Climate Change Vulnerability and IPO Underpricing[☆]

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Abstract

Studying 12,874 IPOs issued in 35 countries between 1998 and 2018, I find that greater climate change vulnerability is associated with larger first-day returns. A one standard deviation increase in a country's climate vulnerability score is associated with an additional $18.92 million "left on the table" for the typical offering. The positive relation is present for all components and most sectors of the vulnerability score, stronger for smaller IPO firms, and robust to alternative estimation techniques, instrumental variable analysis, and the exclusion of individual countries with large numbers of IPOs. Short-term orientation, low trust in science, and more transparent accounting disclosures attenuate the positive relation between climate vulnerability and underpricing.

JEL classifications*: G12, G15, G24, Q54*

Keywords: *Climate change, initial public offerings, underpricing*

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1. Introduction

According to a recent study by insurance giant Swiss Re, climate change could shave as much as 18 percent off of global GDP by 2050, with severe economic consequences for investors and the firms in which they invest.[1] A burgeoning literature finds that climate risk is already reflected in the prices of many financial and real assets, including equities (Bansal et al., 2019), bank loans (Javadi and Masum, 2021), corporate bonds (Huynh and Xia, 2021), municipal bonds (Painter, 2020), commodities (Barnett, 2019), derivatives (Ilhan et al., 2021), and real estate (Baldauf et al., 2020; Bernstein et al., 2019; Giglio et al., 2021). However, to date there is no evidence on the impact of climate change vulnerability on the pricing of initial public offerings (IPOs). This is surprising given that a significant portion of the value of many IPO firms is tied to expectations of future growth, which is particularly sensitive to climate change (e.g., Bansal et al., 2019). Climate change also threatens IPO firms' operating performance, as the following passage from Sweetgreen's IPO prospectus demonstrates:[2]

> *The profitability of our restaurants depends in part on our ability to anticipate and react to changes in commodity costs, including food, paper, supplies, fuel, utilities and distribution, and other operating costs. Additionally, the commodity markets, including markets for key produce items, such as kale and avocado, will likely continue to increase over time if global warming trends continue and may also become volatile due to climate change and climate conditions, all of which are beyond our control and, in many instances, extreme and unpredictable (such as more frequent and/or severe fires and hurricanes). We can only partially address future price risk due to climate change through hedging and other activities, and therefore increases in commodity costs, particularly due to climate change, could have an adverse impact on our ability to achieve or maintain profitability. (p. 41)*

[1] https://www.swissre.com/media/news-releases/nr-20210422-economics-of-climate-change-risks.html
[2] https://www.sec.gov/Archives/edgar/data/0001477815/000119312521334087/d104360d424b4.htm

Given that climate change is a global concern, I address this gap in the literature by examining the association between country-level indicators of climate vulnerability and firm-level IPO underpricing in a sample of 12,874 IPOs issued in 35 countries from 1998 to 2018. An added benefit of studying this issue in an international setting (rather than a single country) is that climate vulnerability varies more between countries than within countries. Consistent with the widely-accepted positive association between uncertainty and first-day returns (e.g., Beatty and Ritter, 1986; Rock, 1986), I find statistically and economically significant evidence that IPO first-day returns are higher in countries that are more vulnerable to climate change. The positive relation between climate vulnerability and first-day returns is evident for a range of vulnerability indicators, including ND-GAIN's vulnerability index, the GDP-adjusted vulnerability index, all three components of the index (i.e., exposure, sensitivity, and adaptive capacity), and most of the sectors considered. For example, my main result indicates that a one standard deviation increase in a country's climate vulnerability index is associated with an additional $18.92 million "left on the table," which is approximately 14.6 percent of the total proceeds raised by the typical IPO firm. Thus, firms in countries that are more vulnerable to climate change tend experience a substantially higher cost of going public than firms in less vulnerable countries.

While the above passage from Sweetgreen's IPO prospectus suggests that climate change is exogenous and cannot be completely eliminated through traditional risk management practices, I take two steps to alleviate potential concerns about omitted variable bias, errors in variables bias, and simultaneous causality bias. First, I perform instrumental variable analysis that uses two instruments motivated by evidence that climate change vulnerability is associated with a country's geography: distance from the equator and length of coastline. These instruments satisfy the relevance condition, as evidence suggests that geographic characteristics are associated with

climate vulnerability (e.g., Deutsch et al., 2008; Huey et al., 2009). While the exclusion restriction is hard to verify, it is not clear why a country's geography should be associated with underpricing in a way other than through its impact on uncertainty due to climate change. The instrumental variable results provide strong support for a positive relation between climate vulnerability and underpricing. Second, I report the results of Impact Threshold for a Confounding Variable (ITCV) analysis (Frank, 2000). ITCV measures the minimum impact required of a confounding variable that would be necessary to make the coefficient for a variable of interest statistically insignificant. Coupled with the instrumental variable results, the ITCV results help assuage concerns that omitted variables drive the positive association between climate vulnerability and underpricing.

Additional tests aim to understand factors that impact the relation between climate vulnerability and underpricing and to demonstrate the robustness of the results to alternative estimation and sampling techniques. In cross-sectional analysis, I find that small IPO firms are more sensitive to climate vulnerability. This suggests that uncertainty related to climate vulnerability is intensified by financial constraints and information asymmetry, which both tend to be more severe for small IPO firms. I also consider various country-level characteristics that have the potential to impact the association between climate vulnerability and underpricing. Consistent with research that finds that the impact of climate change on asset prices is sensitive to community beliefs about climate change (e.g., Baldauf et al, 2020; Bernstein et al., 2019), I find that the positive relation between climate vulnerability and underpricing is weaker in countries that exhibit low trust in scientists. When I consider the possibility that investors underestimate uncertainty related to climate vulnerability because the most severe effects are likely to arise many decades in the future, I find that the association between climate vulnerability and underpricing is weaker in countries that are more short-term oriented (Hofstede et al., 2010). Consistent with prior

research that finds that transparent disclosures reduce uncertainty and information asymmetry, which results in lower underpricing (e.g., Boulton et al., 2011 & 2017), I find that the relation between climate vulnerability and underpricing is weaker in countries with higher-quality accounting disclosures.

My results contribute to a several literatures. First, I report novel evidence on the relation between climate vulnerability and IPO outcomes. To the best of my knowledge, this is the first study to show that IPO underpricing is higher in countries that are more vulnerable to climate change. In a related study, Baker et al. (2021) find that country-level ESG risk management, which includes environmental factors, is associated with lower firm-level underpricing. Although they are related, climate vulnerability and ESG risk management are distinct concepts. For example, Baker et al. (2021) note that "countries can pursue strategies to effectively manage these [ESG] risks in order to improve their competitiveness and economic sustainability." (p. 4) However, as noted above, climate vulnerability is exogenous and cannot be eliminated through traditional risk management practices. When I orthogonalize the vulnerability index to Baker et al.'s (2021) environmental risk management measure, I find evidence consistent with both studies' hypotheses. Namely, I find that underpricing is both negatively correlated with environmental risk management and positively correlated with climate vulnerability.

Second, my results are consistent with prior research that finds that climate risk affects firms' cost of equity capital. For example, Bansal et al. (2019) find that equity markets require a positive temperature risk premium of about 0.8 percent per year, and Huynh et al. (2020) find report a drought risk premium of 0.92-1.62 percent that depends on the severity of drought conditions. Thus, firms exposed to greater temperature and drought risk pay a higher cost of equity capital. My results compliment these studies that examine secondary market prices by showing that climate

risk also increases the cost of raising equity capital in the primary market. Namely, IPO firms in countries with greater climate vulnerability suffer from greater underpricing, which Ritter (1987) notes is often the larger of the two measureable costs of going public.

2. Related literature

2.1. Climate change vulnerability

Krueger et al. (2020) categorize climate risk, which refers to risks related to climate change and efforts to mitigate its impact, into regulatory, physical, and technological risks. Regulatory risk is perhaps the most immediate of the three, as governments around the world pursue regulatory actions to address climate change. Taxes, cap-and-trade systems, and emission limits have all been proposed as ways to reduce carbon emissions, which would substantially increase costs for affected firms. According to World Bank data, dozens of countries have already implemented carbon pricing initiatives, with several more scheduled to follow in coming years.[3] Consistent with the immediacy of regulatory risk, Krueger et al.'s (2020) survey of institutional investors indicates that many believe that regulatory risks have already begun to materialize. However, Ilhan et al. (2020) note that it is difficult for investors to measure the impact of regulatory risk on stock prices because climate policy is still very uncertain.

Although perhaps of less immediate concern than regulatory risks, Krueger et al. (2020) find that institutions believe that physical and technological risks are still relevant today, with long-term and larger institutional investors viewing them as more financially material than other investors. Physical risks include extreme temperatures, floods, droughts, and other natural disasters that could negatively impact firm performance (e.g., Hong et al., 2019). Technological risk refers to innovations related to climate change that pose a threat to an existing firm's business model.

[3] https://carbonpricingdashboard.worldbank.org/map_data

For example, technological advances related to renewable energy (e.g., solar, wind) threaten the fossil fuel industry.

An emerging literature finds that financial and real asset prices often reflect climate risk. In the case of equities, Bansal et al. (2019) find that equity values reflect long-run temperature shifts related to global warming, and Huynh et al. (2020) find that the ex ante cost of equity is higher for firms headquartered in places that are more exposed to drought risk. Evidence also suggests that lenders price climate risk. In the case of bank loans, Javadi and Masum (2021) find that firms in locations with higher climate change exposure pay higher spreads. In the bond markets, Huynh et al. (2021) find that investors pay higher prices for corporate bonds issued by firms with better environmental performance, while Painter (2020) reports that greater climate risk is associated with higher municipal bond underwriting fees and yields. Other studies report evidence that commodity prices (Barnett, 2019) and derivative prices (Ilhan et al., 2021) are also sensitive to climate risk.

Substantial evidence also indicates that climate risk affects real estate prices. Bernstein et al. (2019) find that exposure to sea level rise results in a discount of about 7 percent to home prices. However, the discount is sensitive to whether the property is owner-occupied, with non-owner-occupied properties (i.e., more sophisticated investors) driving the result. Differences in beliefs about sea level rise affect the discount in the owner-occupied segment of the housing market (i.e., less sophisticated investors), as areas that express greater worry about sea level rise exhibit greater discounts. Similarly, Baldauf et al. (2020) find that house prices projected to be underwater sell at discounts in neighborhoods that view climate-related events as more likely ("believers") compared to neighborhoods that discount the likelihood ("deniers").

2.2. Initial public offerings

Logue (1973) and Ibbotson and Jaffe (1975) report early evidence on the tendency for IPOs to be underpriced. In the years since these studies were published, scores of single- and multi-country studies report that IPOs are, on average, underpriced in nearly every country and time period considered. For example, Ritter (2021) summarizes dozens of IPO studies that collectively consider IPOs in 54 countries going back as far as 1959. The data indicate the first-day returns range from 3.3 percent to 270.1 percent, depending on the country and time period studied. As Ljungqvist (2007) notes, underpricing reduces the amount of money pre-IPO shareholders receive for the shares they sell at the IPO and dilutes the value of shares that they keep. As a result, interest in this pervasive and persistent empirical regularity continues to this day.

Ljungqvist (2007) argues that among the four most prominent groups of underpricing theories – asymmetric information, institutional reasons, control considerations, and behavioral explanations – asymmetric information is the most recognized. According to these models, underpricing results from information disparities among IPO participants. For example, Baron (1982) points to information disparities between IPO issuers and underwriters, Welch (1989) highlights IPO issuers' information advantage over IPO investors, and Rock (1986) notes that some investors are more informed than others. In each case, underpricing emerges as a potential consequence of information asymmetry. Greater uncertainty encourages information gathering, which increases the information gap between the informed and uninformed and further amplifies underpricing (Beatty and Ritter, 1986).

I posit several reasons why uncertainty related to climate vulnerability may exacerbate information disparities among IPO participants, resulting in larger first-day returns. First, the science of climate change is complex, which makes pricing climate risk difficult for some IPO

participants and contributes to greater information asymmetry. For example, Hotz (2021) notes the exponential increase in the volume of data collected to study climate change, which requires ever more sophisticated data access and analysis techniques, including machine learning and artificial intelligence. A second reason is the wide range of potential outcomes due to climate change, which in part depend on global mitigation efforts (e.g., Barnett et al., 2020). For example, the 2017 U.S. Climate Sciences Report considers possible scenarios where the global temperature increases anywhere from 2.4 to 10.2 degrees Fahrenheit compared to the 1901-1960 global average.[4] Therefore, even if IPO participants consider climate risk, their estimates of its impact on IPO firm value could diverge substantially. A third factor is the important role of institutional investors in the IPO process. Aggarwal et al. (2002) report that institutions receive the bulk of the shares in most IPOs. However, institutional investors increasingly consider climate risk when making investment decisions (Krueger et al., 2020), which has been shown to impact institutional ownership in companies with greater environmental concerns (Bolton and Kacperczyk, 2021; Chava, 2014). If IPO participants differ in their ability to interpret and price the potential effects of climate change vulnerability on IPO firms, I predict the following:

H1: Climate change vulnerability is associated with higher IPO underpricing.

3. Data and methodology

3.1. Sample construction

The Securities Data Company (SDC) Platinum database is used to gather data on IPOs listed between 1998 and 2018. As is customary in the IPO literature, I discard closed-end funds, depositary receipts, financial firms, limited partnerships, rights offerings, trusts, and unit offerings. I also discard cross-listed firms to ensure that investors' perception of climate vulnerability is in

[4] https://science2017.globalchange.gov/

alignment with the primary location of the IPO firm. The SEDOL identifier is used to link SDC with Datastream, from which I gather first-day closing prices. Before discarding unmatched IPOs, I attempt to manually match using the IPO firm name, listing country, and Datastream entry date. I retain all matched IPOs that have a first valid secondary market price that occurs within the window [–3, +60] relative to the IPO issue date. Underpricing is calculated as the difference between the first-day closing price and the IPO offer price, divided by the first-day closing price. Observations with extreme underpricing that are likely to result from incorrect matches between SDC and Datastream are trimmed (top and bottom one percent), as are IPOs with missing data required to calculate key control variables. These steps result in a final sample of 12,874 IPOs issued in 35 countries.

