits, endogeneity concerns, and exogenous shocks.

Plain English Summary

How does climate change risk impact IPO success? We find that climate change risk reduces both underpricing and long-term performance of IPOs and this negative effect is stronger when investor sentiment is pessimistic. Our study shows that climate change risk impacts IPO performance in two main ways: it reduces underpricing by affecting the volume of IPOs and lowers long-term performance by limiting growth opportunities. Overall, our findings highlight that climate risk plays a key role in shaping the IPO market. This has important implications for states vulnerable to climate change, investors, and the management of new entrant firms on the importance of climate change risk as an additional risk factor. In particular, our work encourages IPO firms and stock market regulators to address environmental and social issues to reduce uncertainties tied to climate risks.

Keywords: Initial public offering; Climate risk, Investor sentiment

JEL: G32; G40; D80

INTRODUCTION

A decade ago, the share of companies mentioning "climate change" in their IPO registration documents—the S-1 and F-1 forms required by the US Securities and Exchange Commission for domestic and foreign filers, respectively—started to rise. Back then, about 5% of companies cited climate change in their pre-IPO filings. More recently, between 10% and 15% of companies mention climate change in these disclosures (...), suggesting that more businesses are at least considering it when planning for the future. (Marc Bain, Jason Karaian, 2019)

In 2015, global investment consultant Mercer identified climate change risk as "*a significant source of portfolio risk for institutional investors to manage over the next 20 years*." In January 2020, Larry Fink, CEO of BlackRock, one of the world's largest asset managers, announced in his annual letter to CEOs that BlackRock "*will now make climate change central to its investment considerations*".[1] Regulatory bodies increasingly aim to promote the financial markets' attention to climate risks by encouraging both voluntary and mandatory disclosures of firms' exposure to climate risks (e.g., SEC, 2010).[2] Extant literature documents that climate change poses substantial costs to the economy (e.g., Nordhaus, 2007; Stern, 2007; Burke et al., 2015; Dietz et al., 2016; Lesk et al., 2016, Thistlethwaite and Wood, 2018). The question of how financial markets price climate risk has been the subject of a growing literature in asset pricing (e.g., Hong et al., 2019; Garvey et al., 2018; Daniel et al., 2016; Kumar et al., 2019), credit markets (e.g., Javadi and Masum, 2021; Painter, 2020; Engle et al., 2020; Huynh and Xia, 2020), and external financing (e.g., Ginglinger and Moreau, 2019; Elnahas et al., 2018; Chava, 2014).

[1] https://www.npr.org/2020/01/14/796252481/worlds-largest-asset-manager-puts-climate-at-the-center-of-its-investment-strate.

[2] US Securities and Exchange Commission (SEC); Commission Guidance Regarding Disclosure Related to Climate Change Retrieved from https://www.sec.gov/rules/interp/2010/33-9106.pdf (2010).

A survey by Krueger et al. (2020), shows that institutional investors believe climate risks have financial implications for their portfolio firms and begun to affect their portfolios. In fact, 26% of institutional investors indicate that they incorporate climate risks into their valuation models. Provided that firms' operations account for a large proportion of overall economic activities, it follows that climate change should significantly impact a cross-section of individual firms (see Huynh et al., 2020). Since climate risk cannot be easily hedged, the controversial issue for financial market participants is how exposure to climate risk affects firms' performance. As Hong et al. (2019) noted, natural disasters amplified by climate change can cause significant disruption to firms' production processes and substantially damage their profits. Drought is among the natural disasters that might be intensified by climate change and is the most devastating for economic activities (Huynh et al., 2020; Hong et al., 2019; Lesk et al., 2016). For example, Hyunh et al. (2020) document that the cost of equity capital, on average is 92 bps higher for firms headquartered in states affected by climate risk as measured by severe drought conditions. Javadi and Masum (2021) document that firms in locations with higher exposure to climate risk, as measured by drought conditions, pay significantly higher spreads for their bank loans.

Climate change risk has relevant and important information for a range of financial market transactions including the initial public offerings. Information about IPO issuers is limited, and this is due to the fact that private firms are not subject to the same disclosure requirements as public firms in the US (Baker et al., 2021). Therefore, an insight into how uncertainty, such as climate change risk, affects IPOs is valuable to the IPO participants and the market. Going public is considered a major corporate event in a firm's life cycle and marks the beginning of a firm's listing periods (Economidou et al., 2023), which provides an interesting setting to explore the impact of climate risk. Previous studies have examined the impact of factors related to environmental, social, and governance (ESG) on IPOs. For instance, Economidou et al.

(2023) investigate whether ESG information disclosed prior to going public affects IPO underpricing. Baker et al. (2021) examine whether ESG government risk management affects IPOs' underpricing. Our study focuses on climate change risk measures that are visible to the market and IPO participants. For instance, in 2018, many European countries experienced unusually hot weather, which led to extreme drought and agricultural losses (Jia and Li, 2020). Similarly, at the firm level climate risk change affects business operations and discourages firms' long-term investment. Collier (2016) finds that extreme weather events affect small and young firms. Since IPOs are typically fast-growing firms with poor resources (Filatotchev et al., 2006), the lack of breadth in managerial talent to absorb the complexity (Walters et al., 2010) of climate change risk makes it more challenging to adopt necessary changes and reposition their firms when climate change risk is high. Therefore, it is expected that climate change risk could potentially influence the performance of the IPO firms.

This paper addresses the question of how and in which way climate risk affects the IPO market and its performance. For example, Lee et al. (1991) find that companies go public when investor sentiment is high. Cornelli et al. (2006) find that over-optimism by retail investors contributes to higher underpricing in the IPO market, while Guo et al. (2023) find that investor sentiment is positively related to the perceived value of corporate cash holdings and reduces their perception of firm risk. Brav and Gompers (1997) suggest that investor sentiment is an important factor in IPO underperformance. Dorn (2009) shows that IPOs that are aggressively bought by investors who trade on sentiment exhibit high initial returns followed by poor aftermarket returns. Derrien (2005) finds that high sentiment by individual investors leads to large initial returns and poor long-run performance for the IPOs. More recently, Dong and Huang (2022) suggest that high investor sentiment significantly increases IPO underpricing in China. In light of previous studies, investors are likely to be pessimistic when climate change risk is high, and hence, we explore the interplay between climate change risk and investor sentiment on IPO performance.

We investigate the relationship between climate risk and IPO performance. Our first climate risk measure is based on the Palmer Drought Severity Index (PDSI) developed by Palmer (1965). The measure is widely used in economics, finance, and climate literature (Dai, 2011; Hong et al., 2019; Huynh et al., 2020; Javadi and Masum 2021). Among the natural disasters that might be intensified by climate change is drought, which is the most disturbing event for economic activities (Huynh et al., 2020; Hong et al., 2019; Javadi and Masum, 2021). However, it is possible to argue that the PDSI measure does not capture the long-term trend in droughts (see Hong et al., 2019).

Following Huynh et al. (2020) and Javadi and Masum (2021), we use the state location of firms' headquarters to determine their exposure to climate risk, and this is consistent for IPO firms since IPOs often operate within their country of origin. However, there may be exceptions in the technology sector where IPOs might have a global customer base, and presumably, their business operations are not affected by the location of their headquarters.[3] To examine the robustness of our results we investigate the impact of climate change risk for high-tech IPOs and those with an international presence.

We find that the level of underpricing is lower when climate change risk is high. Possibly, this is because the attraction of investing in IPO firms is minimal during high climate change risk, affecting the demand for IPO shares. Low demand for IPO shares would result in lower initial returns since underwriters and issuers are unlikely to adjust the offer price (Economidou et al. 2023). The fact that climate change risk could affect IPO demand is consistent with Ginglinger and Moreau's (2019) findings. We also find that climate risk adversely affects long-

[3] Our results are robust using state of incorporations instead of headquarters. We have not reported the results for brevity but available from the authors on request.

term post-IPO performance. We further investigate the impact of investor sentiment as a moderating factor on the negative effect of climate risk on long-term IPO performance. We find that the negative effect of drought risk on IPO long-term performance is stronger for firms going public when investors are pessimistic. The negative effect of climate change risk persists following Stern's 2006 report on climate risk but declines post-2016 US general elections (i.e., Trump era). We further explore the channels driving the negative impact of climate change risk on initial returns. Our results show that the negative effect of climate change risk on IPO underpricing is channeled through the IPO volume. It can be argued that the adverse impact of climate change risk might not be limited to the time of listing, but also extends beyond listing. Hence, potential growth opportunities for the IPO firms might be affected by climate change risk resulting in poor long-term performance. Our results show that the long-run underperformance of the IPO firms is due to the negative impact of climate change risk on IPO growth opportunities.

We examine the robustness of our results by: *(i)* using "Entropy Balancing matching" to account for possible endogeneity, *(ii)* excluding Oil and Gas companies and those listed in California states, due to a significant adverse effect of climate risk on these IPOs, *(iii)* investigating the impact of climate risk for IPOs with a global customer base by considering high-tech IPOs and international intensity, and (*iv*) using firm-specific climate risk measures developed by Sautner et al. (2023), alternative measures of climate risk using Spatial Hazard Events and Losses Database (SHELDUS), and CEO characteristics. Overall, our results of the negative impact of climate risk on IPO volume and performance remain robust.

Our study makes important contributions to the climate change literature in several respects. We contribute to the wide-ranging debate on the impact of climate change risk on firms and financial markets (Chava, 2014; Bernstein et al., 2019; Ginglinger and Moreau, 2019; Painter, 2020; Javadi and Masum, 2021), by investigating how external uncertainty such as climate change risk affects the equity market of new entrant firms. We also contribute to the existing literature of newly listed firms (Fisch et al., 2022; Gounopoulos et al., 2021; Yan and Williams, 2021, Economidou et al., 2023, Baker et al., 2021, etc.) by showing that higher exposure to climate change risk using discernible measure is associated with poor performance. Hence, issuers, underwriters, and IPO participants should be aware of the uncertainty associated with periods of rising climate change risk. We show that the effect of climate change risk on IPO performance is more pronounced when investors are pessimistic. These are novel findings and suggest that investors' beliefs and perceptions from photos in the news and the information embedded in the text adversely influence IPOs' performance.

Our study also contributes to the global policy debates regarding the climate risk on financial stability, following the concerns raised by the Federal Reserve (Board of Governors of the Federal Reserve System, 2021), the IMF (International Monetary Fund, 2021), and the European Central Bank (Bank for International Settlements, 2018, European Central Bank, 2021) regarding the threat of climate change to financial stability. Our results provide insights to both entrepreneurial firms seeking listing on the stock market and stock market regulators on the importance of the climate change risk for IPO firms. Our work should encourage IPO firms and stock market regulators to contribute toward the resolution of environmental and social issues in mitigating uncertainty related to climate change risks.

The rest of the paper proceeds as follows. In Section 2 we discuss the theoretical framework and development of our hypotheses. In Section 3, we discuss our data and methodology, and in Section 4, we discuss the main empirical results and robustness tests. We conclude in Section 5.

THEORY AND HYPOTHESES

Climate Risk

Climate risk refers to risks related to climate change and efforts to mitigate its impact, which are categorized into physical, regulatory, and technological risks (Krueger et al., 2020). Their survey of financial investors reports that institutions believe that physical and technological risks are still relevant today. In fact, long-term and larger institutional investors share the view that climate risk influences the performance of their investments.

Huynh et al. (2020) find that climate risk, measured by drought, is not easily diversifiable and the market prices this risk into firm-level equity risk premium. They compute the forward-looking required rate of return as the cost of equity capital and show that it is positively associated with drought intensity and the severity of drought conditions. Javadi and Masum (2021) report that firms in locations with higher exposure to climate risk pay significantly higher spreads on their bank loans. Similarly, Chava (2014) finds that investors demand a higher cost of debt and equity capital for firms with environmental concerns. The evidence in Degryse et al. (2020) indicates that green firms reporting in the Carbon Disclosure Project (CDP) pay significantly lower spreads on their loans. This effect is stronger when the loan syndicate is classified as green.