The climate vulnerability measures at the center of this study are reported by the Notre Dame Global Adaptation Initiative (ND-GAIN). According to ND-GAIN, "The ND-GAIN Country Index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. It aims to help governments, businesses and communities better prioritize investments for a more efficient response to the immediate global challenges ahead."[5] The country index considers two areas: vulnerability and readiness. I focus on indicators of climate vulnerability, which capture the "propensity or predisposition of human societies to be negatively impacted by climate hazards" (Chen et al., 2015, p. 3).[6]

Six sectors contribute to the construction of the vulnerability index: food, water, health, ecosystem services, human habitat and infrastructure. Each sector considers three components: exposure to climate hazards, sensitivity to the impacts of climate hazards, and capacity to cope with or adapt to the impacts of climate hazards. To illustrate, consider the food component of the

[5] https://gain.nd.edu/our-work/country-index/
[6] In untabulated analysis, I find mixed evidence on the relation between readiness and underpricing.

vulnerability index. A total of six indicators are used to measure food vulnerability, with two indicators aimed at capturing each of the three components. The exposure component of food vulnerability is measured using indicators for the projected change in cereal yields and the projected population change. The sensitivity component of food vulnerability considers indicators for food import dependency and rural population. The adaptive capacity component of food vulnerability considers agriculture capacity and child malnutrition. Applying a similar approach to the other five sectors results in a total of 36 indicators used to construct the broad vulnerability index.[7]

Figure 1 groups sample countries into quartiles based on their average vulnerability index across all sample IPOs. Countries shaded red (blue) are the sample countries that are most (least) vulnerable to climate change. Among the most vulnerable countries are China and India, which together represent over one-third of the world's total population. In addition to the vulnerability index and the GDP-adjusted vulnerability index, I also examine the relation between underpricing and the vulnerability sector scores (i.e., water, agriculture, health, infrastructure, food, and ecosystems) and the vulnerability component scores (i.e., exposure, sensitivity, and adaptive capacity) in multivariate analyses that I describe below.

[Place Figure 1 about here]

3.2. Descriptive statistics

Table 1 reports country-level summary statistics for my sample. The number of IPO events varies substantially across countries, from one IPO in both Argentina and Israel to 2,412 IPOs in the U.S. The vulnerability index is the average vulnerability index value across all IPOs issued in a country. Higher vulnerability index values indicate greater vulnerability to the effects of climate

[7] Chen et al. (2015) provide a detailed description of the construction of all measures used in this study.

change. According to this measure, India (Norway) is the country that is most (least) vulnerable to climate change in my sample. The last column reports the average first-day return for IPOs issued in each country. Consistent with prior cross-country IPO underpricing studies (e.g., Boulton et al., 2020), there is substantial country-level variation in average underpricing. Israel and Japan represent the extremes, with average underpricing of -8.3 percent and 77.4 percent, respectively.

[Place Table 1 about here]

Figure 2 plots each sample country's average vulnerability index score (x-axis) and its average IPO first-day return (y-axis). The trend line demonstrates that the vulnerability index and underpricing are positively correlated. This provides early support for my hypothesis, which predicts a positive relation between climate vulnerability and underpricing. In subsequent multivariate analyses, I control for other factors that prior research finds are correlated with underpricing.

[Place Figure 2 about here]

Table 2 reports IPO-level descriptive statistics. The Appendix provides detailed definitions and primary data sources for all variables used in my analysis. The average IPO experiences *underpricing* of 34.3%, with a range of -32.1% to 441.7%. The average value for the *vulnerability index* is 0.352, with values that range from 0.241 (Norway, 2010) to 0.536 (India, 1999).

[Place Table 2 about here]

The remaining variables in Table 2 are used as covariates in my multivariate models. Their inclusion is motivated by prior research on the determinants of IPO underpricing. Boulton et al. (2010) find that country-level governance is associated with IPO underpricing. *Anti-self-dealing* is an index of minority shareholder protection against expropriation by corporate insiders constructed by Djankov et al. (2008). Marcato et al. (2018) find that greater financial market

integration is associated with lower IPO first-day returns. *Economic integration*, which is the Economic Globalization Index reported by the KOF Swiss Economic Institute for listing country and year, takes values between 23.603 and 95.431, where higher scores indicate greater market integration.[8] Aggarwal (2000) notes that IPO underwriters often engage in price stabilization aimed at preventing secondary market prices from falling below the IPO offer price. I follow Boulton et al. (2011) and construct the country-level variable *price stabilization*, which is the difference between the number of IPOs with first-day returns between zero and one percent and the number of IPOs with first-day returns between zero and negative one percent, divided by the total number of IPOs. The average value (0.014) suggests a greater likelihood of small positive first-day returns than small negative first-day returns, which is consistent with a tendency for price stabilization.

Two variables control for the fact that underpricing tends to be higher during hot issue markets (Ritter, 1984). The first, *IPO activity*, captures recent IPO issuance and is calculated for each country-year as the number of new issues divided by the total number of listed equities. The second, *market return*, captures broad market performance over the three months prior to the IPO for the country-level Datastream index for the listing country. Ellul and Pagano (2006) report a negative correlation between aftermarket liquidity and underpricing. *Liquidity* is measured at the country-year level as the total value of shares traded divided by the aggregate market capitalization. *Offer size*, which averages $129.871 million (cpi-adjusted), controls for the fact that smaller firms are generally riskier than larger firms (Ritter, 1984). Additionally, investors often have more information about larger IPO firms.

[8] https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html

Evidence is mixed on the relation between underwriter reputation and IPO underpricing. One possibility is that reputable financial intermediaries reduce uncertainty and underpricing by certifying an IPO (e.g., Barry et al., 1990; Carter and Manaster, 1990; Megginson and Weiss, 1991). However, Nimalendran, Ritter, and Zhang (2007) note that conflicts of interest may alter the incentives of underwriters, while Liu and Ritter (2011) suggest that non-price dimensions decrease IPO issuers' sensitivity to IPO prices and proceeds. These theories are consistent with studies that find a positive correlation between underwriter reputation, venture capital backing, and first-day returns (e.g., Beatty and Welch, 1996; Loughran and Ritter, 2004). I construct an underwriter reputation measure that is based on the notion that higher-reputation underwriters capture a greater share of the available underwriting work (e.g., Megginson and Weiss, 1991). *Underwriter rank* is the underwriter's market share decile rank, where market share is the aggregate proceeds for IPOs in which an underwriter is present divided by the aggregate proceeds raised for the entire IPO sample. I also construct the indicator variable, *VC backed*, which identifies the 24.6% of firms that received venture capital funding prior to their IPO.

Share lockups commit pre-IPO shareholders to retain their shares for a period of time after the IPO, most commonly six months. Brav and Gompers (2003) posit that share lockups decrease moral hazard problems for IPO firms. However, Aggarwal et al. (2002) suggest that underpricing creates information momentum that benefits pre-IPO shareholders who are subject to share lockups. The average *lockup length* is 114.7 days for my sample. Consistent with Sherman (2000), which notes that book building is the main method form taking firms public around the world, 64.3% of sample IPOs are *bookbuilt*. Underwriters assume the inventory risk in *firm commitment* IPOs, which tend to be underpriced less than best efforts offerings (Ritter, 1987). Information gleaned from the parent firm aids in the pricing of *equity carve-outs*, which are 9.2% of the IPO

sample (Ghosh et al., 2012). I use the SIC codes identified in Ljungqvist and Wilhelm (2003) to identify the 21.0% of IPO firms that operate in the high-tech sector, which tend to experience higher underpricing than firms from other industries.

3.3. Hierarchical linear modeling

Country-level clustering is a potential concern with the pooled cross section that I employ to estimate the relation between climate vulnerability and underpricing. IPOs that come from the same country are likely to share some common variance associated with their country of issuance, which means that they cannot be treated as completely independent of one another. Using OLS regression to analyze clustered or nested data can result in underestimated standard errors (Garson, 2013). To address this concern, recent cross-country IPO underpricing studies (e.g., Baker et al., 2021; Marcato et al., 2018) use multi-level modeling or hierarchical linear modeling (HLM), which allows for correlation across clusters. HLM models the intercept of the underpricing regression as a random effect of the country in which the IPO is issued. For example, consider Eq. (1) which expresses the general specification for studying the association between climate vulnerability and underpricing:

$$Underpricing_{ijt} = \beta_0 + \beta_1 Vulnerability\ measure_{jt} + \beta X_{ijt} + \mu_i + \propto_t + \omega_j + \varepsilon_{ijt} \quad (1)$$

where $Underpricing_{ijt}$ is the first-day return on the IPO of firm i issued in country j at time t; $Vulnerability\ measure_{jt}$ is one of the climate vulnerability measures for country j at time t; X_{ijt} is a vector of covariates measured for IPO i issued in country j at time t; μ_i and α_t are industry and issue year effects, respectively; ω_j is the random country effect that shifts the intercept between countries; and ε_{ijt} is the error term. While HLM is the primary estimate technique reported in the tables, I also demonstrate robustness to alternative estimation techniques, including ordinary least squares and country fixed effects.

4. Results and discussion

4.1. Climate change vulnerability and underpricing

My hypothesis predicts a positive relation between country-level climate vulnerability and firm-level IPO underpricing. Table 3 reports the baseline results. The dependent variable in each model is underpricing, while the primary variables of interest are *vulnerability index*, the GDP-adjusted vulnerability index (*vulnerability adjusted*), and the six components (*food, water, health, ecosystem, habitat,* and *infrastructure*) and three sectors (*exposure, sensitivity,* and *adaptive capacity*) that comprise the index. In addition to the controls discussed in conjunction with Table 2, all regressions include issue year fixed effects and industry fixed effects (Dyck and Zingales, 2004).

[Place Table 3 about here]

In the first column, I consider the relation between the *vulnerability index* and underpricing. Consistent with my hypothesis, I find that greater climate vulnerability is associated with higher underpricing. The result is both statistically and economically significant. The coefficient on *vulnerability index* (2.5373) implies that a one standard deviation increase in a *vulnerability index* is associated with a 14.57 percentage point increase in underpricing. For context, a one standard deviation increase in *vulnerability index* is approximately equivalent to a move from the U.S., which has a vulnerability index that is near the sample median, to Singapore, which is at the bottom of the quartile of countries most vulnerability to climate change based on *vulnerability index*. The second column, which replaces *vulnerability index* with the GDP-adjusted vulnerability index (*vulnerability adjusted*), also indicates a positive relation between climate vulnerability and underpricing. The economic magnitude is similar for the GDP-adjusted value, as the coefficient

(2.6431) implies that a one standard deviation increase (0.0472) is associated with a 12.48 percentage point increase in underpricing.

Subsequent columns in Table 3 replace *vulnerability index* with its six components and three sectors to gain a better understanding of the factors that drive the positive relation between climate vulnerability and underpricing. Three of the six components, *health, food,* and *ecosystems,* exhibit a positive and significant relation with underpricing. The coefficients on the remaining three components (*habitat, water,* and *infrastructure*) are not statistically significant. The economic impact of the significant coefficients ranges from 6.29 percentage point (*health*) to 23.92 percentage point (*food*) larger first-day returns for a one standard deviation increase. The coefficients for all three sectors are also positive and significant, with economic impact ranging from an additional 6.97 percentage points (*exposure*) to 16.96 percentage points (*sensitivity*) of underpricing for a one standard deviation increase in the sector measure. Thus, a country's adaptive capacity, susceptibility, and exposure all contribute to the positive relation between climate change vulnerability and underpricing.

Many of the control variables are significant in the Table 3 results. The coefficients on *IPO activity* and *market return* offer mixed support for hot market effects, as underpricing is lower during more active IPO markets, but higher following stronger recent overall market performance. Consistent with Ellul and Pagano (2006), first-day returns are lower in more liquid markets. Offer size is negatively correlated with underpricing, which is consistent with the idea that smaller IPO firms are riskier and more opaque than larger firms. Consistent with studies such as Beatty and Welch (1996) and Loughran and Ritter (2004) IPO underpricing is higher for IPOs underwritten by more reputable underwriters and IPOs backed by venture capital investors. The negative coefficient on lockup length is consistent with Brav and Gompers (2003), which posits that longer

lockups reduce adverse selection problems. Bookbuilt and firm commitment offerings are underpriced less than other offering types, while high-tech IPOs experience higher underpricing than their non-high-tech peers.

Consistent with my hypothesis, Table 3 provides evidence that IPO underpricing tends to be greater in countries that are more vulnerable to climate change. The positive relation between climate vulnerability and underpricing is evident for many of the components and all of the sectors of the composite vulnerability measure. In the sections that follow, I report the results of additional analyses designed to demonstrate the robustness of the association between climate vulnerability and underpricing and examine other factors that might influence this relation.

4.2. Omitted variable bias

Potential sources of concern about the results reported in Table 3 include omitted variable bias, errors in variables bias, and simultaneous causality bias. A common technique for addressing these biases is instrumental variable analysis. An appropriate instrument is one that has a significant effect on climate vulnerability, but influences underpricing only through this relation. I propose two instruments motivated by evidence that climate change vulnerability is associated with a country's geography. Rising temperatures and rising sea levels are two of the primary risk factors related to climate change. To capture a country's sensitivity to rising temperatures, I use the distance of each country's capital city from the equator as one instrument for climate change vulnerability. On the one hand, evidence indicates that temperatures are rising faster at higher latitudes than at latitudes closer to the equator.[9] On the other hand, because temperatures are already higher near the equator, countries at lower latitudes are more vulnerable to small temperature increases. To capture a country's sensitivity to rising sea levels, I use the length of

[9] https://www.nasa.gov/topics/earth/features/warmingpoles.html

each country's coastline as my second instrument. Rising sea levels lead to more frequent high-tide flooding and accelerated coastal erosion. It is reasonable to expect that these geographic characteristics are associated with a country's climate vulnerability, which would fulfill the relevance condition of the instruments. However, it is not clear why a country's distance from the equator or its length of coastline should be associated with underpricing in a way other than through their impact on climate change. Therefore, these instruments also are likely to satisfy the exclusion restriction. I estimate the following two-stage model:

$$Vulnerability\ measure_{jt} = \alpha_1 + \alpha_2 Geography_j + \gamma X_{ijt} + \mu_i + \propto_t + \varepsilon_{1it} \quad (2)$$

$$Underpricing_{ijt} = \beta_1 + \beta_2 Vulnerability\ measure'_{jt} + \theta X_{ijt} + \mu_i + \propto_t + \varepsilon_{2it} \quad (3)$$

where $Geography_j$ is the first principal component of the distance of the capital city from the equator and the total coastline for country j, respectively; $Vulnerability\ measure'_{jt}$ is the instrumented vulnerability measure for country j in year t; X_{ijt} is a vector of control variables measured for IPO i issued in country j in year t; μ_i and α_t are industry and issue year effects, respectively; and ε_{1it} and ε_{2it} are error terms. Control variables are as previously defined. I use the first principal component of a country's distance from the equator and length of coastline as my instrument to reduce its dimensionality (Bontempi and Mammi, 2015).

The instrumental variable results are reported in Table 4. The first-stage results reported in Panel A confirm that geography is associated with a climate vulnerability. Namely, *geography* loads negatively and is highly significant in every model. The second-stage results reported in Panel B help alleviate concerns that endogeneity drives the positive relation between climate vulnerability and underpricing reported in Table 3. The positive coefficients on the fitted values of the vulnerability measures confirm that underpricing tends to be higher for IPOs issued in countries with greater climate vulnerability. At the bottom of the table, I report the results of

several tests that provide support for my instrumental variables approach. Durbin and Wu-Hausman tests provide mixed support for the notion that the vulnerability measures should be treated as endogenous. Anderson-Rubin, Cragg-Donald, and Stock-Yogo statistics indicate that *geography* is a valid instrument.