Climate risk and IPO performance

Firms seeking listing on the stock markets are subject to higher information asymmetry. This is because information related to private companies prior to listing on the stock market is limited. Economidou et al. (2023) document that the IPO market is associated with high information asymmetries. The authors argue that information about the IPO firms from the prospectuses is limited. Hence, this outcome could give rise to information asymmetry between the issuers, underwriters, and investors (e.g., Baron, 1982; Rock, 1986, and Welch, 1989). Beyond traditional sources of asymmetry, climate change risk introduces another layer of complexity, amplifying uncertainty in the IPO market. Schiemann and Sakhel (2019) argue that climate-related risks inherently increase information asymmetry by obscuring critical factors such as the scale, timing, or likelihood of regulatory and physical impacts. The lack of clear and complete information not only complicates firms' decision-making processes but also heightens investor concerns. Moreover, according to the adjustment cost theory (Gould, 1968), the higher information asymmetry intensifies the adjustment challenges of the firms, as it complicates their decision-making process regarding how to implement necessary adaptions and respond effectively to climate-induced changes while balancing the associated costs of adaptation (Van den Bremer and van der Ploeg, 2021). For example, incomplete information about the scale, timing, or probability of climate impacts, such as future regulatory policies or physical damage, could result in adjustment costs for firms, which need to be weighed against the long-term benefits of mitigating climate risks. We argue that climate change risk, amplifies both information asymmetry and adjustment costs, by negatively affecting investors' willingness to invest in IPOs with high climate risk exposure. This is because integrating climate risks into the investment process presents significant challenges, in that climate-related uncertainties leave investors with incomplete and unclear information. Moreover, the lack of well-established investment tools and best practices further complicates the effective incorporation of these risks into the investment process (Krueger, et al., 2020). Furthermore, a lack of transparent data regarding physical risks, such as vulnerability to extreme weather events may make it harder for many market participants, including institutional investors, to assess the IPO firm's long-term viability and profitability, and to price or hedge climate change risk (Krueger, et al., 2020). Investors are often skeptical about how heightened adjustment costs, such as investments in greener technologies, will impact the firm's near-term financial performance and whether the firm has a viable strategy to balance these expenditures with long-term benefits (Semieniuk et al., 2021). As a result, we argue that the combination of increased information asymmetry and adjustment costs tied to climate change risks significantly undermines investor confidence in the IPO market. This reduced confidence makes investors, both individual and institutional, less willing to participate, leading to reduced demand for shares and lower valuations during IPOs. A survey by Krueger et al. (2020) finds that institutional investors recognize the financial implications of climate risks for their portfolio firms. Typically, institutional investors are important and key players in the IPO market (Chemmanur and Huang, 2010) and their hesitations to participate in the IPO offering because of climate change risk could have a significant impact on the outcomes of the IPO firms. Economidou et al. (2023) explore the effect of environmental, social, and governance (ESG) information on the IPO market. While underwriters may not explicitly account for environmental concerns when determining the offer price, their findings suggest that climate change risks could dampen investor enthusiasm for participating in IPO offerings. This reduced enthusiasm is likely to contribute to lower levels of underpricing in the IPO market. In other words, if IPO participants are highly concerned about climate change risk, underpricing/initial return is likely to be lower as they proactively adjust the price to reflect the perceived risks. By incorporating climate-related uncertainties into their pricing strategies, participants align the price more closely with market expectations, thereby reducing the extent of underpricing. Therefore, based on these arguments, we hypothesize that climate change risks, increase information asymmetry and adjustment costs, which negatively affect IPO firms' initial returns. Elevated perceived risks, coupled with reduced investor confidence, dampen participation in IPO offerings leading to lower initial returns. Hence, we test the following hypothesis.

Hypothesis 1: Climate change risk has a negative impact on IPO firms' initial returns.

The climate economy literature suggests that the adverse impact of climate change risks to the overall economic output. Using a large multi-country sample, Jones and Olken (2010) and Dell et al. (2012) demonstrate the negative impact of temperature shocks on the gross domestic product (GDP) growth and exports. They suggest two channels through which climate shocks affect economic output: (1) decreased labor supply amid extremely high temperatures, and (2) agriculture and food-related industries that are sensitive to temperature extremes. In addition, the related literature reports the same evidence of the negative impact of climate risk at the firm level. For example, Ginglinger and Moreau (2019) and Elnahas et al. (2018) show that firms adopt a more conservative debt financing policy (lower leverage) when facing greater climate risk. Hyunh et al. (2020) document that the cost of equity capital, on average is 92 bps higher for firms headquartered in states affected by climate risk as measured by severe drought conditions. In the same vein, Huang et al. (2018) find that firms located in countries characterized by more severe weather tend to hold more cash to build financial slack and resilience to climatic threats by using less short-term debt, but more long-term debt. They argue that extreme weather can negatively affect firm performance because the value of the assets and earnings could be destroyed due to extreme weather inflicted by physical damage on firms' fixed assets (e.g., property, plant, and equipment). Moreover, Hong et al. (2019) find that firms located in countries with severe drought trends experience not only weaker profit growth but also lower abnormal stock returns. Their results are consistent with Pankratz et al. (2019) who find that climate risk measured by high temperatures reduces firms' revenues and operating income in 93 countries. The discussion above suggests a negative effect of climate risk on economic activity, firms' operations, and financing.

Moreover, we argue that higher climate change risk leads to more complexity for the management team of the IPO firms. Complex environments often increase uncertainty requiring top executives to process more information, affecting cognitive abilities to understand important relationships among many environmental sectors, and increasing the need to alter environmental perception (Tung, 1979). Therefore, we expect the implication of the negative impact of climate risk to be particularly important for new entrant firms. Generally, IPO firms lack sufficient resources but are fast-growing companies (Filatotchev et al., 2006). Hence, a simple strategy might prove challenging for the IPO management team due to the limited resources needed to cope with complex environments (Miller, 1993). We argue that IPO firms' management teams may not be well-equipped to absorb the complexity related to higher climate change risk. In fact, it is well documented in the literature that environmental characteristics may challenge managers (Gedajlovic et al., 2004; Jayaraman et al., 2000; Zahra and Filatotchev, 2004) in dealing with necessary changes and repositioning their firm resources. As such, an increase in external complexity may adversely affect the firms' performance (Walters et al., 2010). Our arguments above suggest that climate change risk brings complexity to the firms, and such complexity could have a negative impact on management teams' efficacy (Walters et al., 2010). We expect to observe a negative effect of climate change risk on long-term IPO firms' performance. Since the objective of the IPOs is to remain in the public equity market to capitalize on their growth opportunities, and to strengthen their profitability and market share, limited financing options could hamper the growth dynamics of newly listed firms and their performance. Therefore, it is likely that the long-term performance of IPOs with greater climate risk will be negatively affected.[4] We test the following hypothesis.

Hypothesis 2: Climate change risk has a negative impact on IPO firms' performance.

[4] It is worth noting that if investors are reluctant to buy shares in IPOs, for firms subject to high climate risk, these IPOs are likely to be more under-priced to compensate investors for such increased risk-taking or delay listing. We thank the referee for pointing out this possible outcome. The evidence of Economidou et al. (2023) suggests that issuers and underwriters do not adjust the offer price in the light of climate change risk. Hence, low underpricing could be due to low first day closing price reflecting investors' negative reactions to climate change risk rather than high offer price set by underwriters. However, exploring whether the IPOs delay listing when the climate change risk is high cannot be tested due to data limitation for US IPOs (Helbing and Lucey 2024). We leave this test for future research when reasons for IPO withdrawals are formally documented in the US stock market.

Climate risk, investor sentiment, and IPO performance

It is well documented that some investors in the financial market are far from being rational utility maximizers as viewed by traditional finance. They are likely to act in a manner that is irrational when making investment decisions (Altanlar et al., 2023). De Long et al. (1990) show a model of an asset in which irrational noise traders with erroneous stochastic beliefs both affect prices and earn higher expected returns. Prices can diverge significantly from fundamental values even in the absence of fundamental risk because of the unpredictability of noise traders' actions. Sentiment measures investors' positive or negative attitudes about future stock market performance (Baker and Wurgler, 2006). Typically, when sentiment is high (low), irrational investors will increase (decrease) their demand for assets driving up (down) prices away from the fundamental values. The mispricing might not be corrected immediately because of limits to arbitrage (Pontiff, 1996; Shleifer and Vishny, 1997). However, rational investors will take advantage of mispricing, leading prices to reverse to their fundamental levels over time. Similarly, Barberis et al. (1998) develop a theoretical argument and claim that investors' irrationality could cause a divergence of the short-term market price of assets from their fundamental values. Baker and Wurgler (2006) find that when beginning-of-period proxies for sentiment are low, subsequent returns are relatively high for small stocks, young stocks, high volatility stocks, unprofitable stocks, non-dividend-paying stocks, extreme growth stocks, and distressed stocks. This investors' irrationality can have significant effects on the IPOs' performance, and it is well documented in the literature. For example, Dorn (2009) argues that investor sentiment matters in IPOs. Using data on IPOs listed in Germany, the author shows that IPOs that are aggressively bought by investors who trade on sentiment exhibit high initial returns and, subsequently, poor aftermarket returns. Derrien (2005) examines the impact of high sentiment by individual investors in French IPOs. The results show that high sentiment leads to large initial returns and poor long-run performance for the IPOs. Dong and Huang

(2022) argue that due to the Chinese stock market's weaker information disclosure system, the first-day listing price limit may raise irrational sentiment and cause more speculation, and hence investor sentiment leads to a significant increase in underpricing.

Investor sentiment can also affect firm managers' decisions (Stein, 1996; Grundy and Li, 2010; Zhaohui and Wensheng, 2013; Arif and Li, 2014). Considering the market timing theory, managers consider stock market conditions and change their financing decisions in response to investors' sentiment. For example, they issue new equity in periods of high investor sentiment (Baker and Stein, 2004). The literature also suggests that managers pursue market timing policies in relation to corporate decisions, such as IPOs and seasoned equity offerings (SEOs) (Jenter, 2005). They tend to buy shares when their firms have low market valuations and sell when the valuation is high. Stein (1996) argues that investment decisions are more responsive to the market valuation of the firms, which depends on equity and how attractive the investment is. In this regard, Grundy and Li (2010) present a model suggesting that investors' optimism is significantly and positively related to the level of investment. Optimistic investors over-estimate the marginal productivity of an investment, and thus, the share price at which the manager will sell is maximized by over-investing. Boulton et al. (2010) suggest that firms typically announce stock issuance during overpricing periods, as overvalued stocks enable firms to raise more funds and pay lower issuing costs. Stock overpricing offers financial flexibility and eases underinvestment in value-enhancing projects (Danso et al., 2019), which is expected to boost subsequent performance.

The behavioral argument above has implications for the relationship between IPO performance and climate risk. Since attention-grabbing events such as investors' beliefs from photos in the news and the information embedded in the text may influence investors to update their beliefs, it could potentially moderate the relationship between IPOs' performance and climate risk. Therefore, we expect those optimistic investors to mitigate the negative impact of climate risk, while pessimistic investors to heighten the negative effect of climate risk on performance. Hence, we test the following hypothesis:

Hypothesis 3: The negative impact of climate risk is stronger (weaker) when investors are pessimistic (optimistic) leading to poor IPO firms' performance.