[Place Table 4 about here]

A second approach for addressing omitted variable bias is to perform Impact Threshold for a Confounding Variable (ITCV) analysis (Frank, 2000).[10] ITCV is based on the fact that the bias created by an omitted variable is affected by both its correlation with the independent variable of interest and its correlation with the dependent variable. I report the results of the ITCV analysis in Table 5.

[Place Table 5 about here]

For brevity, I report the ITCV results for *vulnerability index* and *vulnerability adjusted*. The first row reports the ITCV value, which measures the minimum impact required of a confounding variable that would be necessary to make the coefficient for the climate vulnerability measure statistically insignificant. To illustrate, consider the results for *vulnerability index*. The ITCV value is calculated as the product of the correlation between the confounding variable and *vulnerability index* and the correlation between the confounding variable and *underpricing*. Larger (smaller) ITCV values indicate that the main result is more (less) robust to omitted variable concerns. The ITCV value (0.0149) implies that the correlations between *vulnerability index* and *underpricing* with the unobserved confounding variable each only need to be 0.122 ($= \sqrt{0.0149}$) for the main result to be overturned. Because *vulnerability index* is positively related to underpricing, the two

[10] Representative papers that use ITCV analysis include Larcker and Rusticus (2010), Fu et al. (2012), Karampatsas et al. (2014), Croci and Petmezas (2015), and Baker et al. (2021).

correlations would need to be of the same sign (either positive or negative), or else the confounding variable would strengthen the relation between climate vulnerability and underpricing.

Beneath the ITCV value are impact scores based on partial and raw correlations that show the impact of each independent variable on *vulnerability index*. The impact score for each control variable is calculated as the product of the raw (partial) correlation between *vulnerability index* and the control variable and the correlation between the *underpricing* and the control variable. A positive (negative) impact score indicates that inclusion of the control variable makes the coefficient on *vulnerability index* more positive (negative). The impact scores provide a benchmark for the magnitude of the possible correlations for an unobserved confounding variable. Three (one) of the impact scores based on raw (partial) correlations are larger than the ITCV for *vulnerability index*. To interpret the results, consider impact score for *firm commitment* using the more conservative raw correlations in the first column. The impact score (0.0153) is slightly larger than the ITCV for *vulnerability index*. This indicates that, in order to overturn the results, the unobserved confounding variable would need to have a similar impact to *firm commitment*, which is a common explanatory variable used in the underpricing literature typically found to be negatively associated with underpricing (Ritter, 1987). The results for *vulnerability adjusted* are even stronger, as the ITCV value is greater than the impact values (both raw and partial) for all of the control variables. Thus, a confounding variable would need to have a greater impact than any of the current control variables to invalidate the positive relation between *underpricing* and *vulnerability adjusted*. Assuming the regression model employs an appropriate set of control variables, these results help alleviate concerns that omitted variables drive the relation between climate vulnerability and underpricing.

4.3. IPO firm size

Climate vulnerability may be more salient for some firms than others. For instance, financial flexibility could limit small firms' ability to adapt to the realities of climate change compared to their larger peers. Additionally, because information disparities tend to be greater for smaller firms, IPO investors might require larger discounts due to greater uncertainty associated with climate change. I consider this possibility in Table 6, where I introduce the variable *small firm*, which is an indicator variable set equal to one for firms that are below the sample median based on IPO offer size. I interact this variable with the climate vulnerability measures to consider the marginal effect of firm size on the relation between climate vulnerability and underpricing.

[Place Table 6 about here]

The coefficients for the vulnerability measures continue to point to a positive relation between climate vulnerability and underpricing for large IPO firms. However, three of the sectors (*habitat*, *water*, and *infrastructure*) and one of the components (*exposure*) are not statistically significant. The positive coefficients reported for the interaction terms indicate that the marginal impact of climate vulnerability on underpricing is greater for small IPO firms. The sum of the coefficients for the vulnerability measures and their interaction with *small firm* reported at the bottom of Table 6 capture the total effect of climate vulnerability on underpricing for small IPOs. In every case except one (*habitat*), the sum is positive and significant. Thus, climate vulnerability affects underpricing for both large and small IPOs, but the effect is significant for more sectors and components of climate vulnerability for small IPOs.

4.4. Trust in science

Despite near unanimous support in the scientific community for the notion that human activity causes global warming (Cook et al., 2013), a nontrivial number of individuals express skepticism

regarding climate change and humans' role in it. For example, according to a recent survey conducted by the YouGov-Cambridge Globalism Project, 14 percent of Americans polled do not believe that human activity is responsible for climate change and an additional 5 percent said that the climate was not changing.[11] According to Chen et al. (2012), a small number of "optimistic" investors can substantially reduce the impact of latent risk, such as climate change, on asset prices. Consistent with this idea, Baldauf et al. (2020) report that houses projected to be underwater in the future sell at lower prices in "believer" neighborhoods compared to "denier" neighborhoods. In a related study, Bernstein et al. (2019) find that property discounts are greater for owner-occupied properties in areas that express greater concern about climate change. However, concern about climate change is not associated with property discounts for non-owner-occupied properties purchased by more sophisticated investors. I consider the possibility that the relation between climate vulnerability and underpricing is impacted by investor beliefs in Table 7.

[Place Table 7 about here]

I introduce the variable *low science trust* to capture a country's general attitude towards science and scientists, which proxies for a country's beliefs about climate science. Wellcome Global Monitor's Trust in Science Index forms the basis for this measure.[12] The index, which is available for all sample countries, is based on responses to five questions that ask individuals about their trust in different aspects or expectations of scientists. Individuals are classified as high, medium, or low trust based on their responses. *Low science trust* is an indicator variable set equal to one for IPOs issued in sample countries where the percentage of respondents classified as having high trust in scientists falls in the bottom quartile (within sample). In addition to adding *low science trust* as a control variable in my regressions, I interact the measure with the climate vulnerability

[11] YouGov Cambridge Globalism 2020
[12] https://wellcome.org/

measures to gauge the marginal impact of trust in scientists on the relation between climate vulnerability and underpricing.

The results suggest that low trust in scientists dampens the positive relation between climate vulnerability and underpricing. Namely, the interaction term is negative and significant in five of the regression models reported in Table 7. The sum of the vulnerability measures and their interaction with *low science trust* are reported at the bottom of the table. In many instances, the relation between climate vulnerability and underpricing is not statistically significant countries with low trust in scientists.

4.5. Short- versus long-term orientation

Recent extreme weather events are often viewed as early warning signs of the effects of climate change. However, the full consequences of climate change are unlikely to be apparent for many decades. For example, the year 2100 is commonly used as a benchmark for the potential long-term effects of climate change (e.g., Moss et al., 2010). Such time horizon uncertainty poses a challenge to investors (Andersson et al., 2016; Barnett et al., 2020). This could lead investors who are more short-term focused to discount uncertainty related to climate vulnerability, while investors with a longer-term view might price the risk. Painter (2020) finds evidence consistent with this in the municipal bond markets, as U.S. counties with greater climate vulnerability experience higher underwriting fees and yields, but only for longer-term issues. To control for sample countries' short- or long-term orientation, I introduce the variable *short term*, which is an indicator variable set equal to one for sample countries in the bottom quartile based on Hofstede's (2010) long- versus short-term orientation cultural dimension (i.e., more short-term oriented countries). If investors in short-term oriented countries are more likely to discount or ignore longer-term

uncertainty, the relation between climate vulnerability and underpricing should be weaker than in long-term oriented countries.

I report the results of models that include *short term* in Table 8. The evidence is consistent with the idea that IPOs in short-term oriented countries are less sensitive to climate vulnerability. Specifically, the interaction term is negative in all but one of the Table 8 regressions and is significant in eight of the models. The sum of the vulnerability measures and their interaction with *short term* are reported at the bottom of the table. In many instances, the relation between climate vulnerability and underpricing is not statistically significant countries that are short-term oriented.

[Place Table 8 about here]

4.6. Disclosure transparency

Boulton et al. (2011 & 2017) report that IPO underpricing is lower in countries with higher quality accounting disclosures. If more transparent disclosures reduce uncertainty related to climate change, they could dampen the positive association between climate vulnerability and underpricing. I measure disclosure transparency using aggregate earnings management (Leuz et al., 2003), which is the average ranking of each sample country based on four indicators of earnings management activity. I follow Boulton et al. (2011) and construct each measure annually over our sample period using accounting data from Compustat Global from the prior five years. *Transparent* is an indicator variable that takes the value of one for IPOs issued in a country with an aggregate earnings management score in the bottom quartile within my sample, and zero otherwise. I introduce this variable and its interaction with the vulnerability measures to test the impact of disclosure transparency on the relation between climate vulnerability and underpricing. I report the results in Table 9.

[Place Table 9 about here]

As reported in prior tables, climate vulnerability is associated with larger first-day returns. The negative coefficients for the interaction terms suggest that transparency mitigates the positive relation between climate vulnerability and underpricing. Consider the results for *vulnerability index*, for example. The sign on the interaction term is negative and the coefficient is highly significant, which suggests that transparent disclosures help offset the positive impact of climate vulnerability on underpricing. The sum of *vulnerability index* and the interaction of *vulnerability index* and *transparent* reported at the bottom of the table represents the effect of climate vulnerability on underpricing in a country with more transparent disclosures (i.e., an aggregate earnings management score that is in the bottom quartile). The insignificant coefficient indicates that transparent disclosures offset the impact of climate vulnerability on underpricing.

In the remaining columns of Table 9, I report the results for the components and sectors of the vulnerability index. In most cases, the interaction term is negative and significant. The *F*-tests of the joint significance of the vulnerability measures and their interactions with *transparent* confirm that the effect climate vulnerability on first-day returns is mitigated by transparent disclosures. Presumably, transparent disclosures help reduce climate change uncertainty for IPO investors.

4.7. The Stern Review

The October 30, 2006 release of Nicholas Stern's "Economics of climate change" is a pivotal moment that increased public awareness of the potential effects of climate change. For example, Painter (2020) shows that Google searches for "climate change" spiked following the release of the Stern Review and remained elevated in subsequent quarters. Investor attention to climate change risk was also affected, as Painter (2020) finds that the cost of issuing long-term climate bonds increased compared to long-term non-climate bonds following the release of the Stern Review. In Table 10, I separate my IPO sample into pre-Stern (i.e., IPOs issued before October

30, 2006) and post-Stern (i.e., IPOs issued on or after October 30, 2006) subsamples to examine the impact of this event on the relation between climate change vulnerability and underpricing.

[Place Table 10 about here]

The results are consistent with Painter's (2020) finding that investor attention to climate change increased following the release of the Stern Review. Namely, I find that the positive relation between climate vulnerability and underpricing is only evident for the post-Stern subsample. More generally, this speaks to both greater awareness and price effects in the later sample years.

5. Additional robustness

In Table 11, I report the results of several tests that confirm the robustness of the positive relation between climate vulnerability and underpricing. The first two models show that the relation is evident when using OLS regression and country fixed effects models instead of HLM. Because *anti-self-dealing* and *price stabilization* are country-level variables, they are excluded from the country fixed effects model.

[Place Table 11 about here]

In a related study, Baker et al. (2021) show that IPO underpricing is lower in countries that have stronger ESG risk management ratings. The third column of Table 11 demonstrates that climate vulnerability has incremental explanatory value beyond the environmental component of ESG risk management examined in their study. I show this by orthogonalizing *vulnerability index* to Baker et al.'s (2021) *Environmental RM* measure. Specifically, *residual vulnerability* is the residual from a regression of *vulnerability index* on Baker et al.'s (2021) *Environmental RM* measure. The number of observations in this test is reduced because *Environmental RM* is only available between 2008 and 2018. The negative coefficient for *Environmental RM* confirms Baker et al.'s (2021) finding of a negative relation between environmental risk management and

underpricing. More importantly, the positive coefficient for *residual vulnerability* both confirms the positive association between climate vulnerability and underpricing and demonstrates that the effect is unique from the environmental component of ESG risk management.

The remaining columns of Table 11 demonstrate the robustness of the positive relation between climate vulnerability and underpricing to the exclusion of potentially influential countries (e.g., large numbers of IPOs and/or extreme climate vulnerability index values). I report the results after excluding all IPOs issued in the following countries individually: Australia, China, India, Japan, South Korea, U.K., and U.S. The coefficient for *vulnerability index* is positive and significant in every case, which alleviates concerns that individual countries drive the positive association between climate vulnerability and underpricing.

6. Conclusion

It is generally accepted in the IPO literature that IPO investors demand deeper price discounts when uncertainty is high (Beatty and Ritter, 1986; Rock, 1986). In this study I consider a potential source of uncertainty that is difficult for firms and investors to hedge – uncertainty related to climate change. Namely, I examine the relation between country-level climate vulnerability and firm-level IPO underpricing using a sample of 12,874 IPOs issued in 35 countries from 1998 to 2018. Consistent with greater uncertainty leading to higher underpricing, I report a robust positive relation between a variety of indicators of climate vulnerability and IPO underpricing. From an economic perspective, the results suggest that a one standard deviation increase in a country's climate vulnerability index, a composite measure that captures six sectors and three components of climate vulnerability, is associated with an additional $18.92 million "left on the table" for the average IPO. Simply put, the cost of raising equity capital is higher for firms that go public in countries that are more vulnerable to climate change, all else equal.

Subsequent tests confirm the robustness of the positive association between climate vulnerability and underpricing and highlight several important factors that impact the relation. First, instrumental variable analysis and ITCV analysis help to alleviate concerns about omitted variable bias, errors in variables bias, and simultaneous causality bias. Second, I report that the positive relation between climate vulnerability and underpricing is greater for small IPOs, which suggests that financial constraints and information asymmetry exacerbate the impact of climate vulnerability. Third, the positive relation between climate vulnerability and underpricing is weaker in countries that exhibit low trust in science, long-term orientation, and transparent accounting disclosures. Together, these results highlight the role that climate risk plays in financial markets, particularly for young firms seeking to raise capital.

References

Aggarwal, R., 2000. Stabilization activities by underwriters after initial public offerings. *Journal of Finance* 55(3): 1075–1103.

Aggarwal, R., L. Krigman, K. Womack. 2002. Strategic IPO underpricing, information momentum, and lockup expiration selling. *Journal of Financial Economics* 66(1): 105–137.

Aggarwal, R., N. Prabhala, M. Puri. 2002. Institutional allocation in initial public offerings: Empirical evidence. *Journal of Finance* 57(3): 1421–1442.

Andersson, M., P. Bolton, F. Samama. 2016. Hedging climate risk. *Financial Analysts Journal* 72(3): 13–32.

Baker, E., T. Boulton, M. Braga-Alves, M. Morey. 2021. ESG government risk and international IPO underpricing. *Journal of Corporate Finance* 67.

Baldauf, M., L. Garlappi, C. Yannelis. 2020. Does climate change affect real estate prices? Only if you believe in it. *Review of Financial Studies* 33(3): 1256–1295.

Bansal, R., D. Kiku, M. Ochoa. 2019. Climate change risk. *Working paper*.

Barnett, M., 2019. A run on oil: Climate policy, stranded assets, and asset prices. *Working paper*.

Barnett, M., W. Brock, L. Hansen. 2020. Price uncertainty induced by climate change. *Review of Financial Studies* 33(3): 1024–1066.

Baron, D., 1982. A model of the demand for investment banking advising and distribution services for new issues. *Journal of Finance* 37(4): 955–976.

Barry, C., C. Muscarella, J. Peavy, M. Vetsuypens. 1990. The role of venture capital in the creation of public companies. *Journal of Financial Economics* 27(2): 447–471.

Beatty, R., J. Ritter. 1986. Investment banking, reputation, and the underpricing of initial public offerings. *Journal of Financial Economics* 15(1-2): 213–232.

Beatty, R., I. Welch. 1996. Issuer expenses and legal liability in initial public offerings. *Journal of Law and Economics* 39(2): 545–602.

Bernstein, A., M. Gustafson, R. Lewis. 2019. Disaster on the horizon: The price effect of sea level rise. *Journal of Financial Economics* 134(2): 253–272.

Bolton, P., M. Kacperczyk. 2021. Do investors care about carbon risk? *Journal of Financial Economics* 142(2): 517–549.

Bontempi, M., I. Mammi. 2015. Implementing a strategy to reduce the instrument count in panel GMM. *The Stata Journal* 15(4): 1075–1097.

Boulton, T., S. Smart, C. Zutter. 2010. IPO underpricing and international corporate governance. *Journal of International Business Studies* 41(February-March): 206–222.

Boulton, T., S. Smart, C. Zutter. 2011. Earnings quality and international IPO underpricing. *The Accounting Review* 86(2): 483–505.

Boulton, T., S. Smart, C. Zutter. 2017. Conservatism and international IPO underpricing. *Journal of International Business Studies* 48(6): 763–785.

Boulton, T., S. Smart, C. Zutter. 2020. Worldwide short selling regulations and IPO underpricing. *Journal of Corporate Finance* 62.

Brav, A., P. Gompers. 2003. The role of lockups in initial public offerings. *Review of Financial Studies* 16(1): 1–29.

Carter, R., S. Manaster. 1990. Initial public offerings and underwriter reputation. *Journal of Finance* 45(4): 1045–1067.

Chava, S., 2014. Environmental externalities and cost of capital. *Management Science* 60(9): 2223–2247.

Chen, C., I. Noble, J. Hellmann, J. Coffee, M. Murillo, N. Chawla. 2015. University of Notre Dame Global Adaptation Index: Country index technical report. Available at: https://gain.nd.edu/assets/254377/nd_gain_technical_document_2015.pdf

Chen, H., S. Joslin, N-K. Tran. 2012. Rare disasters and risk sharing with heterogeneous beliefs. *Review of Financial Studies* 25(7): 2189–2224.

Cook, J., D. Nuccitelli, S. Green, M. Richardson, B. Winkler, R. Painting, R. Way, P. Jacobs, A. Skuce. 2013. Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters* 8.

Croci, E., D. Petmezas. 2015. Do risk-taking incentives induce CEOs to invest? Evidence from acquisitions. *Journal of Corporate Finance* 32(June): 1–23.

Deutsch, C., J. Tewksbury, R. Huey, K. Sheldon, C. Ghalambor, D. Haak, P. Martin. 2008. Impacts of climate warming on terrestrial ectotherms across latitude. *Proceedings of the National Academy of Sciences* 105(18): 6668–6672.

Djankov, S., R. La Porta, F. Lopez-de-Silanes, A. Shleifer. 2008. The law and economics of self-dealing. *Journal of Financial Economics* 88(3): 430–465.

Dyck, A., L. Zingales. 2004. Private benefits of control: An international comparison. *Journal of Finance* 59(2): 537–600.

Ellul, A., M. Pagano. 2006. IPO underpricing and after-market liquidity. *Review of Financial Studies* 19(2): 381–421.

Frank, K. 2000. Impact of a confounding variable on a regression coefficient. *Sociological Methods & Research* 29(2): 147–194.

Fu, R., A. Kraft, H. Zhang. 2012. Financial reporting frequency, information asymmetry, and the cost of equity. *Journal of Accounting and Economics* 54(2-3): 132–149.

Garson, G. 2013. Fundamentals of hierarchical linear and multilevel modeling. In: Garson, G.D. (Ed.), Hierarchical Linear Modeling: Guide and Applications. SAGE, London.

Ghosh, C., M. Petrova, Z. Feng, M. Pattanapanchai. 2012. Does IPO pricing reflect public information? New insights from equity carve-outs. *Financial Management* 41(1): 1–33.

Giglio, S., M. Maggiori, K. Rao, J. Stroebel, A. Weber. 2021. Climate change and long-run discount rates: Evidence from real estate. *Review of Financial Studies* 34(8): 3527–3571.

Hofstede, G., G. Hofstede, M. Minkov. 2010. Cultures and organizations: Software of the mind. 3rd Edition. USA: McGraw-Hill.

Hong, H., F. Li, J. Xu. 2019. Climate risks and market efficiency. *Journal of Econometrics* 208(1): 265–281.

Hotz, R. 2021. Climate change data deluge has scientists scrambling for solutions. *The Wall Street Journal*. December 5, 2021. Available online at: https://www.wsj.com/articles/climate-change-data-deluge-has-scientists-scrambling-for-solutions-11638720016.

Huey, R., C. Deutsch, J. Tewksbury, L. Vitt, P. Hertz, H. Pérez, T. Garland. 2009. Why tropical forest lizards are vulnerable to climate warming. *Proceedings of the Royal Society B: Biological Sciences* 276(1664): 1939–1948.

Huynh, T., T. Nguyen, C. Truong. 2020. Climate risk: The price of drought. *Journal of Corporate Finance* 65.

Huynh, T., Y. Xia. 2021. Climate change news risk and corporate bond returns. *Journal of Financial and Quantitative Analysis* 56(6): 1985–2009.

Ibbotson, R., J. Jaffe. 1975. ‘‘Hot issue’’ markets. *Journal of Finance* 30(4): 1027–1042.

Ilhan, E., Z. Sautner, G. Vilkov. 2021. Carbon tail risk. *Review of Financial Studies* 34(3): 1540–1571.

Javadi, S., A. Masum. 2021. The impact of climate change on the cost of bank loans. *Journal of Corporate Finance* 69.

Karampatsas, N., D. Petmezas, N. Travlos. 2014. Credit ratings and the choice of payment method in mergers and acquisitions. *Journal of Corporate Finance* 25(April): 474–493.

Krueger, P., Z. Sautner, L. Starks. 2020. The importance of climate risks for institutional investors. *Review of Financial Studies* 33(3): 1067–1111.

Larcker, D., T. Rusticus. 2010. On the use of instrumental variables in accounting research. *Journal of Accounting and Economics* 49(3): 186–205.

Leuz, C., D. Nanda, P. Wysocki. 2003. Earnings management and investor protection: an international comparison. *Journal of Financial Economics* 69(3): 505–527.

Liu, X., J. Ritter. 2011. Local underwriter oligopolies and IPO underpricing. *Journal of Financial Economics* 102(3): 579–601.

Ljungqvist, A., 2007. IPO underpricing. Handbook of Empirical Corporate Finance. Vol. 1. Edited by Espen Eckbo. 375–422.

Ljungqvist, A., W. Wilhelm. 2003. IPO pricing in the dot-com bubble. *Journal of Finance* 58(2): 723–752.

Logue, D., 1973. On the pricing of unseasoned equity issues: 1965-1969. *Journal of Financial and Quantitative Analysis* 8(1): 91–103.

Loughran, T., J. Ritter. 2004. Why has IPO underpricing changed over time? *Financial Management* 33(3): 5–37.

Marcato, G., S. Milcheva, C. Zheng. 2018. Market integration, country institutions and IPO underpricing. *Journal of Corporate Finance* 53: 87–105.

Megginson, W., K. Weiss. 1991. Venture capitalist certification in initial public offerings. *Journal of Finance* 46(3): 879–903.

Moss, R., J. Edmonds, K. Hibbard, M. Manning, S. Rose, D. van Vuuren, T. Carter, S. Emori, M. Kainuma, T. Kram, G. Meehl, J. Mitchell, N. Nakicenovic, K. Riahi, S. Smith, R. Stouffer, A. Thomson, J. Weyant, T. Wilbanks. 2010. The next generation of scenarios for climate change research and assessment. *Nature* 463(7282): 747–756.

Nimalendran, M., J. Ritter, D. Zhang. 2007. Do today's trades affect tomorrow's IPO allocations? *Journal of Financial Economics* 84(1): 87–109.

Painter, M., 2020. An inconvenient cost: The effects of climate change on municipal bonds. *Journal of Financial Economics* 135(2): 468–482.

Ritter, J., 1984. The hot issue market of 1980. *Journal of Business* 57(2): 215–240.

Ritter, J., 1987. The costs of going public. *Journal of Financial Economics* 19(2): 269–281.

Ritter, J., 2021. Initial public offerings: international insights - updated. https://site.warrington.ufl.edu/ritter/files/International.pdf.

Rock, K., 1986. Why new issues are underpriced. *Journal of Financial Economics* 15(1-2): 187–212.

Sherman, A., 2000. IPOs and long-term relationships: An advantage of book building. *Review of Financial Studies* 13(3): 697–714.

Welch, I., 1989. Seasoned offerings, imitation costs, and the underpricing of initial public offerings. *Journal of Finance* 44(2): 421–449.

Appendix – Variable definitions and data sources

Dependent variable	
Underpricing	The first-day secondary market closing price (Source: Datastream) divided by the IPO offer price (Source: SDC), minus one.
Climate measures	
Vulnerability index	Propensity or pre-disposition of a country to be negatively affected by climate hazards in the following sectors: health, food, ecosystems, habitat, water, and infrastructure (Source: ND-GAIN).
Vulnerability adjusted	GDP-adjusted vulnerability index (Source: ND-GAIN).
Health	Health vulnerability indicator that considers the following components: projected change of deaths from climate induced diseases, projected change of length of transmission season of vector-borne diseases, slum population, dependency on external resources for health services, medical staffs, and access to improved sanitation facilities (Source: ND-GAIN).
Food	Food vulnerability indicator that considers the following components: projected change of cereal yields, projected population change, food import dependency, rural population, agriculture capacity, and child malnutrition (Source: ND-GAIN).
Ecosystems	Ecosystem services vulnerability indicator that considers the following components: projected change of biome distribution, projected change of marine biodiversity, dependency on natural capital, ecological footprint, protected biomes, and engagement in international environmental conventions (Source: ND-GAIN).
Habitat	Human habitat vulnerability indicator that considers the following components: projected change of warm period, projected change of flood hazard, urban concentration, age dependency ratio, quality of trade and transport-related infrastructure, and paved roads (Source: ND-GAIN).
Water	Water vulnerability indicator that considers the following components: projected change of annual runoff, projected change of annual groundwater recharge, fresh water withdrawal rate, water dependency ratio, access to reliable drinking water, and dam capacity (Source: ND-GAIN).
Infrastructure	Infrastructure vulnerability indicator that considers the following components: projected change of hydropower generation capacity, projection of sea level rise impacts, dependency on imported energy, population living under 5m above sea level, electricity access, and disaster preparedness (Source: ND-GAIN).
Adaptive capacity	"The ability of society and its supporting sectors to adjust to reduce potential damage and to respond to the negative consequences of climate events (Chen et al., 2015, p. 4)" (Source: ND-GAIN).
Sensitivity	"The degree to which people and the sectors they depend upon are affected by climate related perturbations (Chen et al., 2015, p. 3)" (Source: ND-GAIN).
Exposure	"The extent to which human society and its supporting sectors are stressed by the future changing climate conditions (Chen et al., 2015, p. 3)" (Source: ND-GAIN).
Control variables	
Anti-self-dealing	Index of minority shareholder protection against expropriation by corporate insiders (Source: Djankov et al., 2008).
Economic integration	Composite index measuring a country's level of economic globalization (Source: KOF Swiss Economic Institute).
Price stabilization	Difference in the number of IPOs with small positive initial returns ([0, +1%]) and the number of IPOs with small negative initial returns ((0, -1%]), divided by the total number of IPOs in each country (Sources: SDC and Datastream).
IPO activity	Total number of IPOs divided by the number of publicly listed firms for each country-year combination (Source: World Bank).
Market return	Return on the Datastream index for the country of listing over the three months prior to the IPO (Source: Datastream).
Liquidity	Total value of shares traded divided by aggregate market capitalization for each country-year combination (Source: World Bank).
Offer size	Inflation-adjusted offer value in millions of U.S. dollars. The log transformation of this measure is used in the multivariate analysis to alleviate skewness (Source: SDC).

Top-tier underwriter	Indicator variable set equal to one for IPOs with an underwriter that appears in the top 25 of SDC's global league tables for the issue year (Source: SDC).
VC backed	Indicator variable set equal to one for VC-backed IPOs (Source: SDC).
Lockup length	Days between the IPO issue date and the first lockup expiration date. The log transformation of this measure is used in the multivariate analysis to alleviate skewness (Source: SDC).
Bookbuilt	Indicator variable set equal to one for bookbuilt deals (Source: SDC).
Firm commitment	Indicator variable set equal to one for firm commitment deals (Source: SDC).
Equity carve-out	Indicator variable set equal to one for equity carve-out deals (Source: SDC).
High-tech firm	Indicator variable set equal to one for firms in one of the high-tech industries identified by Ljungqvist and Wilhelm (2003) (Source: SDC).
Instruments	
Geography	First principal component of the distance of a country's capital city from the equator in kilometers (degrees latitude × 111km) and the length of a country's coastline in kilometers (Source: The World Factbook).
Interaction variables	
Small firm	Indicator variable set equal to one for IPOs with a cpi-adjusted offer size below the sample median (Source: SDC).
Low science trust	Indicator variable set equal to one for IPOs issued in a country with a Trust in Science Index that is in the bottom quartile of sample countries (Source: Wellcome Global Monitor).
Short term	Indicator variable set equal to one for IPOs issued in a country with a long-term orientation score that is in the bottom quartile of sample countries (Source: Hofstede, 2010).
Transparent	Indicator variable set equal to one for IPOs issued in a country with an aggregate earnings management score that is in the bottom quartile of sample countries (Source: Leuz et al., 2003).
Robustness	
Environmental RM	Rating of a country's management of environmental risk factors (Source: MSCI).