SAMPLE AND METHODOLOGY

Sample

Our sample of US IPOs is collected from the SDC Platinum New Issue database, Worldscope, and Thomson One from January 1, 2000 to December 31, 2020.[5] We impose the following four restrictions consistent with previous studies (Krishnan et al., 2011; Espenlaub et al., 2016; Gounopoulos and Pham, 2018); (1) The offer price is at least $5 a share (e.g., Krishnan et al., 2011; Gounopoulos and Pham, 2018); (2) The IPO is not a spin-off, privatization, an American Depositary Receipt (ADR), a leveraged buyout (LBO), a Real Estate Investment Trust (REIT), a unit offering, a rights issue, a limited partnership, a closed-end fund, or a financial institution (e.g., Gounopoulos and Pham, 2018); (3) We exclude cross-listed firms as they are likely to be affected by the legal requirements of more than one country (e.g., Espenlaub et al., 2016); (4) For each firm, we require data to be available on Compustat and/or DataStream. To be included in the sample, we require both accounting data (e.g., total assets, earnings, sales, and debt level) and market data (first-day price and market capitalization) to be available. After imposing these restrictions, our final sample consists of 1668 IPOs with complete data[6]. In our panel data, we collect data for IPO characteristics from the listing date to the end of the sample period.

[5] We exclude international IPOs headquartered in the US.
[6] It is also worth noting that our sample size aligns with that of Amini et al. (2023), which examines US IPOs from 2000 to 2016.

Methodology

We investigate the impact of climate risk on long-term performance (Equation 1) by estimating the following regression model:

$$Performance = \alpha + \beta_c Climate\ Risk + \sum_{B=1}^{K} B_k Control + \mu_I + \delta_Y + \theta_S \qquad (1)$$

In Equation 1 *Performance* is post-IPO firm performance measured as (i) underpricing calculated as the first-day closing price minus the offer price deflated by the offer price and (ii) market-adjusted buy-and-hold returns for the first three years post-IPO following Brau et al. (2012) and Ritter and Welch (2002) approach. We use the value-weighted CRSP index as the market benchmark for buy-and-hold returns.[7] μ_I is a vector of industry-fixed effects to control for differences across industries, δ_Y is a vector of year-fixed effects to control for changing economic conditions, and θ_S is a vector of state-fixed effects. Climate risk, measured by *NegPDSI* and *Trend*, is discussed in the next section, along with definitions and a comprehensive list of variables used to control for other known performance determinants. To mitigate the impact of outliers, we winsorize all variables at their first and 99th percentiles.

Independent variable constructions

Our main variable of interest is climate change risk. We use drought as a proxy for the climate risk measure following Huynh et al. (2020) and Javadi and Masum (2021). We construct our drought measures using historical PDSI data available from the National Climate Data Center (NCDC) of the US National Oceanic and Atmospheric Administration (NOAA), which is updated on a monthly basis.[8] Palmer (1965) created this index to evaluate the severity and frequency of abnormally dry periods. This data is collected by measuring geo-stations from

[7] We also apply ROA and ROE as alternative measures of long-term performance. The results are qualitatively remain the same.

[8] Available at www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers [Accessed on August 01, 2022]

48 different states[9] and we exclude data from Hawaii so that our focus would be on the US mainland. The PDSI has advantages compared to other drought indices as it enables scholars to compare the severity of drought across time and regions (Dai, 2011). Following Huynh et al. (2020) and Javadi and Masum (2021), we take the average of the monthly PDSIs across all geo-stations for each state year to aggregate the data at the state level for every year. PDSI is a standardized measure and ranges from −10 to +10, where the lower values indicate more severe droughts. To ease the interpretation, we use the negative of PDSI (*NegPDSI*) as the measure of climate risk in our analysis, where higher values are associated with greater drought-like conditions.

Although the climate risk measure (PDSI) is widely used in climate studies (Dai, 2011), one might argue that the PDSI index reflects short-term variations in weather. However, climate scientists investigate long-term trends of weather patterns for climate change analysis.[10] To measure climate change in long-term trend as an alternative measure, we follow Javadi and Masum (2021) and estimate a trend-stationary model using AR (1) model with a time trend, using the long time series data available for PDSI since 1895. β_s captures the differential time trends in droughts of each state as well as the longer-run climate change vulnerability of the states to droughts.

$$PDSI_{s,t} = \alpha_s + \beta_s Time + \gamma_s PDSI_{s,t-1+} \varepsilon_{s,t}$$

The above regression is estimated for each state in each month separately. β_s for state S in month m is estimated using the PDSI data for the earliest date available until month m. The estimation is for an expanding window where the starting point is fixed to the earliest data available, and the rolling window expands as we move forward in time to estimate βs in months $m + 1$, $m + 2$, and so on. We then aggregate the data to the state-year level by taking the average

[9] PDSI data for Hawaii and Alaska are not available.
[10] See https://www.climate.gov/taxonomy/term/3434

of the estimated monthly β_s at state-year levels to construct our alternative measure of climate change named *Trend*. To maintain consistency with the interpretation of NegPDSI and in line with the previous studies (see Javadi and Masum,2021), we multiply the *Trend* variable by -1. This indicates that the greater the *Trend* in any given year, the larger the exposure to long-term climate change for State *S* in that year. Our measure of climate change risk is visible to the market and IPO participants.

We control for IPO characteristics consistent with the previous studies (see Bertone et al., 2023), which include (i) IPO age measured in years as the difference between the date of incorporation and IPO date. (ii) IPO size measured as the natural logarithm of the total asset. (iii) IPO proceeds measured as the natural logarithm of the IPO proceeds. (iv) underwriters' reputation calculated as the average underwriters' ranking following Loughran and Ritter (2004). (v) VC dummy is an indicator taking a value of one if the IPO is backed by the VC firms at the time of listing and zero otherwise. Finally, we control for market-related variables such as: (i) market liquidity calculated as a ratio of Volume relative to outstanding shares. (ii) IPO hotness measured as the average initial returns of IPOs issued during the three months prior to the month of the IPO. (iii) market volatility calculated by the Garch model (iv) GDP is state GDP. (v) Political leaning is the natural logarithms of the ratio of votes cast for a Democrat presidential candidate to the votes cast for the Republican candidate. (vi) Pessimism measured as an investor sentiment index developed by Obaid and Pukthuanthong (2022) and calculated as the average pessimism score generated from the sentiment tool in Stanford's CoreNLP software[11]. We control for year, state, and industry-fixed effects.

[11] You can find the complete definitions of all the study variables in online Appendix A1.

EMPIRICAL FINDINGS

Univariate analysis

Table 1, Panel A, shows the descriptive statistics for the full sample of IPOs listed from 2000 through 2020. The mean underpricing (*Underpricing*) and buy-and-hold abnormal returns (*Buy-and-Hold*) for the IPOs in our sample are 0.0571 and -0.0331, respectively. The mean value of the political leaning (*Political leaning*) is equal to 7.551. The average value for the GDP (*GDP*) is 13.566. The average initial return over the past three months (*IPO hotness*) is 0.115. The stock return volatility (*Market volatility*) on average is 3.26%. The average age of the firms at the IPO time (*IPO age*) and the size are 15.068 and 15.623, respectively. The mean ranking of underwriters at the time of listing is 8.283and the natural logarithm of IPO proceeds (*Ln proceeds*) is 5.874. Our first climate risk variable, (*NegPDSI)* is similar to Javadi and Masum's (2021) study, where higher values are associated with greater drought conditions. The mean value of *NegPDSI* is 0.445. The mean value of *Trend*, which is the second climate risk variable is similar to Hong et al. (2019) and captures the differential time trends in droughts of each state and the longer-run climate change vulnerability of the states to droughts. The mean value of the Trend is 0.008. In our sample, 48.8% of the IPOs are backed by venture capital (VC) compared to 45.4% of non-VC-backed IPOs. IPO volume as measured by the number of IPOs (*IPO volume*) in each year has a mean value of 198.02. Finally, the investor sentiment variable (*OP sentiment*) is developed by Obaid and Pukthuanthong (2022) to capture the pessimism embedded in news text. The average value of OP sentiment is 0.353. Panel B in Table 1 provides the characteristics of firms with high and low climate risk. High climate risk is based on the above median value for both measures (*NegPDSI* and *Trend*) and low is below the median for both measures. The results show that, compared to low climate-risk firms, our high climate-risk sample has lower long-run performance measured by three-year buy-and-hold abnormal returns (*Buy-and-Hold*), generates lower initial returns (*Underpricing*), has lower market value as measured by the market-to-book ratio (*M/B*) and market liquidity (*Market liquidity*). Interestingly, their size (*Size*), political leaning (*Political leaning*), age (*IPO age*), and underwriters' reputation (*Underwriter reputation*) are similar to the low climate risk firms. The results also show that there are less average initial returns during the three months before undertaking IPOs (*IPO hotness*), and lower proceeds (*Ln proceeds*) when climate risk is high. Table Pearson correlation coefficients in the online Appendix A2 suggest that there are no concerns over multicollinearity problems.

[Table 1]

Multivariate analysis

Extant IPO studies examine the impact of firms' characteristics including size (Ritter, 1984), industry (e.g., Ljungqvist and Wilhelm, 2003), and underwriters' traits (e.g., Wang et al., 2022; Hu et al., 2021) on underpricing. In Table 2 we examine the determinants of IPOs' underpricing in our sample and include our variable of interest (i.e., the climate risk variables) to examine its effect on IPO underpricing. In models 1 and 2, we use the lag of the NegPDSI variable ($NegPDSI_{t-1}$), which measures the drought index and climate risk. The results of these two models suggest lower underpricing for IPOs going public in states with greater drought risk. In Model 1, the economic significance of $NegPDSI_{t-1}$ coefficient suggests 13.70% (0.0689*1.989) lower underpricing due to one standard deviation increase in $NegPDSI_{t-1}$. This suggests that investors pay attention to the climate risk factors when investing in IPO firms and seem less enthusiastic about investing in IPOs located in states with higher climate risk. Since institutional investors receive the bulk of the shares in most IPOs (Aggarwal et al., 2002), they increasingly consider climate risk when making investment decisions (Krueger et al., 2020), influencing institutional ownership in companies with greater environmental concerns (Bolton and Kacperczyk, 2021; Chava, 2014). The lower interest of institutional investors in investing in IPO firms with higher climate risk can be a potential reason for lower underpricing for IPOs when the climate risk is high. These results are consistent after controlling for common measures affecting IPO underpricing. Consistent with Ellul and Pagano (2006), we find higher underpricing for IPO firms when market liquidity (*Market liquidity*) and return volatility at IPO year (*Market volatility*) are high. In addition, underpricing is positive during hotness (*IPO hotness*), associated with reputable underwriters (*Underwriter reputation*)[12], bigger in size (*Size*) as measured by total assets, and raises large proceeds (*Ln proceeds*). These findings are consistent with prior empirical results (Derrien and Womack, 2003, Boulton et al., 2010, Ellul and Pagano, 2006). The results also show that the underpricing is higher in IPOs associated with VC (*VC dummy*) at the time of listing, consistent with Gompers' (1996) grandstanding hypothesis[13,14]. In Models 3 and 4 we use the lag of the *Trend* variable as an alternative measure of the drought and the results are robust. In Model 3, the economic significance of $Trend_{t-1}$ coefficient suggests 1.47% (0.1911*0.077) lower underpricing due to one standard deviation increase in $Trend_{t-1}$. Overall, Table 2 suggests that climate risk negatively influences IPO underpricing using both measures of climate risk namely *NegPDSI* and *Trend*.

[Table 2]

In Table 3 we report the determinants of IPOs' long-term performance for our IPO sample. In Models 1-4, the dependent variable is buy-and-hold abnormal return[15], whereas, in Models 5-8, we explore the interaction effect between investor sentiment and climate risk. Specifically, we examine how investor sentiment moderates the negative effect of climate risk on long-term

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[12] The impact of underwriters' reputation is mixed (e.g., Loughran and Ritter, 2004 and Migliorati and Vismara, 2014).