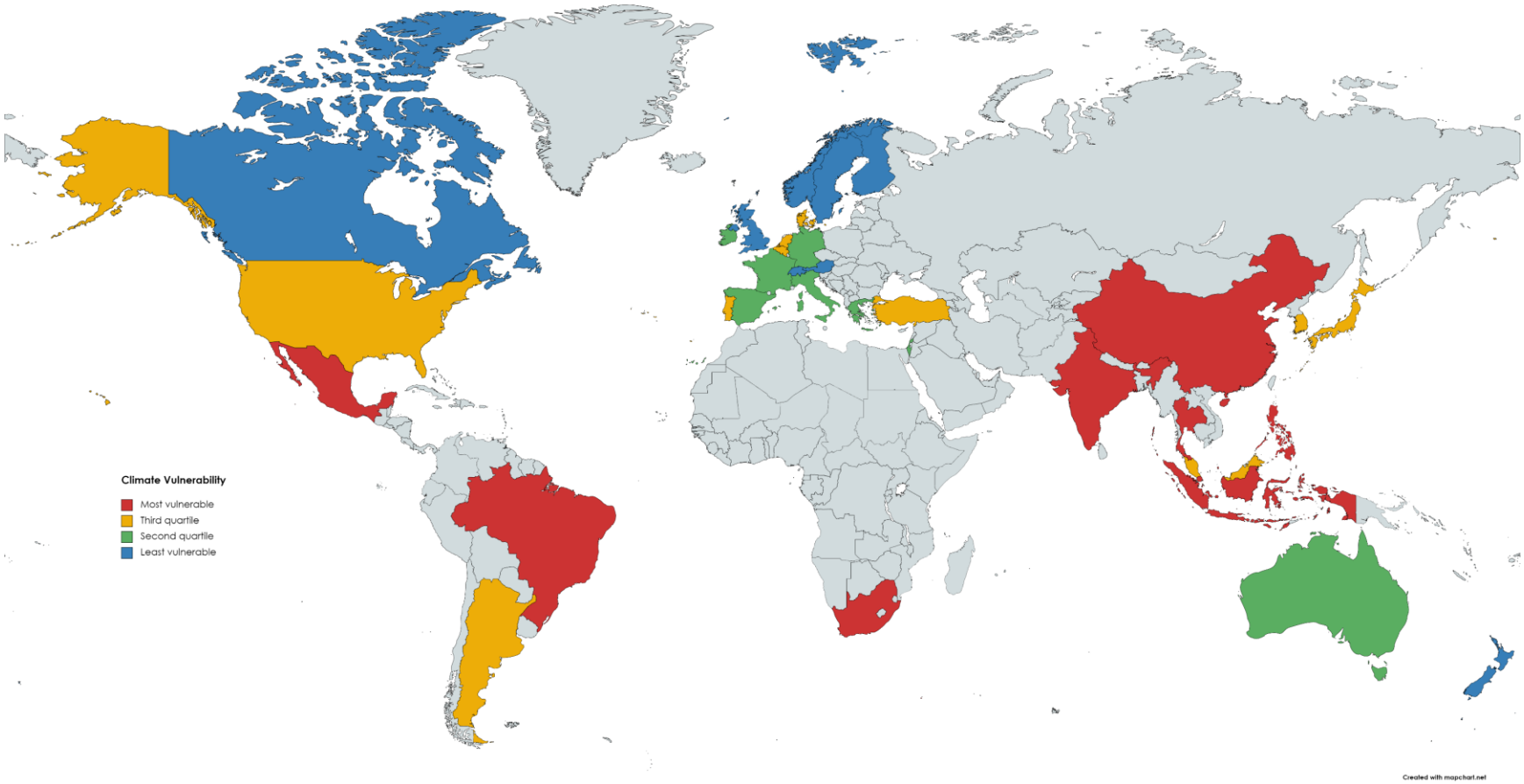

Figure 1 – Sample countries by climate vulnerability quartile
This figure groups sample countries into quartiles based on the ND-GAIN Vulnerability Index.

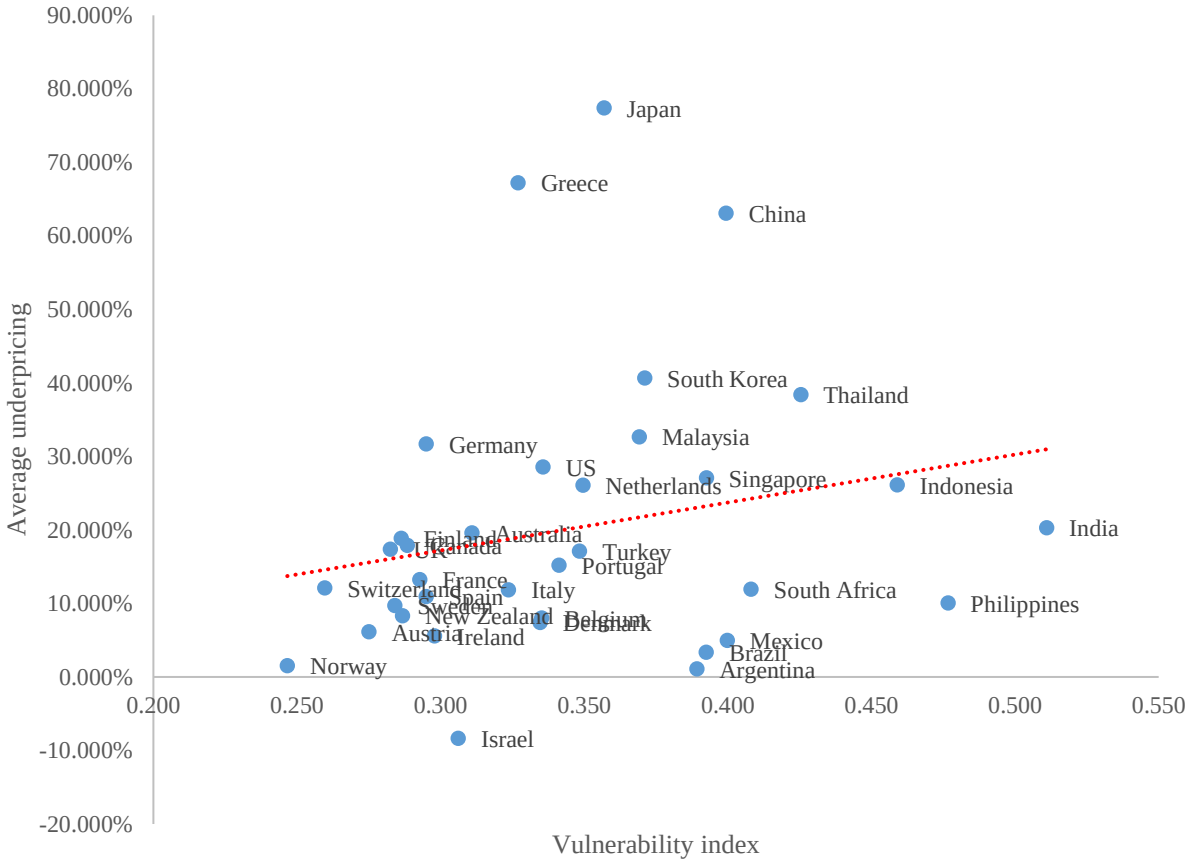

Figure 2 – Climate vulnerability and underpricing

Table 1 – Country summary statistics

Country	N	Average vulnerability index	Average initial return
Argentina	1	0.389	1.081%
Australia	1,178	0.311	19.584%
Austria	23	0.275	6.143%
Belgium	60	0.335	8.023%
Brazil	54	0.393	3.382%
Canada	220	0.288	17.919%
China	2,357	0.399	63.081%
Denmark	44	0.335	7.423%
Finland	61	0.286	18.859%
France	616	0.293	13.266%
Germany	407	0.295	31.684%
Greece	114	0.327	67.233%
India	495	0.511	20.317%
Indonesia	166	0.459	26.137%
Ireland	6	0.298	5.603%
Israel	1	0.306	-8.349%
Italy	203	0.324	11.869%
Japan	619	0.357	77.420%
Malaysia	415	0.369	32.678%
Mexico	6	0.400	4.966%
Netherlands	50	0.350	26.095%
New Zealand	53	0.287	8.335%
Norway	116	0.247	1.536%
Philippines	49	0.477	10.064%
Portugal	8	0.341	15.204%
Singapore	424	0.393	27.077%
South Africa	13	0.408	11.948%
South Korea	957	0.371	40.678%
Spain	65	0.295	10.953%
Sweden	161	0.284	9.698%
Switzerland	60	0.260	12.124%
Thailand	305	0.425	38.387%
Turkey	78	0.348	17.128%
UK	1,077	0.283	17.373%
US	2,412	0.336	28.583%

This table reports country-level descriptive statistics for the sample of 12,874 IPOs issued from 1998-2018. N reports the number of IPO observations. Initial return is the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price.

Table 2 – IPO event-level descriptive statistics

	N	Average	SD	Minimum	Maximum
Initial return	12,874	0.343	0.568	-0.321	4.417
Vulnerability index	12,874	0.352	0.056	0.241	0.536
Anti-self-dealing	12,874	0.658	0.197	0.172	1.000
Economic integration	12,874	64.154	13.124	23.603	95.431
Price stabilization	12,874	0.014	0.023	-0.058	0.091
IPO activity	12,874	0.054	0.043	0.000	0.198
Market return	12,874	0.029	0.101	-0.488	1.132
Liquidity	12,874	1.218	0.773	0.044	6.944
Offer size	12,874	129.871	540.845	0.001	27,809.560
Underwriter market share	12,874	0.010	0.023	0.000	0.160
VC backed	12,874	0.246	0.431	0.000	1.000
Lockup length (days)	12,874	114.692	164.125	0.000	2,555.000
Bookbuilt	12,874	0.643	0.479	0.000	1.000
Firm commitment	12,874	0.646	0.478	0.000	1.000
Equity carve-out	12,874	0.092	0.289	0.000	1.000
High tech firm	12,874	0.210	0.407	0.000	1.000

This table reports IPO-level descriptive statistics for the sample of 12,874 IPOs issued from 1998-2018. All variables are defined in the Appendix.

Table 3 – EPU index and underpricing

	Vulnerability index	*Vulnerability adjusted*	*Health*	*Food*	*Ecosystems*	*Habitat*	*Water*	*Infrastructure*	*Adaptive Capacity*	*Sensitivity*	*Exposure*
Vulnerability measure	2.6054***	2.6431***	0.5074***	2.4949***	2.1654***	-0.0595	0.4774	0.4929	0.8461***	3.1699***	1.3844*
	(5.02)	(6.69)	(3.63)	(6.34)	(4.63)	(-0.17)	(1.29)	(1.50)	(4.07)	(5.43)	(1.84)
Anti-self-dealing	-0.0680	-0.0598	-0.0112	-0.0881	-0.1579	0.0285	0.0088	0.0221	-0.0126	0.0392	-0.0710
	(-0.39)	(-0.36)	(-0.07)	(-0.37)	(-1.00)	(0.17)	(0.05)	(0.13)	(-0.07)	(0.21)	(-0.41)
Economic integration	0.0011	-0.0012	0.0002	0.0042**	0.0032*	-0.0007	-0.0007	-0.0014	0.0005	-0.0012	0.0005
	(0.62)	(-0.73)	(0.11)	(2.17)	(1.68)	(-0.41)	(-0.39)	(-0.79)	(0.29)	(-0.67)	(0.26)
Price stabilization	-0.2883	0.3010	-0.1110	-0.8720	-0.0990	0.3310	0.1553	0.3902	-0.3040	-1.1591	0.9122
	(-0.23)	(0.25)	(-0.09)	(-0.51)	(-0.09)	(0.27)	(0.13)	(0.32)	(-0.24)	(-0.85)	(0.74)
IPO activity	-0.6231***	-0.4494**	-0.6574***	-0.5697***	-0.5316***	-0.5930***	-0.6014***	-0.5640***	-0.6375***	-0.5261***	-0.5967***
	(-3.59)	(-2.57)	(-3.77)	(-3.27)	(-3.06)	(-3.41)	(-3.46)	(-3.23)	(-3.66)	(-3.02)	(-3.44)
Market return	0.7461***	0.7367***	0.7467***	0.7451***	0.7494***	0.7481***	0.7471***	0.7493***	0.7471***	0.7424***	0.7484***
	(15.90)	(15.70)	(15.90)	(15.89)	(15.96)	(15.92)	(15.90)	(15.93)	(15.91)	(15.82)	(15.93)
Liquidity	-0.0868***	-0.0760***	-0.0870***	-0.0785***	-0.0857***	-0.0921***	-0.0910***	-0.0962***	-0.0870***	-0.0924***	-0.0910***
	(-8.81)	(-7.54)	(-8.80)	(-7.80)	(-8.68)	(-9.30)	(-9.24)	(-9.60)	(-8.81)	(-9.43)	(-9.27)
Offer size (log)	-0.0484***	-0.0503***	-0.0485***	-0.0475***	-0.0460***	-0.0474***	-0.0475***	-0.0479***	-0.0486***	-0.0480***	-0.0469***
	(-11.17)	(-11.57)	(-11.19)	(-10.97)	(-10.60)	(-10.95)	(-10.97)	(-11.03)	(-11.19)	(-11.08)	(-10.81)
Underwriter rank	0.0136***	0.0139***	0.0138***	0.0131***	0.0135***	0.0140***	0.0140***	0.0140***	0.0138***	0.0136***	0.0138***
	(5.86)	(5.99)	(5.93)	(5.63)	(5.82)	(6.02)	(6.02)	(6.01)	(5.93)	(5.86)	(5.96)
VC backed	0.0270**	0.0309**	0.0276**	0.0287**	0.0242*	0.0246*	0.0250**	0.0240*	0.0276**	0.0229*	0.0243*
	(2.13)	(2.43)	(2.17)	(2.26)	(1.91)	(1.94)	(1.97)	(1.89)	(2.17)	(1.81)	(1.92)
Lockup length	-0.0293***	-0.0290***	-0.0291***	-0.0287***	-0.0294***	-0.0289***	-0.0288***	-0.0292***	-0.0290***	-0.0297***	-0.0291***
	(-12.14)	(-12.00)	(-12.03)	(-11.87)	(-12.14)	(-11.94)	(-11.90)	(-12.02)	(-12.01)	(-12.26)	(-12.01)
Bookbuilt	-0.1244***	-0.1227***	-0.1272***	-0.1241***	-0.1396***	-0.1371***	-0.1367***	-0.1352***	-0.1269***	-0.1238***	-0.1386***
	(-8.91)	(-8.85)	(-9.10)	(-8.88)	(-10.17)	(-9.95)	(-9.96)	(-9.80)	(-9.09)	(-8.86)	(-10.07)
Firm commitment	-0.0308**	-0.0279**	-0.0266*	-0.0280**	-0.0253*	-0.0221	-0.0226	-0.0223	-0.0299**	-0.0212	-0.0250*
	(-2.16)	(-1.97)	(-1.88)	(-1.97)	(-1.78)	(-1.54)	(-1.60)	(-1.57)	(-2.10)	(-1.50)	(-1.75)
Equity carve-out	0.0208	0.0222	0.0194	0.0220	0.0187	0.0169	0.0173	0.0173	0.0202	0.0184	0.0173
	(1.24)	(1.33)	(1.16)	(1.32)	(1.12)	(1.02)	(1.04)	(1.04)	(1.21)	(1.10)	(1.04)
High tech firm	0.1160***	0.1166***	0.1155***	0.1195***	0.1165***	0.1153***	0.1148***	0.1144***	0.1153***	0.1187***	0.1152***
	(3.17)	(3.19)	(3.16)	(3.27)	(3.18)	(3.15)	(3.14)	(3.11)	(3.15)	(3.25)	(3.15)
Constant	-0.4286*	0.8333***	0.3725**	-0.5010**	-0.4404*	0.5884***	0.4127**	0.4500**	0.2213	-0.3378	-0.0741
	(-1.71)	(5.22)	(2.28)	(-2.06)	(-1.65)	(2.79)	(2.11)	(2.55)	(1.25)	(-1.47)	(-0.19)
Observations	12,874	12,874	12,874	12,874	12,874	12,874	12,874	12,851	12,874	12,874	12,874
Number of groups	35	35	35	35	35	35	35	34	35	35	35

This table reports the results of HLM that examine the relation between measures of climate change vulnerability and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. All other variables are defined in

the Appendix. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers between parentheses below each coefficient are the *z*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 4 – Instrumental variable analysis

Panel A – First-stage regressions

	Vulnerability index	*Vulnerability adjusted*	*Health*	*Food*	*Ecosystems*	*Habitat*	*Water*	*Infrastructure*	*Adaptive Capacity*	*Sensitivity*	*Exposure*
Geography	-0.0264***	-0.0207***	-0.0387***	-0.0194***	-0.0200***	-0.0008**	-0.0434***	-0.0376***	-0.0364***	-0.0310***	-0.0155***
	(-121.95)	(-73.31)	(-68.60)	(-32.78)	(-51.77)	(-2.38)	(-80.76)	(-67.82)	(-76.06)	(-93.02)	(-47.12)
Anti-self-dealing	0.0222***	-0.0012	0.0982***	0.0650***	-0.0220***	-0.0293***	0.0513***	-0.0354***	0.0578***	-0.0052***	0.0178***
	(19.59)	(-0.82)	(33.23)	(20.97)	(-10.89)	(-15.73)	(18.26)	(-12.32)	(23.04)	(-3.00)	(10.31)
Economic integration	-0.0039***	-0.0005***	-0.0081***	-0.0055***	-0.0060***	-0.0004***	-0.0032***	-0.0001**	-0.0081***	-0.0016***	-0.0022***
	(-184.22)	(-17.35)	(-146.87)	(-95.49)	(-158.51)	(-12.37)	(-61.09)	(-2.55)	(-173.11)	(-47.71)	(-67.78)
Price stabilization	0.2318***	0.4494***	0.9340***	0.9335***	-0.4301***	-0.4664***	0.4486***	-0.0216	0.3789***	0.2426***	0.0999***
	(22.04)	(32.70)	(34.03)	(32.43)	(-22.89)	(-26.97)	(17.19)	(-0.81)	(16.27)	(14.98)	(6.24)
IPO activity	-0.0139**	-0.1880***	0.2696***	-0.0890***	-0.2902***	-0.3150***	0.3131***	0.0263*	0.1473***	0.1299***	-0.2965***
	(-2.26)	(-23.46)	(16.84)	(-5.30)	(-26.48)	(-31.24)	(20.57)	(1.70)	(10.85)	(13.77)	(-31.77)
Market return	0.0059***	0.0004	0.0299***	0.0148**	-0.0130***	-0.0117***	0.0182***	-0.0034	0.0195***	0.0101***	-0.0091***
	(2.70)	(0.14)	(5.28)	(2.49)	(-3.37)	(-3.28)	(3.39)	(-0.62)	(4.05)	(3.02)	(-2.77)
Liquidity	-0.0133***	-0.0050***	-0.0356***	-0.0380***	0.0141***	-0.0160***	-0.0077***	0.0036***	-0.0301***	-0.0018***	-0.0094***
	(-36.28)	(-10.41)	(-37.32)	(-37.92)	(21.57)	(-26.53)	(-8.46)	(3.92)	(-37.23)	(-3.17)	(-16.97)
Offer size (log)	-0.0018***	-0.0015***	0.0053***	0.0015***	-0.0045***	-0.0029***	-0.0058***	-0.0042***	0.0035***	-0.0023***	-0.0065***
	(-9.79)	(-6.14)	(10.86)	(2.94)	(-13.55)	(-9.58)	(-12.58)	(-8.85)	(8.52)	(-8.20)	(-23.01)
Underwriter rank	-0.0002**	0.0017***	-0.0030***	-0.0032***	0.0024***	0.0007***	0.0000	0.0017***	-0.0032***	0.0010***	0.0015***
	(-2.22)	(12.85)	(-11.03)	(-11.18)	(12.79)	(4.30)	(0.05)	(6.36)	(-13.86)	(6.27)	(9.59)
VC backed	-0.0030***	0.0092***	-0.0299***	-0.0053***	0.0000	0.0137***	-0.0110***	0.0142***	-0.0265***	0.0041***	0.0132***
	(-5.51)	(12.74)	(-20.73)	(-3.51)	(0.05)	(15.15)	(-8.04)	(10.20)	(-21.67)	(4.83)	(15.67)
Lockup length	0.0014***	0.0019***	0.0027***	0.0001	0.0026***	-0.0001	0.0012***	0.0018***	0.0011***	0.0016***	0.0014***
	(12.68)	(13.53)	(9.62)	(0.39)	(13.29)	(-0.28)	(4.33)	(6.60)	(4.76)	(9.72)	(8.30)
Bookbuilt	0.0029***	-0.0035***	-0.0103***	-0.0073***	-0.0081***	-0.0101***	0.0252***	0.0284***	-0.0094***	0.0183***	0.0004
	(4.97)	(-4.62)	(-6.82)	(-4.64)	(-7.84)	(-10.64)	(17.64)	(19.50)	(-7.39)	(20.68)	(0.45)
Firm commitment	0.0109***	0.0247***	0.0025	0.0178***	0.0321***	0.0288***	-0.0101***	-0.0069***	0.0073***	-0.0046***	0.0300***
	(18.33)	(31.74)	(1.60)	(10.90)	(30.11)	(29.35)	(-6.84)	(-4.59)	(5.52)	(-5.05)	(33.07)
Equity carve-out	-0.0011	-0.0038***	-0.0053***	0.0057***	-0.0073***	0.0045***	-0.0031	-0.0013	-0.0021	-0.0013	0.0003
	(-1.38)	(-3.81)	(-2.66)	(2.71)	(-5.33)	(3.53)	(-1.62)	(-0.65)	(-1.22)	(-1.14)	(0.27)
High tech firm	0.0006	0.0004	-0.0072	-0.0181***	0.0116***	-0.0033	0.0077*	0.0124***	-0.0080**	0.0060**	0.0020
	(0.36)	(0.18)	(-1.63)	(-3.90)	(3.82)	(-1.18)	(1.82)	(2.89)	(-2.13)	(2.30)	(0.76)
Constant	0.5911***	-0.0389***	0.7521***	0.6799***	0.7977***	0.5162***	0.4853***	0.3196***	0.8189***	0.3650***	0.5981***
	(233.98)	(-11.78)	(114.09)	(98.34)	(176.72)	(124.27)	(77.40)	(50.02)	(146.41)	(93.85)	(155.56)
Observations	12,874	12,874	12,874	12,874	12,874	12,874	12,874	12,851	12,874	12,874	12,874
R-squared	0.832	0.597	0.767	0.571	0.808	0.347	0.528	0.403	0.804	0.564	0.519

Panel B – Second-stage regressions

	Vulnerability index	*Vulnerability adjusted*	*Health*	*Food*	*Ecosystems*	*Habitat*	*Water*	*Infrastructure*	*Adaptive Capacity*	*Sensitivity*	*Exposure*
Vulnerability measure	0.6298***	0.8017***	0.4290***	0.8560***	0.8303***	19.6589*	0.3832***	0.4454***	0.4561***	0.5364***	1.0709***
	(3.43)	(3.43)	(3.42)	(3.37)	(3.44)	(1.90)	(3.44)	(3.42)	(3.42)	(3.45)	(3.41)
Anti-self-dealing	0.1621***	0.1770***	0.1339***	0.1204***	0.1944***	0.7518**	0.1564***	0.1913***	0.1497***	0.1789***	0.1570***
	(6.24)	(6.99)	(4.61)	(3.81)	(7.63)	(2.47)	(5.94)	(7.53)	(5.52)	(7.10)	(5.93)
Economic integration	-0.0114***	-0.0134***	-0.0103***	-0.0091***	-0.0088***	-0.0053	-0.0126***	-0.0138***	-0.0101***	-0.0130***	-0.0115***
	(-16.99)	(-30.66)	(-11.20)	(-7.10)	(-6.70)	(-1.28)	(-27.67)	(-29.56)	(-10.32)	(-30.30)	(-17.76)
Price stabilization	-1.8364***	-2.0506***	-2.0911***	-2.4894***	-1.3333***	7.4776	-1.8623***	-1.6772***	-1.8632***	-1.8205***	-1.7973***
	(-7.56)	(-7.72)	(-7.66)	(-7.08)	(-5.37)	(1.55)	(-7.62)	(-7.16)	(-7.58)	(-7.57)	(-7.44)
IPO activity	0.8684***	1.0104***	0.7440***	0.9358***	1.1006***	7.0527**	0.7397***	0.8494***	0.7925***	0.7900***	1.1772***
	(6.34)	(7.38)	(5.05)	(6.79)	(7.69)	(2.18)	(5.04)	(6.18)	(5.57)	(5.59)	(7.68)
Market return	0.7093***	0.7127***	0.7002***	0.7004***	0.7238***	0.9429***	0.7060***	0.7150***	0.7041***	0.7076***	0.7228***
	(14.59)	(14.69)	(14.28)	(14.08)	(14.96)	(6.42)	(14.53)	(14.80)	(14.40)	(14.62)	(14.81)
Liquidity	-0.0051	-0.0094	0.0019	0.0191	-0.0251***	0.3002*	-0.0105	-0.0150*	0.0003	-0.0125	-0.0033
	(-0.57)	(-1.12)	(0.19)	(1.40)	(-3.00)	(1.78)	(-1.26)	(-1.84)	(0.04)	(-1.52)	(-0.36)
Offer size (log)	-0.0457***	-0.0456***	-0.0491***	-0.0481***	-0.0431***	0.0108	-0.0446***	-0.0450***	-0.0484***	-0.0456***	-0.0399***
	(-10.88)	(-10.88)	(-11.70)	(-11.35)	(-9.90)	(0.34)	(-10.51)	(-10.68)	(-11.59)	(-10.90)	(-8.36)
Underwriter rank	0.0261***	0.0246***	0.0272***	0.0287***	0.0240***	0.0116	0.0259***	0.0252***	0.0274***	0.0254***	0.0243***
	(11.29)	(10.48)	(11.58)	(11.51)	(10.11)	(1.35)	(11.25)	(10.90)	(11.61)	(11.03)	(10.27)
VC backed	0.0918***	0.0825***	0.1027***	0.0944***	0.0898***	-0.1804	0.0941***	0.0837***	0.1019***	0.0877***	0.0758***
	(7.39)	(6.68)	(7.74)	(7.39)	(7.29)	(-1.27)	(7.53)	(6.81)	(7.73)	(7.15)	(5.94)
Lockup length	-0.0261***	-0.0267***	-0.0264***	-0.0253***	-0.0273***	-0.0242***	-0.0257***	-0.0261***	-0.0257***	-0.0261***	-0.0267***
	(-10.76)	(-10.92)	(-10.80)	(-10.31)	(-11.02)	(-5.52)	(-10.66)	(-10.81)	(-10.62)	(-10.82)	(-10.84)
Bookbuilt	-0.0743***	-0.0697***	-0.0681***	-0.0663***	-0.0658***	0.1256	-0.0822***	-0.0851***	-0.0682***	-0.0824***	-0.0729***
	(-5.80)	(-5.34)	(-5.15)	(-4.88)	(-4.93)	(1.13)	(-6.49)	(-6.70)	(-5.16)	(-6.52)	(-5.64)
Firm commitment	0.0236*	0.0107	0.0295**	0.0153	0.0039	-0.5352*	0.0344***	0.0337**	0.0272**	0.0330**	-0.0016
	(1.70)	(0.68)	(2.19)	(1.01)	(0.23)	(-1.76)	(2.62)	(2.56)	(1.99)	(2.51)	(-0.09)
Equity carve-out	-0.0016	0.0008	0.0000	-0.0072	0.0038	-0.0901	-0.0011	-0.0017	-0.0013	-0.0016	-0.0026
	(-0.09)	(0.05)	(0.00)	(-0.41)	(0.22)	(-1.61)	(-0.06)	(-0.10)	(-0.08)	(-0.09)	(-0.15)
High tech firm	0.1211***	0.1212***	0.1246***	0.1370***	0.1119***	0.1860**	0.1186***	0.1155***	0.1252***	0.1183***	0.1194***
	(3.19)	(3.20)	(3.27)	(3.51)	(2.95)	(2.41)	(3.13)	(3.05)	(3.28)	(3.13)	(3.13)
Constant	0.8590***	1.2625***	0.9086***	0.6493***	0.5690***	-8.9169*	1.0454***	1.0901***	0.8578***	1.0356***	0.5908***
	(7.81)	(21.29)	(9.26)	(3.85)	(3.04)	(-1.67)	(15.29)	(17.70)	(7.75)	(14.81)	(3.23)
Durbin χ^2	2.43	0.08	37.81	53.83	0.20	12.96	3.51	26.74	45.83	65.38	24.82
Wu-Hausman *F*-stat	2.42	0.08	37.79	53.87	0.20	12.93	3.50	26.40	45.83	65.49	24.79
Anderson-Rubin *F*-stat	15.26	15.26	15.26	15.26	15.26	15.26	15.26	15.26	15.26	15.26	15.26
Cragg-Donald *F*-stat	14871.50	5374.49	4706.33	1074.70	2680.32	5.65	6522.55	4600.02	5785.21	8653.38	2220.62
Stock-Yogo (10%)	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38

Observations	12,874	12,874	12,874	12,874	12,874	12,874	12,874	12,851	12,874	12,874	12,874
R-squared	0.178	0.180	0.172	0.148	0.183		0.182	0.187	0.172	0.186	0.169

This table reports the results of two-stage least squares regressions that examine the relation between climate change vulnerability and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. The first principal component of the distance of a country's capital city from the equator (in kilometers) and the length of a country's coastline (in kilometers) is used to instrument for the climate vulnerability measures. All other variables are defined in the Appendix. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers in parentheses below each coefficient are heteroskedasticity-robust *t*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 5 – ITCV analysis

	Vulnerability index		*Vulnerability adjusted*	
	Raw	Partial	Raw	Partial
ITCV	0.0149		0.0390	
Anti-self-dealing	0.0023	0.0067	0.0017	0.0008
Economic integration	0.1595	0.1661	0.0166	-0.0264
Price stabilization	-0.0094	-0.0046	-0.0196	-0.0062
IPO activity	0.0089	0.0088	-0.0389	-0.0117
Market return	0.0087	0.0030	-0.0021	-0.0006
Stock market turnover	0.0069	0.0053	0.0007	0.0022
Offer size (log)	-0.0013	0.0099	-0.0015	0.0086
Underwriter rank	0.0014	-0.0009	0.0064	0.0097
VC backed	0.0009	-0.0068	0.0109	0.0026
Lockup length	-0.0245	-0.0100	-0.0313	-0.0201
Bookbuilt	0.0052	0.0062	-0.0010	0.0077
Firm commitment	0.0153	-0.0038	0.0165	-0.0055
Equity carve-out	0.0019	0.0001	-0.0031	-0.0003
High tech firm	-0.0096	-0.0004	-0.0037	-0.0005

This table reports Impact Threshold for Confounding Variable (ITCV) analysis for our sample. The first (last) two row reports the ITCV values for the vulnerability index (GDP-adjusted vulnerability index). These values indicate the minimum impact of a confounding variable that would be needed to render the coefficient statistically insignificant and is defined as the product of the correlation between the climate vulnerability measure and the confounding variable and the correlation between underpricing and the confounding variable. Beneath each ITCV value are impact measures based on partial and raw correlations that show the impact of each independent variable on the climate vulnerability measure.