[13] Grandstanding hypothesis suggests that VCs will grandstand by taking younger companies public and hence allowing for greater underpricing (Elston and Yang, 2010).

[14] Note that empirical evidence on the effect of VC presence on IPO underpricing is mixed. For example, according to certification role hypothesis, Megginson and Weiss (1991) and Lin and Smith (1998) find a negative relationship between VC presence and IPO underpricing. Whereas, according to grandstanding hypothesis Francis and Hasan (2001) and Lee and Wahal (2004) find a positive relationship between VC presence and IPO underpricing.

[15] Following Colombo et al. (2019), we also use ROA as alternative measure of performance, and the results are quantitively similar.

IPO performance.[16] Models 1-4 results show that climate risk, as measured by two drought variables of *NegPDSI* and *Trend,* has a significant and negative effect on the long-term performance of the IPO firms. In Models 1 and 2, we show poor long-term performance measured by buy-and-hold returns for IPOs going public in states with higher drought risk (*NegPDSI*). The economic significance of $NegPDSI_{t-1}$ coefficient in Model 1 suggests 48.70% (0.2448*1.989) lower buy-and-hold abnormal returns due to one standard deviation increase in $NegPDSI_{t-1}$ *NegPDSI.* This result is consistent in Models 3 and 4, using an alternative measure of drought risk (*Trend*). For example, the economic significance of $Trend_{t-1}$ coefficient in Model 3 suggests 30.90% (0.1554*1.989) lower buy-and-hold abnormal returns due to one standard deviation increase in $Trend_{t-1}$. In line with the existing literature, better performance is observed in IPOs going public when the market liquidity (*Market liquidity*), market volatility (*Market volatility*) (Abraham et al., 2016), and market hotness are high. Also, the results show better performance in older IPOs (*IPO age*) and bigger in terms of total assets (*Size*) with higher proceeds at IPO (*Ln proceeds*). The positive effect is also observed in IPOs associated with more reputable underwriters and backed by VC firms. The findings are consistent with Kirshinan et al. (2011), who found a positive effect on IPO performance when IPOs are older, bigger, and backed by VC firms.

Model 5 includes investor sentiment, *Pessimism,* as an additional variable similar to Obaid and Pukthuanthong (2022) and captures the pessimism embedded in news text. The results show that higher average pessimism embedded in news text in the month before the IPO negatively affects the long-term performance of the IPO firms. In Model 6, we interact the Obaid and Pukthuanthong (2022) sentiment variable, *Pessimism*, with the NegPDSI variable (*NegPDSI * Pessimism*). The coefficient of the interaction variable is negative and significant suggesting that the negative effect of drought risk on IPO long-term performance (documented

[16] Please refer to Appendix Table 1 for the calculation of dependent variables.

in Models 1-4) is stronger in firms going public when investors are pessimistic (higher average pessimism embedded in news text in the month before IPO). In Models 7 and 8 we repeat the same analysis using an alternative drought risk measure (i.e., *Trend)*. The results in both models are consistent with the previous results where the negative news sentiment reinforces the negative effect of climate risk on IPO long-term performance. Overall, the results presented in Table 3 suggest that IPO long-term performance is negatively affected by the climate risk of the state where the IPO firms are listed, and the results are stronger when investors are pessimistic.

[Table 3]

Investor attention (exogenous shock)

The significant role of investor attention is well documented in the literature (e.g., Da, Engelberg, Gao, 2011; Hirshleifer et al., 2011; Andrei and Hasler, 2015). We examine whether IPOs' performance is influenced by the role of market participants' attention on climate change risk in Table 4. In Panel A, following Javadi and Masum (2021) and Painter (2020), we use the release of the "Stern Review" to identify and capture the effect of investors' attention to climate change. The Stern Review contains the result of a UK Government-sponsored project and exceeds 700 pages providing an in-depth analysis of the devastating impact of climate change on the global economy (Painter, 2020; Stern, 2008). As suggested in the report, investors and regulators would become more aware of climate risks following the Stern Review (Javadi and Masum, 2021; Javadi et al., 2023; Painter, 2020). This report provides a natural platform for evaluating the impact of a firm's climate risk on IPO performance. In fact, the dissemination of the 2006 Stern Review can be used as an exogenous shock to a firm's climate risk to establish a causal link between climate risk and IPO performance to address endogeneity concerns. We conjecture that the repercussions of firm-level climate risk will be higher after Stern and, therefore, newly listed firms with higher climate risk might be associated with poor long-term performance.

To investigate the impact of the Stern Review on long-term IPO performance, we use a dummy variable (*Post-2006*), which equals one if a firm is publicly listed after the release of the Stern Review in 2006 and zero otherwise. We interact this variable with our climate risk measures, showing the underperformance of IPOs in the post-2006 period, suggesting that investors pay more attention to the risks of climate change following the release of the Stern Review. Specifically, the interaction terms coefficient between climate risk and the post-2006 dummy variable (*NegPDSI*Post-2006* and *Trend*Post-2006*) is negative in Models 1 and 2. The results indicate that Stern's report has aggravated the negative relation between climate risk and long-term performance. However, the signs of the interaction variable in Models 3 and 4 are positive, suggesting greater awareness of climate change increases the price effect, leading to higher underpricing for IPOs.

While the Stern Review created global awareness of climate change risk, we use President Trump's election in 2016 as an alternative exogenous shock. He was vocal against the impact of climate risk, and therefore, it is likely that post-2016, the effect of climate risk on IPO performance might become less significant. He dubbed climate change "a hoax" and tweeted that "the concept of global warming was created by and for the Chinese in order to make US manufacturing non-competitive" (Trump 2012). His stance can be interpreted as a desire to keep the lenient status quo intact, whereas Clinton's position was more radical with a desire to make forward progress in pro-climate regulation (Ilham et al., 2021). Therefore, the set of climate policies likely to be adopted under that Presidency post-2016 should suggest that investors pay less attention to climate change. The results of climate change risk on IPO performance are reported in Panel B of Table 4. It is observed that the interaction term between climate risk and the post-2016 dummy variable (*NegPDSI*Post-2016* and *Trend*Post-2016*) is mainly insignificant. This indicates that in the post-2016 election, investors became less concerned with the possible impact of climate risks on IPO firms.

[Table 4]

Channels

We further examine the channels through which climate change risk impacts IPOs' underpricing. We investigate whether climate risk is a concern for the IPO market. Table 5, Panel A, reports the determinants of IPO volume, which is measured as the aggregate number of IPOs in each year using annual frequency for the IPOs conducted between 2000 and 2020, and explores whether the IPO volume is affected by climate risk. This test allows us to examine whether the effect of climate change risk on IPO underpricing is channeled through its effect on IPO volume. Ljungqvist et al. (2006) document that IPO volume tends to increase in hot markets, while Derrien and Womack (2003) find that underpricing is higher in hot IPO markets. In Table 5 (Panel A), Models 1 and 2 we use the lag value of *NegPDSI* as a measure of climate risk. The results show that the number of firms that go public is lower when the climate risk is higher (as measured by higher *NegPDSI*). In Model 1, the economic significance of $NegPDSI_{t-1}$ coefficient suggests 2.66 (1.339*1.989) fewer IPOs per year due to one standard deviation increase in $NegPDSI_{t-1}$. Model 2 shows that this relationship holds after controlling for common factors affecting the level of IPO activity. In particular, it is evident from the results that states with higher market liquidity and higher GDP are associated with a higher number of IPOs. Moreover, a higher number of IPO flotations is positively associated with IPO hotness and market volatility. In Models 3 and 4, we use the lag of the Trend variable ($Trend_{t-1}$) as an alternative measure of climate risk. As stated earlier, a higher Trend variable captures a higher risk of drought. The results presented in Models 3 and 4 are consistent with those of Models 1 and 2, suggesting that IPO activity in each state is negatively affected by climate change risk, controlling for the common variables affecting the IPO activity. In Model 3, the economic significance of *Trend* $_{t-1}$ coefficient suggests that 2.12 (27.5010*0.077) fewer IPOs per year due to one standard deviation increase in *Trend* $_{t-1}$. So far, our results show that higher climate change risk decreases the IPO volume. We interact climate change risk measure with a volume indicator that takes a value of one if the volume is above the median and zero otherwise. The results are reported in Models 5 and 6 (*NegPDSI t-1* High volume* and *Trend t-1* High volume*). The interaction term between climate change risk and volume indicator is negative while the un-interacted volume indicator is positive. This suggests that despite IPO volume increasing the underpricing, it seems to have a negative impact on underpricing when the climate change risk is higher.

Next, we explore the channel through which climate change risk affects IPO long-term performance. We empirically investigate our theoretical argument that climate change risk results in lower growth options for IPO firms, resulting in lower long-term performance. Chava (2014), Elnahas et al. (2018) and Javadi and Masum (2021) find that climate change risk increases the cost of capital raising and reduces access to capital. We infer from the results of the previous studies that climate change risk might impose challenges to the IPO firms in financing their growth options. Since growth opportunities are critical for IPOs given that much of the IPOs' values are based on their growth opportunities (Aggarwal et al., 2009), a decrease in growth opportunities could lead to poor long-term performance for the IPOs. To examine this conjecture empirically, we investigate the relationship between climate change risk and IPO long-term performance conditional on growth opportunities. We use industry-adjusted market-to-book ratios calculated over the first three years post-IPO to measure the IPO firms' growth opportunities. The results are reported in Panel B of Table 5. We find that climate change risk affects IPOs' growth opportunities as measured by the market-to-book ratios (*M/B*). The results in Models 1-4 indicate that lower growth opportunities result in poor long-term performance. In Models 5 and 6, the interaction between climate change risk and an indicator for higher growth opportunity negatively impacts the IPO firm's long-term performance (*NegPDSI t-1* High M/B* and *Trend t-1*High M/B*). This indicates that although growth opportunity enhances the performance, it seems only to hold in the absence of climate change risk. The presence of climate change risk has a negative impact on growth and such a negative impact on growth tends to affect the IPO performance adversely. Our results show that climate change risk affects IPOs' performance through volume in the short run and growth opportunities in the long run.

[Table 5]

Other robustness checks

Our results show that the climate change risk has an impact on IPO performance. Possibly, the impact of climate change risk might be driven by the IPO firm's characteristics. For instance, IPOs located in a state associated with high climate change risk might have certain firm-specific characteristics that can be driving a negative effect on performance. To address this possible endogeneity concerns we use the *entropy balancing* method to explore if the effect is mainly driven by IPO firm characteristics. Using the sample median, we split our IPO sample into a high and low climate change risk. We match the characteristics of IPOs located in a state with low climate change risk (treatment) with IPOs located in a state with high climate change risk (control). Provided that the IPO characteristics drive the negative effect of climate change risk, we do not expect climate change risk to have an impact on IPO performance. Nevertheless, if the effect of climate change risk is not driven by IPO characteristics, we expect a negative and significant impact of climate change risk on IPO performance.

We use "entropy balancing" because our matched sample size remains the same as the full sample. The method provides a balanced covariate between IPOs located in a state associated with low climate change risk (treatment) and those located in a state with high climate change risk (control) along several determinants. Specifically, we matched the characteristics of the treatment group with control using IPO age, size, market volatility, IPO hotness, underwriters' reputation, proceeds, and industry. The entropy method works by first determining the distributional properties (i.e., mean and variance) of the treatment observations. These distributional properties become the target distributional properties of the post-weighting control sample (known as "*balance conditions*"). The algorithm proceeds by first assigning possible weights to control observations and then testing whether the balancing conditions have been satisfied (distributional properties of treatment and post-weighted control observations are identical). This process is repeated over multiple iterations until a set of weights that satisfy the balance conditions for control observations are satisfied. *Entropy balancing* also has higher model efficiency and less first-stage model dependency than PSM (Hainmueller, 2012). Table 6 reports the results of the *entropy balance,* and it is evident from the table that the negative impact of climate change risk remained robust across all measures of IPO performance. This suggests that the negative effect is not driven by IPO characteristics.