Table 6 – Firm size

	Vulnerability index	*Vulnerability adjusted*	*Health*	*Food*	*Ecosystems*	*Habitat*	*Water*	*Infrastructure*	*Adaptive Capacity*	*Sensitivity*	Exposure
Vulnerability measure	1.8795***	2.1126***	0.3209**	2.4114***	1.8845***	-0.2234	0.0091	0.0007	0.5419**	2.4817***	1.1932
	(3.57)	(5.14)	(2.23)	(6.12)	(3.95)	(-0.63)	(0.02)	(0.00)	(2.55)	(4.14)	(1.55)
VM × Small firm	1.0758***	0.5699**	0.3977***	0.0568	0.8155***	0.2495	0.7333***	0.6488***	0.4807***	1.1013***	0.6717***
	(5.95)	(2.54)	(4.75)	(0.54)	(7.17)	(1.08)	(5.57)	(4.29)	(5.37)	(5.13)	(3.31)
Small firm	-0.2641***	0.1439***	0.0158	0.0948***	-0.2371***	0.0035	-0.1493***	-0.0917*	-0.0383	-0.2014***	-0.1932**
	(-4.08)	(8.72)	(0.65)	(2.62)	(-4.75)	(0.03)	(-3.06)	(-1.85)	(-1.23)	(-3.22)	(-2.08)
Anti-self-dealing	-0.0396	-0.0381	0.0078	-0.0699	-0.1180	0.0436	0.0183	0.0183	0.0167	0.0403	-0.0602
	(-0.23)	(-0.23)	(0.05)	(-0.30)	(-0.74)	(0.26)	(0.11)	(0.11)	(0.10)	(0.21)	(-0.35)
Economic integration	0.0012	-0.0007	0.0007	0.0048**	0.0036*	-0.0001	0.0000	-0.0004	0.0008	-0.0005	0.0010
	(0.71)	(-0.42)	(0.43)	(2.51)	(1.93)	(-0.04)	(0.01)	(-0.21)	(0.45)	(-0.29)	(0.54)
Price stabilization	-0.3340	0.2394	-0.1488	-0.8647	-0.2189	0.2635	0.0702	0.3188	-0.2632	-1.1103	0.8177
	(-0.26)	(0.20)	(-0.12)	(-0.51)	(-0.19)	(0.21)	(0.06)	(0.26)	(-0.21)	(-0.80)	(0.66)
IPO activity	-0.5665***	-0.3940**	-0.6071***	-0.5273***	-0.4527***	-0.5580***	-0.5314***	-0.5283***	-0.5685***	-0.4761***	-0.5722***
	(-3.26)	(-2.25)	(-3.47)	(-3.03)	(-2.60)	(-3.20)	(-3.05)	(-3.02)	(-3.26)	(-2.73)	(-3.29)
Market return	0.7348***	0.7274***	0.7344***	0.7351***	0.7332***	0.7370***	0.7389***	0.7424***	0.7349***	0.7365***	0.7367***
	(15.66)	(15.48)	(15.63)	(15.66)	(15.63)	(15.67)	(15.72)	(15.78)	(15.65)	(15.68)	(15.67)
Liquidity	-0.0867***	-0.0752***	-0.0875***	-0.0767***	-0.0831***	-0.0898***	-0.0888***	-0.0935***	-0.0871***	-0.0911***	-0.0891***
	(-8.80)	(-7.45)	(-8.82)	(-7.61)	(-8.42)	(-9.05)	(-9.02)	(-9.32)	(-8.81)	(-9.30)	(-9.07)
Underwriter rank	0.0077***	0.0090***	0.0084***	0.0084***	0.0067***	0.0093***	0.0080***	0.0086***	0.0081***	0.0076***	0.0089***
	(3.47)	(4.10)	(3.81)	(3.80)	(3.00)	(4.21)	(3.61)	(3.89)	(3.66)	(3.45)	(4.06)
VC backed	0.0380***	0.0415***	0.0400***	0.0395***	0.0333***	0.0349***	0.0353***	0.0336***	0.0391***	0.0334***	0.0344***
	(3.00)	(3.27)	(3.15)	(3.11)	(2.63)	(2.75)	(2.79)	(2.64)	(3.08)	(2.63)	(2.71)
Lockup length	-0.0310***	-0.0298***	-0.0308***	-0.0294***	-0.0311***	-0.0295***	-0.0298***	-0.0294***	-0.0307***	-0.0305***	-0.0301***
	(-12.81)	(-12.32)	(-12.67)	(-12.11)	(-12.84)	(-12.18)	(-12.32)	(-12.10)	(-12.66)	(-12.60)	(-12.42)
Bookbuilt	-0.1289***	-0.1346***	-0.1331***	-0.1354***	-0.1468***	-0.1471***	-0.1453***	-0.1462***	-0.1320***	-0.1336***	-0.1466***
	(-9.26)	(-9.76)	(-9.53)	(-9.70)	(-10.77)	(-10.66)	(-10.64)	(-10.67)	(-9.47)	(-9.62)	(-10.68)
Firm commitment	-0.0337**	-0.0287**	-0.0295**	-0.0288**	-0.0323**	-0.0217	-0.0270*	-0.0267*	-0.0310**	-0.0273*	-0.0267*
	(-2.36)	(-2.02)	(-2.07)	(-2.02)	(-2.27)	(-1.51)	(-1.91)	(-1.87)	(-2.17)	(-1.92)	(-1.88)
Equity carve-out	0.0002	0.0044	-0.0004	0.0056	-0.0010	0.0012	-0.0005	0.0011	-0.0001	0.0010	-0.0001
	(0.01)	(0.27)	(-0.02)	(0.34)	(-0.06)	(0.07)	(-0.03)	(0.07)	(-0.01)	(0.06)	(-0.01)
High tech firm	0.1127***	0.1159***	0.1139***	0.1200***	0.1110***	0.1159***	0.1136***	0.1153***	0.1122***	0.1181***	0.1148***
	(3.08)	(3.16)	(3.11)	(3.28)	(3.03)	(3.16)	(3.10)	(3.14)	(3.06)	(3.23)	(3.13)
Constant	-0.4104	0.5287***	0.1582	-0.7387***	-0.5676**	0.3983*	0.3205	0.3329*	0.0729	-0.3943*	-0.2361
	(-1.62)	(3.35)	(0.96)	(-3.06)	(-2.12)	(1.86)	(1.59)	(1.86)	(0.41)	(-1.69)	(-0.61)
Vulnerability + Interaction	2.9552***	2.6826***	0.7186***	2.4682***	2.7000***	0.0261	0.7424*	0.6495*	1.0226***	3.5830***	1.8650**
	(5.63)	(6.55)	(4.80)	(6.27)	(5.67)	(0.07)	(1.93)	(1.91)	(4.79)	(6.00)	(2.44)
Observations	12,874	12,874	12,874	12,874	12,874	12,874	12,874	12,851	12,874	12,874	12,874
Number of groups	35	35	35	35	35	35	35	34	35	35	35

This table reports the results of HLM regressions that examine the relation between climate vulnerability measures and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. Small firm is an indicator variable set equal to one for IPOs with a cpi-adjusted offer size that is below the sample median. All other variables are defined in the Appendix. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers between parentheses below each coefficient are the *z*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 7 – Trust in science

	Vulnerability index	*Vulnerability adjusted*	*Health*	*Food*	*Ecosystems*	*Habitat*	*Water*	*Infrastructure*	*Adaptive Capacity*	*Sensitivity*	*Exposure*
Vulnerability measure	3.0217***	2.6683***	0.5938***	6.4585***	3.2282***	-0.7778*	0.3696	0.6760*	1.1487***	2.6575***	0.9470
	(5.63)	(6.71)	(4.29)	(11.19)	(5.13)	(-1.91)	(0.96)	(1.79)	(5.52)	(4.34)	(1.14)
VM × Low science trust	-6.3415***	5.9626***	-1.8490***	-9.1505***	-3.5851***	2.3343***	0.5099	-0.9298	-3.0625***	1.7125	0.5065
	(-4.69)	(6.75)	(-5.38)	(-9.34)	(-3.21)	(2.85)	(0.42)	(-1.19)	(-6.97)	(1.14)	(0.21)
Low science trust	2.4774***	0.3182***	0.6990***	3.1503***	1.5886***	-0.9075**	0.0055	0.4922*	1.2648***	-0.3691	-0.0827
	(4.73)	(3.12)	(5.57)	(7.61)	(3.20)	(-2.24)	(0.01)	(1.79)	(6.90)	(-0.80)	(-0.07)
Anti-self-dealing	0.0255	-0.1202	0.0667	0.3727	-0.2340	0.0547	-0.0101	0.0133	0.1494	0.0092	-0.0481
	(0.16)	(-0.69)	(0.53)	(0.96)	(-1.37)	(0.31)	(-0.06)	(0.07)	(1.10)	(0.05)	(-0.27)
Economic integration	0.0004	-0.0058***	-0.0016	0.0061***	0.0049**	0.0013	0.0002	-0.0002	-0.0011	-0.0013	0.0009
	(0.24)	(-2.98)	(-0.96)	(3.03)	(2.49)	(0.70)	(0.13)	(-0.10)	(-0.69)	(-0.71)	(0.47)
Price stabilization	-0.0800	0.0567	0.3508	-2.4021	0.0294	0.1615	0.4791	0.4975	0.4370	-0.7142	1.0015
	(-0.07)	(0.04)	(0.37)	(-0.87)	(0.02)	(0.13)	(0.40)	(0.39)	(0.44)	(-0.55)	(0.82)
IPO activity	-0.6252***	-0.3369*	-0.6184***	-0.4559***	-0.5266***	-0.5786***	-0.6011***	-0.5708***	-0.6092***	-0.5169***	-0.5956***
	(-3.60)	(-1.92)	(-3.56)	(-2.62)	(-3.03)	(-3.33)	(-3.46)	(-3.27)	(-3.52)	(-2.96)	(-3.43)
Market return	0.7461***	0.7397***	0.7470***	0.7330***	0.7461***	0.7449***	0.7480***	0.7503***	0.7480***	0.7433***	0.7489***
	(15.91)	(15.79)	(15.92)	(15.69)	(15.89)	(15.85)	(15.92)	(15.96)	(15.95)	(15.84)	(15.94)
Liquidity	-0.0766***	-0.0651***	-0.0733***	-0.0583***	-0.0807***	-0.0894***	-0.0901***	-0.0952***	-0.0724***	-0.0923***	-0.0904***
	(-7.62)	(-6.39)	(-7.25)	(-5.70)	(-8.07)	(-8.97)	(-9.13)	(-9.46)	(-7.21)	(-9.39)	(-9.20)
Offer size (log)	-0.0473***	-0.0482***	-0.0468***	-0.0487***	-0.0454***	-0.0467***	-0.0472***	-0.0476***	-0.0469***	-0.0477***	-0.0468***
	(-10.92)	(-11.09)	(-10.77)	(-11.24)	(-10.45)	(-10.77)	(-10.88)	(-10.94)	(-10.81)	(-11.02)	(-10.77)
Underwriter rank	0.0134***	0.0127***	0.0132***	0.0129***	0.0133***	0.0134***	0.0139***	0.0138***	0.0134***	0.0136***	0.0138***
	(5.78)	(5.49)	(5.68)	(5.60)	(5.73)	(5.77)	(5.97)	(5.93)	(5.76)	(5.85)	(5.93)
VC backed	0.0278**	0.0303**	0.0285**	0.0291**	0.0238*	0.0229*	0.0247*	0.0237*	0.0287**	0.0229*	0.0242*
	(2.19)	(2.39)	(2.24)	(2.30)	(1.88)	(1.80)	(1.95)	(1.86)	(2.26)	(1.81)	(1.90)
Lockup length	-0.0291***	-0.0290***	-0.0292***	-0.0283***	-0.0293***	-0.0289***	-0.0288***	-0.0291***	-0.0291***	-0.0297***	-0.0290***
	(-12.06)	(-12.03)	(-12.09)	(-11.74)	(-12.12)	(-11.98)	(-11.91)	(-11.92)	(-12.07)	(-12.28)	(-12.00)
Bookbuilt	-0.1344***	-0.1330***	-0.1377***	-0.0953***	-0.1422***	-0.1350***	-0.1379***	-0.1376***	-0.1378***	-0.1249***	-0.1392***
	(-9.54)	(-9.54)	(-9.82)	(-6.63)	(-10.34)	(-9.71)	(-10.03)	(-9.95)	(-9.89)	(-8.93)	(-10.11)
Firm commitment	-0.0340**	-0.0263*	-0.0287**	-0.0355**	-0.0272*	-0.0209	-0.0244*	-0.0245*	-0.0336**	-0.0212	-0.0257*
	(-2.39)	(-1.85)	(-2.02)	(-2.49)	(-1.92)	(-1.46)	(-1.72)	(-1.73)	(-2.36)	(-1.49)	(-1.81)
Equity carve-out	0.0195	0.0262	0.0189	0.0245	0.0191	0.0179	0.0173	0.0170	0.0200	0.0188	0.0173
	(1.17)	(1.57)	(1.13)	(1.47)	(1.14)	(1.07)	(1.04)	(1.02)	(1.20)	(1.13)	(1.04)
High tech firm	0.1124***	0.1149***	0.1117***	0.1151***	0.1160***	0.1160***	0.1148***	0.1145***	0.1113***	0.1189***	0.1153***
	(3.07)	(3.15)	(3.05)	(3.16)	(3.17)	(3.17)	(3.13)	(3.12)	(3.04)	(3.25)	(3.15)
Constant	-0.5803**	1.1440***	0.3934***	-2.0273***	-0.9205***	0.6990***	0.3481*	0.2616	0.1305	-0.2040	0.0367
	(-2.35)	(6.26)	(2.64)	(-5.95)	(-2.93)	(3.13)	(1.73)	(1.31)	(0.79)	(-0.82)	(0.09)