[Table 6]

Potentially, variations in climate risk could influence a firm's decision to go public. For example, certain firms might postpone their IPOs following a significant climate event, while others with immediate financial pressures may proceed with their IPOs despite the heightened risk. This possible endogeneity could significantly impact the composition of firms planning to list on the stock market during periods of elevated climate risk. As a result, the observable outcomes in IPO performance may not solely reflect the influence of climate risk, but rather the underlying quality of firms that choose to go public in these conditions.[17] To address such possible endogeneity, we utilize changes in climate risk regulations as a natural experiment framework, serving as an instrument for climate risk change. Regulatory changes are typically policy-driven and considered exogenous shocks, influencing firms' exposure to climate-related

[17] We thank the referee for pointing out that our analysis might be subject to possible selection issue.

risks without being directly linked to firms' decision to go public. Specifically, the 2017 withdrawal of the United States from the Paris Agreement under President Donald Trump presents a compelling case for an exogenous shock that impacts climate change risk while being plausibly unrelated to IPO decisions. Therefore, in Table 7, we use a two-stage least squares (2SLS) model to address possible endogeneity concerns. In the first stage, we regress the climate risk change measure ($NegPDSI_{t-1}$ and $Trend_{t-1}$) on a dummy variable that takes a value of one following withdrawal from the Paris Agreement post-2017. In the second stage, we examine the impact of climate change risk on long-term performance (Models 1 and 2) and IPO underpricing (Models 3 and 4) using the predicted value from (each of) the first stages. Hausman Test (*p-value*) is not significant at any conventional level, suggesting that endogeneity might not be a concern. Moreover, the coefficients of our variable of interest remain quantitatively similar to our baseline results.

[Table 7]

Since some of the data are missing and reduce our sample size, we use the two-stage Heckman sample selection model to assess whether the missing data or excluding IPOs with international presence bias our results. In the first stage, we estimate the probability of missing data and IPO international presence separately. Next, using the predicted value from each of the first stages, we calculate the inverse mills ratio. It is defined as the ratio of the probability density function relative to the cumulative distribution function. In the second stage, we examine the impact of climate change risk on IPO underpricing and long-term performance controlling for all IPO characteristics and including two inverse mills ratios as additional control variables. The results show that the coefficient for the inverse mill ratio is not significant, while the coefficients of our variable of interest remain quantitatively similar to our baseline results. This suggests that missing data and excluding IPOs with international presence do not bias our results.[18]

In California, greenhouse emissions are found to be contributing to the risks of extreme droughts (Diffenbaugh et al., 2015; Williams et al., 2015). Therefore, to investigate whether our results are not influenced by the impact of emissions of greenhouse gases, we exclude California and emitting industries (online Appendix A3), our results are robust and qualitatively similar to our baseline results.

Furthermore, we check whether high-tech IPOs and those with international presence influence our results as their operations are not affected by their headquarters' location (online Appendix A4). We find that although high-tech IPOs might have better performance, they underperform when climate risk is high. In Panel B, we explore the effect of international intensity. The results suggest that IPOs with better international intensity have better performance, but the negative impact of climate risk is even more pronounced in IPOs with high international intensity. We have re-estimated our baseline results by clustering the standard errors at the state level (online Appendix A5). We have also included GDP measured at the state level (*GDP*), the natural logarithm of the number of firms at the state level (*Ln number of state firms*), the board size (*Ln Board Size*, see Bertoni et al., 2023), per capita income (*Ln Per capita income (counties)*) and population (*Ln population (counties)*) at the county level as additional control variables. Overall, our results are broadly in line with our baseline analysis. [19]

Finally, we use the Spatial Hazard Events and Losses Database for the United States (SHELDUS[20]) to collect other climate risk measures (online Appendix A6). This includes the

[18] We thank the reviewer for drawing our attention to possible sample selection issue. The results are not reported for brevity, but available from the authors.
[19] We thank the reviewer for pointing out the importance of controlling for state level variables.
[20] https://cemhs.asu.edu/sheldus

natural log of duration, property losses, and crop losses allied with natural hazards linked to climate change (hurricanes, thunderstorms, floods, tornados, and heavy rainfalls). We find consistent results, indicating that climate risk measures negatively affect IPO underpricing and post-IPO performance.

Firm-level analysis

To measure variations in the perceived exposure to climate change risk at the firm level, we use the firm-level climate risk as calculated by Sautner et al. (2023). [21] Moreover, previous research examines various CEO characteristics such as age, gender, and tenure (e.g., Serfling, 2014; Orens and Reheul, 2013; Giannopoulos and Pham, 2018; Amini et al., 2023) in the context of remaining listed in the stock exchanges. The results are reported in Table 8 and show that our previous findings on the impact of climate risk on post-IPO performance are robust.

[Table 8]

DISCUSSIONS AND CONCLUSION

In recent years awareness has been raised of climate change risk and how climate risk can affect the economy and the financial system (e.g., Nordhaus, 2007; Stern, 2007; Burke et al., 2015; Dietz et al., 2016; Lesk et al., 2016, Daniel et al., 2016; Kumar et al., 2019; Javadi and Masum, 2021). The rise in investor attention to climate risk is a recent phenomenon (Giglio et al., 2021). Regulatory bodies increasingly aim to promote the financial markets' attention to climate risks by encouraging both voluntary and mandatory disclosures of firms' exposure to climate risks (e.g., SEC, 2010). A survey by Krueger et al. (2020), shows that institutional investors believe that climate risks have financial implications for their portfolio firms. In fact, 26% of institutional investors indicate that they incorporate climate risks into their valuation

[21] See Sautner et al. (2023) for firm-level climate risk methodology. It is worth noting that their measures of climate change risk is only available for a subsample of 762 IPOs.

models. Since climate risk cannot be easily hedged, the controversial issue for financial market participants is how exposure to climate risk affects firms' performance. As noted by Hong et al. (2019), natural disasters amplified by climate change can cause significant disruption to firms' production processes and impose substantial damage to their profits.

Climate change risk is crucial for financial market transactions, including IPOs. Unlike public firms, private firms face fewer disclosure requirements, making information on IPO issuers limited (Baker et al., 2021). Understanding how uncertainties like climate change impact IPOs is valuable for market participants. Going public is a significant corporate event, marking the start of a firm's listing period (Economidou et al., 2023), offering a unique context to explore climate risk's impact.

Previous studies have explored the impact of environmental, social, and governance (ESG) factors on IPOs. For example, Economidou et al. (2023) examined how ESG information prior to going public affects IPO underpricing, while Baker et al. (2021) focused on the role of ESG governance in managing risk related to underpricing. Our study specifically addresses climate change risk measures that are visible to the market and IPO participants. In 2018, for instance, many European countries experienced unusually hot weather, leading to extreme drought and agricultural losses (Jia and Li, 2020). At the firm level, climate risk affects business operations and discourages long-term investment. Collier (2016) found that extreme weather events particularly impact small and young firms. Since IPOs are often fast-growing firms with limited resources (Filatotchev et al., 2006), the lack of extensive managerial talent to handle the complexity of climate change risk (Walters et al., 2010) makes it more challenging for these firms to adapt and reposition when climate risk is high.

Using various climate change risk measures consistent with previous studies, we find that climate change risk negatively impacts the performance of newly listed firms. This adverse effect is evident in the short term through IPO volume and in the long term through growth opportunities. Our results remain robust after controlling for potential endogeneity using "Entropy Balancing matching," exogenous shocks (e.g., the Stern report), IPOs with a global customer base, CEO traits, and other robustness tests. To assess firm-level exposure to climate change risk, we use the climate risk measure calculated by Sautner et al. (2023). The results align with our baseline analysis and confirm that the impact of climate risk on post-IPO performance is robust.

Our results show that climate risk is one of the forefront factors influencing the IPO market. The evidence reported in this paper has important implications for the states, that are likely to be affected by climate change, investors, and management of the IPO firms seeking listing on the stock market on the importance of climate change risk. Our work should encourage IPO firms and stock market regulators to contribute toward the resolution of environmental and social issues in mitigating uncertainty related to climate change risks. Our study is subject to limitations. For instance, it would be interesting, with data availability, to explore whether IPO firms delay their listings when they are subject to higher risks due to climate change.

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Table 1: Summary statistics

Panel A: All sample

Variables	N	Mean	Median	STD	Max	Min
Buy-and-Hold	1668	-0.0331	-0.0313	0.0400	0.0921	-0.1100
Underpricing	1668	0.0571	0.0411	0.1809	0.1742	-0.0411
Market liquidity	1668	12.0779	9.3350	8.6335	18.901	1.0742
Political leaning	1668	7.5519	7.3850	0.4102	12.211	2.114
Pessimism	1668	0.3538	0.4318	0.5276	2.7021	-0.3400
GDP	1668	13.5661	13.2040	0.9097	15.031	9.8360
Market hotness	1668	0.1150	0.1043	0.1130	0.2681	-0.0881
Market volatility	1668	0.0326	0.0177	0.0124	0.1121	0.0031
IPO age	1668	15.0688	10.0000	11.5362	23.321	6.110
Size	1668	15.6236	15.2383	1.5069	21.621	8.5161
Underwriter reputation	1668	8.2839	8.5010	1.0835	9.0012	1.0012
Ln proceeds	1668	5.8746	5.1491	2.1727	25.5311	1.8923
NegPDSI	1668	0.4453	0.2903	1.9890	2.0015	-1.811
Trend	1668	0.0080	0.0045	0.0778	0.0663	-0.0812
VC dummy	1668	0.4544	0.0000	0.4980	1.0000	0.0000

Panel B: High/ Low climate risk sample

	High climate risk		Low climate risk			
Variables	*Mean*	*Median*	*Mean*	*Median*	T-test	Z-test
Buy-and-Hold	-0.044	-0.041	-0.022	-0.022	-2.437**	-2.506**
Underpricing	0.033	0.013	0.087	0.069	-2.797***	-2.658***
Market liquidity	10.127	8.164	14.029	10.506	-2.496**	-2.386**
Political leaning	7.341	6.840	7.763	7.330	-0.724	-1.193*
Pessimism	0.464	0.504	0.244	0.360	2.651***	2.570**
GDP	13.331	13.305	13.788	13.135	-0.135	-0.102
IPO hotness	0.094	0.080	0.136	0.129	-2.269**	-2.182**
Market volatility	0.025	0.016	0.034	0.019	-1.733*	-1.716*
IPO age	17	10	13	10	0.857	0.727
Size	15.699	15.157	15.548	14.919	0.324	0.415
Underwriter reputation	8.242	8.501	8.310	8.501	0.484	0.523
Ln proceeds	5.259	4.594	6.491	5.704	-2.067**	-2.121**
VC dummy	0.377	0.000	0.515	1.000	-2.161**	-2.232**
No of obs	636		1032			

This table reports summary statistics of different variables for the full sample of panel data of IPOs listed from 2000 to 2020 in Panel A and the high/low climate risk sample in Panel B. In Panel B, high climate risk is based on above median value for both climate risk measures (*NegPDSI and Trend*) and low is below the median for both measures. The t-statistics (*T-test*) for the differences in means and the z-statistics (*Z-test*) for the differences in medians are reported. The variables are reported by mean, median, and standard deviations. All the variables are as defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Table 2: The impact of climate change risk on underpricing

Variables	Model 1	Model 2	Model 3	Model 4
NegPDSI t-1	-0.0689**	-0.0508**		
	(0.012)	(0.021)		
Trend t-1			-0.1911**	-0.1263**
			(0.025)	(0.038)
Market liquidity		0.0211***		0.0291***
		(0.007)		(0.001)
IPO age		0.00101		0.0035
		(0.220)		(0.166)
Size		0.0388*		0.0337*
		(0.057)		(0.060)
Market volatility		0.1281***		0.1235***
		(0.000)		(0.000)
IPO hotness		0.0345**		0.0522**
		(0.042)		(0.028)
Underwriter reputation		0.0064***		0.0065***
		(0.000)		(0.000)
Ln proceeds		0.0311*		0.0319*
		(0.070)		(0.061)
VC dummy		0.0781**		0.0589**
		(0.029)		(0.035)
Industry, Year, and State FE	Y	Y	Y	Y
No of obs	1668	1668	1668	1668
adj. R-sq	0.028	0.206	0.031	0.236

The table reports the determinants of IPOs' first-day returns (*Underpricing*) for the IPOs carried out between 2000 and 2020. The dependent variable is underpricing. The values in parenthesis are p-values. All variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Table 3: The impact of climate change risk on long-term performance

	Buy-and-Hold							
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
NegPDSI t-1	-0.2448***	-0.2020***			-0.0767***	-0.0889***		
	(0.000)	(0.000)			(0.000)	(0.000)		
Trend t-1			-0.1554***	-0.1356***			-0.2962**	-0.2414***
			(0.000)	(0.000)			(0.012)	(0.000)
NegPDSI * Pessimism						-0.0544***		
						(0.002)		
Trend * Pessimism								-0.1731**
								(0.032)
Pessimism					-0.0180**	-0.0771**	-0.2671***	-0.3722***
					(0.033)	(0.020)	(0.006)	(0.008)
Market liquidity		0.0510***		0.0460***	0.0562***	0.0354**	0.0502***	0.0392**
		(0.000)		(0.002)	(0.000)	(0.031)	(0.000)	(0.025)
IPO age		0.0237*		0.0163*	0.0296***	0.0253***	0.0241***	0.0193**
		(0.088)		(0.0642)	(0.000)	(0.007)	(0.000)	(0.026)
Size		0.0234***		0.0221***	0.1771***	0.1462***	0.1612***	0.1225***
		(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Market volatility		0.0551*		0.0634*	-0.1387*	-0.1597*	-0.2298***	-0.2046***
		(0.079)		(0.081)	(0.077)	(0.054)	(0.000)	(0.005)
IPO hotness		0.0544***		0.0449**	0.0973***	0.0811***	0.1210***	0.1197**
		(0.000)		(0.031)	(0.000)	(0.000)	(0.000)	(0.015)
Underwriter reputation		0.0306***		0.0218**	0.0957***	0.0842***	0.0988***	0.0473**
		(0.000)		(0.041)	(0.000)	(0.000)	(0.000)	(0.027)
Ln proceeds		0.0280***		0.0275***	0.0881***	0.0948***	0.0971***	0.0568**
		(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.013)
VC dummy		0.0294**		0.0243**	0.0902***	0.0838***	0.1361***	0.0867***
		(0.011)		(0.021)	(0.000)	(0.000)	(0.000)	(0.000)
Industry, Year, and State FE	Y	Y	Y	Y	Y	Y	Y	Y
No of obs	1502	1502	1502	1502	1502	1502	1502	1502
adj. R-sq	0.049	0.196	0.07	0.186	0.135	0.136	0.143	0.144

The table reports the impact of market sentiment on IPOs' long-term performance. The dependent variable is the market-adjusted buy-and-hold abnormal returns (*Buy-and-Hold*) for the first three years post-IPO. The values in brackets are p-values. All variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Table 4: Investor attention and its moderating effect on the impact of climate change risk on IPO performance

	Buy-and-Hold		*Underpricing*	
Variables	Model 1	Model 2	Model 3	Model 4
Panel A: The effect of the Stern Report				
Negpdsi	-0.0429**		-0.0203**	
	(0.035)		(0.044)	
Trend		-0.1226***		-0.0674***
		(0.003)		(0.003)
NegPDSI * Post-2006	-0.0732**		0.0155**	
	(0.028)		(0.027)	
Trend * Post-2006		-0.4821***		0.0473**
		(0.000)		(0.036)
Post-2006	-0.0747***	-0.1006***	0.0521***	0.1135***
	(0.000)	(0.000)	(0.001)	(0.001)
Market liquidity	0.0297**	0.0492**	0.0212***	0.0344***
	(0.038)	(0.019)	(0.003)	(0.000)
IPO age	0.0013	0.0014	0.0011	0.0089
	(0.139)	(0.332)	(0.138)	(0.156)
Size	0.0562**	0.0337***	0.0218**	0.0247**
	(0.018)	(0.000)	(0.027)	(0.020)
Market volatility	0.2134***	0.3632***	0.5432***	0.1383**
	(0.000)	(0.000)	(0.000)	(0.022)
IPO hotness	0.0302*	0.0462**	0.0255**	0.0263**
	(0.072)	(0.033)	(0.036)	(0.041)
Underwriter reputation	0.0781***	0.0873***	0.0048*	0.0079**
	(0.000)	(0.001)	(0.097)	(0.020)
Ln proceeds	0.0613**	0.0453**	0.0292**	0.0308**
	(0.028)	(0.027)	(0.046)	(0.024)
VC dummy	0.170***	0.0842**	0.0818**	0.0719**
	(0.000)	(0.037)	(0.013)	(0.022)
Industry and State FE	Y	Y	Y	Y
No of obs	1502	1502	1668	1668
adj. R-sq	0.1573	0.1481	0.1673	0.1513
Panel B: The effect of Trump				
Negpdsi	-0.0263***		-0.0212**	
	(0.000)		(0.028)	
Trend		-0.0233**		-0.0511**
		(0.032)		(0.032)
NegPDSI * Post-2016	0.0133		-0.0112	
	(0.193)		(0.118)	
Trend * Post-2016		0.0131		-0.0181*
		(0.262)		(0.082)
Post-2016	0.0221	0.0211	0.0161	0.0172
	(0.134)	(0.142)	(0.151)	(0.177)
Market liquidity	0.0162**	0.0261**	0.0384**	0.0349***
	(0.027)	(0.021)	(0.017)	(0.000)
IPO age	0.0011	0.0034	0.0016	0.0073
	(0.171)	(0.157)	(0.275)	(0.265)
Size	0.0433***	0.0415***	0.0159**	0.0187**
	(0.000)	(0.000)	(0.022)	(0.037)
Market volatility	0.1942***	0.3671***	0.5733***	0.1084**
	(0.000)	(0.000)	(0.000)	(0.029)
IPO hotness	0.0312*	0.0485***	0.0431**	0.0452**
	(0.065)	(0.000)	(0.033)	(0.037)
Underwriter reputation	0.0730***	0.0833***	0.0030*	0.0069*
	(0.008)	(0.000)	(0.073)	(0.061)
Ln proceeds	0.0678***	0.0421**	0.0258**	0.0375**
	(0.000)	(0.031)	(0.025)	(0.018)
VC dummy	0.162***	0.0865***	0.0692***	0.0812***
	(0.000)	(0.000)	(0.000)	(0.000)

Industry and State FE	Y	Y	Y	Y
No of obs	1502	1502	1668	1668
adj. R-sq	0.1603	0.1511	0.1661	0.1471

The table reports the impact of investor attention. Panel A shows the results for Stern Review, while Panel B shows the results for Trump on IPOs' long-term performance. The dependent variable in Models 1-2 is the market-adjusted buy-and-hold abnormal returns (*Buy-and-Hold*) for the first three years post-IPO and in Models 3-4 is first-day returns (*Underpricing*). The values in brackets are p-values. All variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Table 5: Channel analysis

Panel A: Volume as an underlying mechanism	*Volume*				*Underpricing*	
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
NegPDSI t-1	-1.3390***	-0.7530***			-0.0511**	
	(0.000)	(0.000)			(0.033)	
Trend t-1			-27.5010**	-1.7280**		-0.1180**
			(0.013)	(0.022)		(0.029)
NegPDSI t-1* High volume					-0.0411**	
					(0.021)	
Trend t-1* High volume						-0.0670**
						(0.033)
High volume					0.0711**	0.0721**
					(0.016)	(0.018)
Market liquidity		0.0310**		0.6580***	0.0221***	0.0242***
		(0040)		(0.004)	(0.011)	(0.001)
Political leaning		-0.0240		-0.0890**	-0.0030	-0.0040
		(0.169)		(0.012)	(0.221)	(0.201)
GDP		0.3570***		0.3600***	0.0310***	0.0289***
		(0.000)		(0.000)	(0.000)	(0.000)
IPO hotness		0.0960*		0.0970*	0.0341**	0.0369**
		(0.075)		(0.085)	(0.033)	(0.031)
Market volatility		0.3030***		0.4290**	0.1274***	0.1301***
		(0.031)		(0.027)	(0.000)	(0.000)
Year and State FE	Y	Y	Y	Y	Y	Y
No of obs	9249	9249	9249	9249	1668	1668
adj. R-sq	0.054	0.103	0.045	0.107	0.151	0.139

Panel B: M/B as an underlying mechanism		*M/B*			*Buy-and-Hold*	
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
NegPDSI t-1	-0.0502**	-0.0318**			-0.2022***	
	(0.014)	(0.037)			(0.000)	
Trend t-1			-0.5772***	-0.2082**		-0.1367***
			(0.002)	(0.026)		(0.000)
NegPDSI t-1* High M/B					-0.1432***	
					(0.000)	
Trend t-1*High M/B						-0.0811***
						(0.000)
High M/B					0.0681**	0.072**
					(0.012)	(0.022)
Market liquidity		0.0851**		0.0612***	0.0511***	0.0462***
		(0.014)		(0.000)	(0.000)	(0.002)
IPO age		0.0241*		0.0267**	0.0234*	0.0161*
		(0.081)		(0.013)	(0.081)	(0.0622)
Size		0.0294*		0.0220*	0.0231***	0.0222***
		(0.063)		(0.079)	(0.000)	(0.000)
Market volatility		0.3612*		0.3091*	0.0548*	0.0635*
		(0.073)		(0.069)	(0.073)	(0.082)
IPO hotness		0.0349**		0.0491***	0.0542***	0.0445**
		(0.036)		(0.000)	(0.000)	(0.022)
Underwriter reputation		0.0145*		0.0155*	0.0302***	0.0219**
		(0.081)		(0.089)	(0.000)	(0.041)
Ln proceeds		0.0475***		0.0274***	0.0282***	0.0271***
		(0.000)		(0.000)	(0.000)	(0.000)
VC dummy		0.0445*		0.0456*	0.0291**	0.0246**
		(0.062)		(0.071)	(0.014)	(0.022)
Industry, Year, and State FE	Y	Y	Y	Y	Y	Y
No of obs	1502	1502	1502	1502	1502	1502
adj. R-sq	0.031	0.191	0.035	0.203	0.197	0.185

The table reports channel analysis. Panel A shows volume as an underlying mechanism. The dependent variable is IPO volume which is the total number of newly listed firms each year over our sample period. High volume (*High volume*) takes a value of one if the volume is above the median and zero otherwise. Panel B shows the results for IPOs' long-term performance and climate change risk relation conditional on growth opportunities for the IPOs listed between 2000 and 2020. The dependent variable is *M/B* which is the industry-adjusted market-to-book ratios over the first three years post-IPO. High M/B (*High M/B*) takes a value of one if the M/B is above the median and zero otherwise. The values in brackets are p-values. All variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Table 6: The impact of climate change risk on IPO performance controlling for endogeneity using Entropy Balancing

	Buy-and-Hold		*Underpricing*	
Variables	Model 1	Model 2	Model 3	Model 4
NegPDSI t-1	-0.2134***		-0.0454**	
	(0.000)		(0.028)	
Trend t-1		-0.1456***		-0.1308**
		(0.000)		(0.012)
Market liquidity	0.0743***	0.0482***	0.0188***	0.0289***
	(0.000)	(0.000)	(0.000)	(0.000)
IPO age	0.0004	0.0004	0.0002	0.0006
	(0.194)	(0.249)	(0.486)	(0.407)
Size	0.0021	0.0031	0.0011	0.0015
	(0.214)	(0.341)	(0.273)	(0.274)
Market volatility	0.0214	0.0218	0.0014	0.0024
	(0.201)	(0.274)	(0.133)	(0.186)
IPO hotness	0.0112	0.0131	0.0028	0.0075
	(0.181)	(0.273)	(0.280)	(0.268)
Underwriter reputation	0.0056	0.0028	0.0011	0.0015
	(0.654)	(0.866)	(0.1641)	(0.214)
Ln proceeds	0.0011	0.0007	0.0013	0.0011
	(0.241)	(0.314)	(0.366)	(0.409)
VC dummy	0.0132**	0.0194**	0.0623**	0.0434**
	(0.601)	(0.563)	(0.021)	(0.041)
Industry, Year, and State FE	Y	Y	Y	Y
No of obs	1502	1502	1668	1668
adj. R-sq	0.0811	0.0791	0.077	0.089

The table reports the results for the Entropy Balancing using the IPOs listed between 2000 and 2020. The dependent variable in Models 1-2 is the market-adjusted buy-and-hold abnormal returns (*Buy-and-Hold*) for the first three years post-IPO and in Models 3-4 is first-day returns (*Underpricing*). The values in brackets are p-values. All variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Table 7: The impact of climate change risk on IPO performance controlling for endogeneity using a two-stage regression

	Stage I: Dep: NegPDSI t-1	*Stage I: Dep:* Trend t-1	*Buy-and-Hold*		*Underpricing*	
Variables			Model 1	Model 2	Model 3	Model 4
NegPDSI t-1 (Insturment)			-0.1982***		-0.0458**	
			(0.000)		(0.041)	
Trend t-1 (Instrument)				-0.1172***		-0.1069**
				(0.000)		(0.029)
Paris Agreement Withdrawal (2017)	0.321***	0.364***				
	(0.000)	(0.000)				
Board Size			-0.012	0.0122	-0.0189	-0.0136
			(0.214)	(0.224)	(0.154)	(0.163)
State GDP	0.2418***	0.2217***	0.3612***	0.3712***	0.0316***	0.0295***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln Per capita income (counties)	0.1562***	0.1412***	0.0411***	0.0366***	0.0214***	0.0294***
	(0.001)	(0.000)	(0.000)	(0.003)	(0.006)	(0.003)
Ln number of firms	0.1171**	0.1321**	0.0104	0.0101	0.0181*	0.0174*
	(0.028)	(0.046)	(0.122)	(0.112)	(0.067)	(0.072)
Ln population (counties)	0.0161	0.0132	0.0118	0.0163*	0.0010	0.0032
	(0.310)	(0.290)	(0.113)	(0.091)	(0.220)	(0.167)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Husman Test (p-value)			(0.351)	(0.383)	(0.221)	(0.321)
Industry & Year FE	No Year FE	No Year FE	Yes	Yes	Yes	Yes
No of obs	1521	1521	1454	1454	1521	1521
adj. R-sq	0.172	0.171	0.201	0.202	0.226	0.246

This table shows the results of a two-stage model. In the first stage, we regress a dummy variable, which equals one for the Donald Trump administration's withdrawal from the Paris Agreement that occurred post-2017, on climate risk measures ($NegPDSI_{t-1}$ and $Trend_{t-1}$). In the second stage, we examine the impact of climate change risk on long-term performance (Models 1 and 2) and IPO underpricing (Models 3 and 4) using the predicted value from each of the first stages. Husman Test (p-value) is also reported for the second stage regressions. The values in brackets are p-values. All variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Table 8: The impact of climate change risk on IPO performance using firm-level measures of climate change risk

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Panel A: Buy-and-Hold							
CCExposure	-0.4223***						
	(0.003)						
$CCExposure^{OPP}$		-0.0117					
		(0.272)					
$CCExposure^{Reg}$			-0.8356***				
			(0.000)				
$CCExposure^{Phy}$				-0.0734			
				(0.284)			
$CCSentiment^{Pos}$					-0.0307		
					(0.119)		
$CCSentiment^{Neg}$						-0.2002***	
						(0.000)	
CCRisks							-0.8039***
							(0.007)
CEO age	0.0030	0.0050*	0.0011	0.0081**	0.0152***	0.0159***	0.0155***
	(0.148)	(0.064)	(0.275)	(0.015)	(0.000)	(0.000)	(0.000)
CEO tenure	-0.0190*	-0.0026	-0.0195	-0.0004	-0.0393***	-0.0444***	-0.0486***
	(0.094)	(0.774)	(0.118)	(0.970)	(0.000)	(0.000)	(0.000)
CEO Gender (Male=1)	-0.318**	-0.0288	-0.2241	-0.2870*	-0.5762***	-0.5952***	-0.5122***
	(0.033)	(0.816)	(0.171)	(0.061)	(0.000)	(0.000)	(0.001)
Other Controls	Y	Y	Y	Y	Y	Y	Y
Year, Industry, and State FE	Y	Y	Y	Y	Y	Y	Y
No of obs	762	762	762	762	762	762	762
adj. R-sq	0.1720	0.1564	0.176	0.1629	0.188	0.1720	0.1819
Panel B: Underpricing							
CCExposure	-0.4114***						
	(0.000)						
$CCExposure^{OPP}$		-0.5567***					
		(0.003)					
$CCExposure^{Reg}$			-0.8045***				
			(0.000)				
$CCExposure^{Phy}$				-0.0343			
				(0.174)			
$CCSentiment^{Pos}$					-0.2694**		
					(0.0022		
$CCSentiment^{Neg}$						-0.3981***	
						(0.000)	
CCRisks							-0.4472**
							(0.017)
CEO age	0.0013	0.077***	0.0001	0.0446**	0.0861***	0.0630***	0.0672***
	(0.251)	(0.000)	(0.621)	(0.017)	(0.000)	(0.009)	(0.007)
CEO tenure	-0.0038***	-0.0036***	-0.0351***	-0.0382***	-0.0039***	-0.0422***	-0.0351***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CEO gender (Male=1)	-0.0172*	-0.0107	-0.0237**	-0.0144*	-0.0129*	-0.0030	-0.0083
	(0.088)	(0.226)	(0.025)	(0.093)	(0.082)	(0.785)	(0.465)
Other Control	Y	Y	Y	Y	Y	Y	Y
Year, Industry, and State FE	Y	Y	Y	Y	Y	Y	Y
No of obs	762	762	762	762	762	762	762
adj. R-sq	0.1740	0.1630	0.1731	0.1170	0.1650	0.1710	0.1520

The table reports the robustness check of climate risk measures using firm-level climate risk developed by Sautner et al. (2023). The dependent variable in Panel A is the market-adjusted buy-and-hold abnormal return (*Buy-and-Hold*) for the first three years post-IPO and in Panel B is first-day returns (*Underpricing*). Firm-level climate risk measures are extracted from Sautner et al. (2023). *CCExposure, CCExposure*^{OPP}, *CCExposure*^{Reg}, and *CCExposure*^{Phy} are the relative frequency with which bigrams related to climate change, opportunities to climate change, regulatory shocks to climate change, and physical shocks to climate change occur in the transcripts of earnings conference calls, respectively. *CCSentiment*^{Pos} and *CCSentiment*^{Neg} are the relative frequency with which bigrams related to climate change are mentioned together with positive and negative tone words that are summarized by Loughran and McDonald (2011) in one sentence in the transcripts of earnings conference calls. CCRisks is the relative frequency with which bigrams related to climate change are mentioned together with the words "risk" or "uncertainty" (or synonyms thereof) in one sentence in the transcripts of earnings conference calls. All these measures are counted as the number of such bigrams and divided by the total number of bigrams in the transcripts. All panels also control for CEOs' age (*CEO age*) at the fiscal year in our panel data, tenure (*CEO tenure*, which is calculated as the difference between the date becoming CEO and the fiscal year in our panel data), and gender (*CEO gender*, which is a dummy is equal to one if CEO is male and zero if CEO is female). CEO data is extracted from Execucomp. The values in brackets are p-values. The remaining variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Online Appendix A1: Variables definitions

Variables	Descriptions	Source
Dependent variables		
Underpricing	First-day return of IPOs	CRSP
Buy-and-Hold	Buy-and-hold abnormal return is computed as $R = \prod_{t=1}^{n}(1 + r_t^i) - \prod_{t=1}^{n}(1 + r_t^b)$, where r_t^i is the raw return for firm *i* in month *t* after going public and r_t^b is the benchmark return in month *t*. Following Brau et al. (2012) and Ritter and Welch (2002), the value-weighted CRSP index is used as the benchmark.	CRSP
Control variables and robustness		
Market liquidity	Volume/outstanding shares	Compustat
Political leaning	Natural logarithms of the ratio of votes cast for a Democrat presidential candidate to the votes cast for the Republican candidate	Dave Leip's Atlas of US Presidential Elections. http://uselectionatlas.org
GDP	GDP in states	The Bureau of Economic Analysis (BEA)
IPO hotness	Average initial returns of IPOs issued during the three months prior to the month of the IPO	Compustat
Market volatility	Garch model	Compustat
IPO age	Year from the incorporation date until the IPO date	Jay Ritter's website
Size	Natural logarithm of total assets	Compustat
Underwriter reputation	Underwriters' average ranking (Loughran and Ritter, 2004)	Jay Ritter's website
Ln proceeds	Natural logarithm of IPO proceeds	
NegPDSI	Negative Palmer Drought Severity Index (PDSI); *NedPDSI* = − 1 * *PDSI*	NOAA's National Climatic Data Center (NCDC); www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers
Trend	The negative time trend coefficient (times 1000) of an AR(1) model extends back to 1895 for each state at each point of the sample period using monthly frequency data; *TREND* = − *b* * 1,000	AR (1) Model: $PDSI_{s,t} = \alpha_s + \beta_s\, Time + \gamma_s\, PDSI_{s,t-1} + \varepsilon_{s,t}$
VC dummy	Dummy variable taking 1 if the IPO is VC-backed and 0 otherwise	SDC Platinum
Pessimism	It is an investor sentiment index developed by Obaid and Pukthuanthong (2022) which is calculated as the average pessimism score generated from the sentiment tool in Stanford's CoreNLP software.	Obaid and Pukthuanthong (2022)
IPO volume	The aggregate number of IPOs in each year and measured annually.	
M/B	Based on the 4-digit Standard Industrial Classification (SIC) code of each IPO issuer, we calculate the median of the market-to-book ratio (M/B) of all IPOs in the same industry in the year of IPO listing and 3 years after IPO (if the 4-digit SIC code cannot be matched, we use the 3-digit or 2-digit SIC code). We	Compustat

	compute the median of M/B ratios for all IPO firms for a given industry and subtract from the M/B of the corresponding IPO firm.	
CCExposure	The relative number of frequencies with which bigrams related to climate change occur in the transcripts of earnings conference calls divided by the total number of bigrams in the transcripts.	Sautner et al. (2023)
$\text{CCExposure}^{\text{OPP}}$	The relative number of frequencies with which bigrams related to opportunities to climate change occur in the transcripts of earnings conference calls divided by the total number of bigrams in the transcripts.	Sautner et al. (2023)
$\text{CCExposure}^{\text{Reg}}$	The relative number of frequencies with which bigrams related to regulatory shocks to climate change occur in the transcripts of earnings conference calls divided by the total number of bigrams in the transcripts.	Sautner et al. (2023)
$\text{CCExposure}^{\text{Phy}}$	The relative number of frequencies with which bigrams related to physical shocks to climate change occur in the transcripts of earnings conference calls divided by the total number of bigrams in the transcripts.	Sautner et al. (2023)
$\text{CCSentiment}^{\text{Pos}}$ ($\text{CCSentiment}^{\text{Neg}}$)	The relative number of frequencies with which bigrams related to climate change are mentioned together with positive (negative) tone words that are summarized by Loughran and McDonald (2011) in one sentence in the transcripts of earnings conference calls divided by the total number of bigrams in the transcripts.	Sautner et al. (2023)
CCRisks	The relative number of frequencies with which bigrams related to climate change are mentioned together with the words "risk" or "uncertainty" (or synonyms thereof) in one sentence in the transcripts of earnings conference calls divided by the total number of bigrams in the transcripts.	Sautner et al. (2023)
CEO age	CEO age at the fiscal year in our panel data	Execucomp
CEO tenure	Calculated as the difference between the date of becoming CEO and the fiscal year in our panel data	Execucomp
CEO Gender (Male=1)	A dummy is equal to one if CEO is male and zero if the CEO is female	Execucomp
High tech	A dummy which takes the value of one for firms operating in high-tech industries	Compustat
Int intensity Dum	A dummy that takes the value of one for firms having an international intensity (measured as firms' international sales as a percentage of total sales) above the median value and zero otherwise	Compustat
Ln Board Size	Natural logarithm of the number of directors on the board	Boardex
Ln number of state firms	Natural logarithm of the number of firms at a state level	The U.S. Census Bureau
Ln Per capita income (counties)	Natural logarithm of per capita income in a county	The Bureau of Economic Analysis (BEA)
Ln population (counties)	Natural logarithm of populations in a county	The Bureau of Economic Analysis (BEA)

This table defines all control variables used in this study using a panel sample of IPOs listed in the US from 2000 through 2020. All variables are in US dollars. We have winsorized all the firm-level control variables at 1% and 99% levels to control for outliers.

Online Appendix A2: Correlations

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Market liquidity	(1)	1											
Political leaning	(2)	0.0177	1										
GDP	(3)	0.0733	0.3831	1									
IPO hotness	(4)	0.0028	0.1068	0.0853	1								
Market volatility	(5)	0.1792	0.0069	-0.026	0.1361	1							
IPO age	(6)	-0.0219	0.1160	-0.0012	-0.0766	-0.1678	1						
Size	(7)	0.0136	0.0297	0.0327	-0.1364	-0.4052	0.3573	1					
Underwriter reputation	(8)	-0.0551	-0.0148	-0.0029	0.0903	-0.1016	0.0432	0.2676	1				
Ln proceeds	(9)	0.0196	0.0542	-0.0100	-0.1326	-0.1868	0.3497	0.6251	0.1520	1			
NegPDSI	(10)	-0.0181	-0.1170	0.1126	0.0203	0.0793	-0.0469	-0.0779	0.0079	-0.0475	1		
Trend	(11)	-0.0220	-0.2237	0.1780	0.0532	0.0731	-0.056	-0.1419	0.0381	-0.0803	0.5290	1	
VC dummy	(12)	-0.0313	0.1858	0.1167	-0.0315	0.0471	0.0529	0.0186	0.0303	0.0809	0.0316	0.1371	1

This table shows the Pearson correlation coefficients for all the variables used in this study.

Online Appendix A3: Excluding California and Oil and Gas firms

Variables	*Buy-and-Hold* Model 1	*Buy-and-Hold* Model 2	*Underpricing* Model 3	*Underpricing* Model 4
NegPDSI t-1	-0.2060***		-0.0276**	
	(0.000)		(0.025)	
Trend t-1		-0.1844***		-0.1108**
		(0.000)		(0.036)
Market liquidity	0.1240***	0.0979***	0.0225***	0.0257***
	(0.000)	(0.000)	(0.000)	(0.000)
IPO age	0.0291**	0.0160*	0.0015	0.0043
	(0.031)	(0.056)	(0.341)	(0.240)
Size	0.1860***	0.0886***	0.0277**	0.0248**
	(0.000)	(0.000)	(0.025)	(0.048)
Market volatility	0.2551***	0.0778***	0.1174**	0.1193**
	(0.000)	(0.000)	(0.048)	(0.037)
IPO hotness	0.0559**	0.0461**	0.0191**	0.0378**
	(0.031)	(0.028)	(0.018)	(0.026)
Underwriter reputation	0.0600**	0.0385**	0.0051**	0.0061**
	(0.015)	(0.039)	(0.044)	(0.028)
Ln proceeds	0.0351***	0.0323***	0.0028	0.0018
	(0.004)	(0.000)	(0.117)	(0.132)
VC dummy	0.0231**	0.0199***	0.0534**	0.0465**
	(0.031)	(0.000)	(0.027)	(0.025)
Industry, Year, and State FE	Y	Y	Y	Y
No of obs	1138	1138	1304	1304
adj. R-sq	0.1403	0.1411	0.1511	0.1552

The table reports the determinants of IPOs' long-term performance for the IPOs listed between 2000 and 2020 excluding California, Oil, and Gas firms. The dependent variable in Models 1-2 is the market-adjusted buy-and-hold abnormal returns (*Buy-and-Hold*) for the first three years post-IPO and in Models 3-4 is first-day returns (*Underpricing*). The values in brackets are p-values. All variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Online Appendix A4: Interaction of climate risk with high-tech and international intensity

	Buy-and-Hold		*Underpricing*	
Panel A: High-tech	Model 1	Model2	Model 3	Model 4
Trend t-1	-0.1923***		-0.0941***	
	(0.004)		(0.000)	
Trend t-1 * High tech	0.0111		0.0181	
	(0.287)		(0.148)	
NegPDSI t-1		-0.1671**		-0.0462**
		(0.021)		(0.015)
NegPDSI t-1 * High tech		0.0125		0.0102
		(0.220)		(0.264)
High tech	0.0410**	0.0551**	0.0198	0.0142
	(0.031)	(0.019)	(0.239)	(0.195)
Other Controls	Y	Y	Y	Y
No of obs	1502	1502	1668	1668
adj. R-sq	0.198	0.193	0.215	0.223
State FE	Y	Y	Y	Y
Panel B: International intensity				
Trend t-1	-0.1814***		-0.0774***	
	(0.000)		(0.000)	
Trend t-1* Int intensity Dum	0.0971		0.0123	
	(0.148)		(0.143)	
NegPDSI t-1		-0.1820***		-0.0501**
		(0.000)		(0.021)
NegPDSI t-1 * Int intensity Dum		-0.0262*		0.01204
		(0.072)		(0.125)
International intensity Dum	0.0153*	0.0270**	0.0185*	0.0107*
	(0.067)	(0.016)	(0.061)	(0.066)
Other Controls	Y	Y	Y	Y
No of obs	1502	1502	1668	1668
adj. R-sq	0.195	0.191	0.225	0.216
Industry & State FE	Y	Y	Y	Y

The table reports the robustness check of climate risk measures. The dependent variable is the market-adjusted buy-and-hold abnormal returns (*Buy-and-Hold*) for the first three years post-IPO in Models 1-2 and first-day returns (*Underpricing*) in Models 3-4, respectively. Panel A reports the results for the high-tech IPOs and Panel B for the international intensity which is measured as firms' international sales as a percentage of total sales. *Int intensity Dum* is a dummy which takes the value of one for firms having an international intensity above the median value and zero otherwise. The values in brackets are p-values. The remaining variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.

Online Appendix A5: The impact of climate change risk on IPO performance

	Buy-and-Hold		*Underpricing*	
Variables	Model 1	Model 2	Model 3	Model 4
NegPDSI t-1	-0.2028***	-0.2028***	-0.0516**	
	(0.000)	(0.000)	(0.022)	
Trend t-1				-0.1375***
				(0.000)
Ln Board Size	-0.013	-0.013	-0.0188	0.0121
	(0.213)	(0.213)	(0.157)	(0.223)
GDP	0.3611***	0.3611***	0.0317***	0.3711***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln number of state firms	0.0102	0.0102	0.0181*	0.0107
	(0.118)	(0.118)	(0.067)	(0.109)
Ln Per capita income (counties)	0.0416***	0.0416***	0.0215***	0.0367***
	(0.000)	(0.000)	(0.007)	(0.002)
Ln population (counties)	0.0117	0.0117	0.0010	0.0162*
	(0.108)	(0.108)	(0.220)	(0.084)
Other controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
No of obs	1454	1454	1521	1454
adj. R-sq	0.201	0.201	0.226	0.202

The table shows the impact of climate change risk on short-term and long-term IPO performance using more control variables. The dependent variable is the market-adjusted buy-and-hold abnormal returns (*Buy-and-Hold*) for the first three years post-IPO in Models 1-2 and first-day returns (*Underpricing*) in Models 3-4, respectively. Additional control variables include the natural logarithm of the board size of the IPO company (*Ln Board Size*), state GDP *(GDP)*, and natural logarithm of firms at a state level (*Ln number of state firms*) are measured at the state level, natural logarithm of per capita income (*Ln Per capita income (counties)*) and natural logarithm of population (*Ln population (counties))* are measured at the county level. The standard errors are clustered at the state level. The values in brackets are p-values. The remaining variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels

Online Appendix A6: Alternative climate risk measures

	Buy-and-Hold			*Underpricing*		
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Crop Damage	-0.0261***			-0.0235***		
	(0.000)			(0.000)		
Property Damage		-0.0122**			-0.0126***	
		(0.012)			(0.000)	
Log (Duration)			-0.0376**			-0.0319***
			(0.016)			(0.001)
CEO age	0.0065*	0.0019	0.0174***	0.00412*	0.0014	0.00601*
	(0.087)	(0.677)	(0.000)	(0.055)	(0.702)	(0.090)
CEO tenure	-0.0162	-0.0187	-0.0261	-0.0012	-0.0013	-0.0078***
	(0.293)	(0.291)	(0.827)	(0.892)	(0.200)	(0.000)
CEO gender (Male=1)	-0.1240*	-0.0021	-0.722***	-0.0017	-0.0319***	-0.0095
	(0.067)	(.412)	(0.000)	(0.843)	(0.000)	(0.552)
Other Controls	Y	Y	Y	Y	Y	Y
Year, Industry, and State FE	Y	Y	Y	Y	Y	Y
No of obs	1502	1502	1502	1502	1502	1502
adj. R-sq	0.1799	0.1801	0.1822	0.1825	0.1777	0.1812

The table reports the robustness check of climate risk measures. The dependent variable is the market-adjusted buy-and-hold abnormal return (*Buy-and-Hold*) for the first three years post-IPO in Models 1-3 and first-day returns (*Underpricing*) in Models 4-6. We use Property Damage, and Crop Damage, the natural logarithm of duration, Log (Duration), and CEO controls such as CEOs' age (*CEO age*) at the fiscal year in our panel data, tenure (*CEO tenure*, which is calculated as the difference between the date become CEO and the fiscal year in our panel data), and gender (*CEO gender*, which is a dummy is equal to one if CEO is male and zero if CEO is female). CEO data is extracted from Execucomp. The values in brackets are p-values. The remaining variables are defined in Appendix Table 1. ***, **, * indicate 1%, 5%, and 10% significance levels.