Vulnerability + Interaction	-3.3198**	8.6308***	-1.2552***	-2.6920***	-0.3570	1.5565**	0.8794	-0,2538	-1.9138***	4.3700***	1.4535
	(-2.52)	(8.86)	(-3.65)	(-3.26)	(-0.37)	(2.17)	(0.77)	(-0.36)	(-4.58)	(3.16)	(0.65)
Observations	12,874	12,874	12,874	12,874	12,874	12,874	12,874	12,851	12,874	12,874	12,874
Number of groups	35	35	35	35	35	35	35	34	35	35	35

This table reports the results of HLM regressions that examine the relation between climate vulnerability measures and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. Low science trust is an indicator variable set equal to one for IPOs issued in countries in the bottom quartile based on trust in science. All other variables are defined in the Appendix. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers between parentheses below each coefficient are the *z*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 8 – Short-term orientation

	Vulnerability index	*Vulnerability adjusted*	*Health*	*Food*	*Ecosystems*	*Habitat*	*Water*	*Infrastructure*	*Adaptive Capacity*	*Sensitivity*	*Exposure*
Vulnerability measure	5.5634***	3.4548***	1.3916***	2.9541***	2.6413***	-0.1064	0.8942*	1.4821***	1.8844***	4.2511***	1.5655**
	(7.94)	(8.08)	(7.02)	(6.76)	(5.10)	(-0.28)	(1.91)	(3.40)	(7.04)	(6.15)	(1.96)
VM × Short term	-6.6328***	-2.3548***	-1.4467***	-2.1333*	-4.2008**	0.4738	-1.4360	-4.2146***	-2.3044***	-4.1337***	-1.1530
	(-6.46)	(-5.03)	(-6.29)	(-1.92)	(-2.40)	(0.43)	(-1.52)	(-4.78)	(-6.21)	(-2.64)	(-0.39)
Short term	2.2650***	-0.1657	0.3077**	0.5875	1.6313**	-0.2795	0.4369	1.3000***	0.6895***	1.1490**	0.4433
	(5.80)	(-1.56)	(2.49)	(1.41)	(2.19)	(-0.53)	(1.27)	(4.19)	(4.02)	(2.47)	(0.32)
Anti-self-dealing	-0.4076*	-0.1140	-0.1334	-0.2141	-0.1879	0.0657	-0.0734	-0.0084	-0.2551	-0.0232	-0.0670
	(-1.77)	(-0.64)	(-0.72)	(-0.81)	(-1.08)	(0.36)	(-0.40)	(-0.04)	(-1.25)	(-0.11)	(-0.37)
Economic integration	0.0023	-0.0021	0.0023	0.0044**	0.0038**	-0.0005	-0.0007	-0.0005	0.0017	-0.0007	0.0005
	(1.27)	(-1.20)	(1.27)	(2.27)	(1.96)	(-0.30)	(-0.43)	(-0.25)	(0.95)	(-0.37)	(0.27)
Price stabilization	-1.3421	0.2721	-0.9549	-0.9739	-0.1501	0.3568	-0.1975	0.0395	-1.3635	-1.5812	0.8772
	(-0.84)	(0.21)	(-0.72)	(-0.55)	(-0.12)	(0.28)	(-0.16)	(0.03)	(-0.95)	(-1.02)	(0.70)
IPO activity	-0.6879***	-0.3169*	-0.7817***	-0.5673***	-0.5627***	-0.5970***	-0.6283***	-0.5452***	-0.7256***	-0.4954***	-0.5991***
	(-3.96)	(-1.79)	(-4.46)	(-3.26)	(-3.22)	(-3.44)	(-3.60)	(-3.11)	(-4.16)	(-2.83)	(-3.45)
Market return	0.7341***	0.7491***	0.7375***	0.7406***	0.7447***	0.7486***	0.7478***	0.7438***	0.7361***	0.7398***	0.7483***
	(15.66)	(15.95)	(15.72)	(15.78)	(15.85)	(15.93)	(15.92)	(15.83)	(15.69)	(15.76)	(15.93)
Liquidity	-0.0793***	-0.0799***	-0.0753***	-0.0765***	-0.0832***	-0.0919***	-0.0921***	-0.0921***	-0.0787***	-0.0908***	-0.0912***
	(-7.99)	(-7.91)	(-7.47)	(-7.57)	(-8.36)	(-9.21)	(-9.33)	(-9.09)	(-7.89)	(-9.23)	(-9.29)
Offer size (log)	-0.0496***	-0.0500***	-0.0499***	-0.0478***	-0.0458***	-0.0473***	-0.0473***	-0.0487***	-0.0497***	-0.0483***	-0.0468***
	(-11.43)	(-11.51)	(-11.49)	(-11.03)	(-10.55)	(-10.91)	(-10.92)	(-11.18)	(-11.45)	(-11.14)	(-10.78)
Underwriter rank	0.0132***	0.0145***	0.0135***	0.0129***	0.0133***	0.0140***	0.0139***	0.0138***	0.0136***	0.0134***	0.0138***
	(5.69)	(6.24)	(5.82)	(5.56)	(5.72)	(6.02)	(6.01)	(5.94)	(5.86)	(5.76)	(5.95)
VC backed	0.0295**	0.0262**	0.0315**	0.0299**	0.0251**	0.0243*	0.0242*	0.0248*	0.0305**	0.0236*	0.0243*
	(2.33)	(2.06)	(2.48)	(2.36)	(1.98)	(1.92)	(1.90)	(1.95)	(2.40)	(1.86)	(1.92)
Lockup length	-0.0276***	-0.0301***	-0.0272***	-0.0286***	-0.0291***	-0.0289***	-0.0290***	-0.0279***	-0.0272***	-0.0294***	-0.0290***
	(-11.39)	(-12.42)	(-11.16)	(-11.84)	(-12.01)	(-11.93)	(-11.97)	(-11.35)	(-11.17)	(-12.14)	(-12.00)
Bookbuilt	-0.1068***	-0.1208***	-0.1077***	-0.1207***	-0.1398***	-0.1378***	-0.1375***	-0.1358***	-0.1121***	-0.1196***	-0.1389***
	(-7.47)	(-8.71)	(-7.51)	(-8.58)	(-10.18)	(-9.97)	(-10.01)	(-9.82)	(-7.89)	(-8.48)	(-10.09)
Firm commitment	-0.0331**	-0.0367**	-0.0301**	-0.0271*	-0.0235*	-0.0224	-0.0239*	-0.0206	-0.0342**	-0.0194	-0.0250*
	(-2.33)	(-2.57)	(-2.12)	(-1.91)	(-1.65)	(-1.56)	(-1.68)	(-1.45)	(-2.39)	(-1.37)	(-1.75)
Equity carve-out	0.0231	0.0190	0.0219	0.0228	0.0189	0.0171	0.0171	0.0192	0.0220	0.0195	0.0173
	(1.39)	(1.14)	(1.32)	(1.37)	(1.13)	(1.02)	(1.02)	(1.15)	(1.32)	(1.17)	(1.04)
High tech firm	0.1183***	0.1156***	0.1166***	0.1204***	0.1175***	0.1154***	0.1153***	0.1151***	0.1165***	0.1194***	0.1153***
	(3.24)	(3.17)	(3.19)	(3.30)	(3.21)	(3.15)	(3.15)	(3.14)	(3.19)	(3.26)	(3.15)
Constant	-1.3184***	0.9548***	0.0859	-0.5555**	-0.6147**	0.5888***	0.3353	0.0877	-0.0244	-0.6468**	-0.1376
	(-4.44)	(5.74)	(0.49)	(-2.23)	(-2.18)	(2.74)	(1.63)	(0.40)	(-0.13)	(-2.51)	(-0.35)
Vulnerability + Interaction	-1.0694	1.1001**	-0.0551	0.8208	-1.5595	0.3674	-0.5418	-2.7325***	-0.4199	0.1174	0.4125
	-1.25	(2.18)	(-0.33)	(0.80)	(-0.91)	(0.36)	(-0.70)	(-3.51)	(-1.38)	(0.08)	(0.14)

Observations	12,874	12,874	12,874	12,874	12,874	12,874	12,874	12,851	12,874	12,874	12,874
Number of groups	35	35	35	35	35	35	35	34	35	35	35

This table reports the results of HLM regressions that examine the relation between climate vulnerability measures and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. Short term is an indicator variable set equal to one for IPOs issued in countries in the bottom quartile based on long term orientation. All other variables are defined in the Appendix. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers between parentheses below each coefficient are the *z*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 9 – Disclosure transparency

	Vulnerability index	*Vulnerability adjusted*	*Health*	*Food*	*Ecosystems*	*Habitat*	*Water*	*Infrastructure*	*Adaptive Capacity*	*Sensitivity*	*Exposure*
Vulnerability measure	5.1670***	3.5603***	1.5409***	2.6817***	2.3093***	-0.1871	0.2740	0.7394**	1.4806***	4.2929***	1.4024*
	(8.14)	(8.42)	(8.42)	(6.62)	(4.90)	(-0.54)	(0.73)	(2.23)	(6.30)	(6.67)	(1.87)
VM × Transparent	-5.8220***	-2.0449***	-1.7903***	-0.6999***	-2.1497***	0.2678	0.2536	-1.0812***	-1.6152***	-2.2534***	-1.8009***
	(-8.45)	(-4.97)	(-7.70)	(-2.60)	(-6.74)	(0.59)	(0.71)	(-3.53)	(-4.84)	(-5.30)	(-4.02)
Transparent	1.7179***	-0.1831***	0.2187***	0.1296	0.7294***	-0.2032	-0.1477	0.1972**	0.3138***	0.4255***	0.7415***
	(7.97)	(-7.19)	(4.90)	(1.49)	(6.01)	(-0.97)	(-1.46)	(2.44)	(3.68)	(4.26)	(3.62)
Anti-self-dealing	-0.0449	-0.0910	-0.0013	-0.0711	-0.1043	0.0364	0.0308	0.0384	0.0402	0.0649	-0.0529
	(-0.18)	(-0.52)	(-0.01)	(-0.29)	(-0.66)	(0.22)	(0.19)	(0.23)	(0.21)	(0.30)	(-0.31)
Economic integration	0.0010	-0.0018	0.0024	0.0043**	0.0026	-0.0006	-0.0006	-0.0019	0.0014	-0.0016	0.0002
	(0.51)	(-1.03)	(1.32)	(2.24)	(1.35)	(-0.36)	(-0.38)	(-1.09)	(0.81)	(-0.85)	(0.10)
Price stabilization	0.4553	0.6306	-0.0014	-0.5415	0.3955	0.3782	0.3209	0.5195	0.3448	-1.2240	1.0150
	(0.26)	(0.49)	(-0.00)	(-0.31)	(0.35)	(0.31)	(0.27)	(0.43)	(0.25)	(-0.77)	(0.83)
IPO activity	-0.5334***	-0.1993	-0.7687***	-0.4846***	-0.3945**	-0.5446***	-0.5569***	-0.5049***	-0.6473***	-0.4098**	-0.4949***
	(-3.07)	(-1.11)	(-4.39)	(-2.78)	(-2.26)	(-3.13)	(-3.20)	(-2.89)	(-3.72)	(-2.34)	(-2.84)
Market return	0.7744***	0.7610***	0.7653***	0.7608***	0.7755***	0.7575***	0.7568***	0.7588***	0.7607***	0.7575***	0.7665***
	(16.54)	(16.20)	(16.34)	(16.21)	(16.52)	(16.12)	(16.10)	(16.14)	(16.22)	(16.16)	(16.30)
Liquidity	-0.0881***	-0.0774***	-0.0718***	-0.0786***	-0.0965***	-0.0894***	-0.0904***	-0.0937***	-0.0807***	-0.0915***	-0.0952***
	(-8.94)	(-7.63)	(-7.17)	(-7.73)	(-9.62)	(-9.00)	(-9.15)	(-9.35)	(-8.14)	(-9.34)	(-9.60)
Offer size (log)	-0.0501***	-0.0499***	-0.0501***	-0.0476***	-0.0470***	-0.0463***	-0.0469***	-0.0461***	-0.0495***	-0.0455***	-0.0475***
	(-11.54)	(-11.50)	(-11.54)	(-10.95)	(-10.82)	(-10.64)	(-10.79)	(-10.59)	(-11.38)	(-10.50)	(-10.92)
Underwriter rank	0.0142***	0.0147***	0.0140***	0.0135***	0.0142***	0.0142***	0.0142***	0.0143***	0.0141***	0.0138***	0.0144***
	(6.14)	(6.36)	(6.05)	(5.83)	(6.12)	(6.14)	(6.13)	(6.14)	(6.09)	(5.97)	(6.20)
VC backed	0.0171	0.0232*	0.0251**	0.0238*	0.0137	0.0202	0.0210*	0.0163	0.0251**	0.0113	0.0187
	(1.35)	(1.82)	(1.98)	(1.87)	(1.07)	(1.58)	(1.65)	(1.27)	(1.98)	(0.89)	(1.47)
Lockup length	-0.0275***	-0.0290***	-0.0271***	-0.0276***	-0.0284***	-0.0284***	-0.0282***	-0.0292***	-0.0275***	-0.0297***	-0.0279***
	(-11.37)	(-11.99)	(-11.20)	(-11.37)	(-11.77)	(-11.72)	(-11.67)	(-11.99)	(-11.33)	(-12.30)	(-11.53)
Bookbuilt	-0.0997***	-0.1253***	-0.1034***	-0.1249***	-0.1226***	-0.1470***	-0.1421***	-0.1492***	-0.1174***	-0.1363***	-0.1331***
	(-6.84)	(-8.96)	(-7.09)	(-8.75)	(-8.58)	(-10.34)	(-10.01)	(-10.67)	(-8.11)	(-9.65)	(-9.34)
Firm commitment	-0.0460***	-0.0349**	-0.0371***	-0.0314**	-0.0361**	-0.0190	-0.0216	-0.0174	-0.0373***	-0.0167	-0.0316**
	(-3.21)	(-2.45)	(-2.61)	(-2.19)	(-2.53)	(-1.32)	(-1.52)	(-1.23)	(-2.60)	(-1.18)	(-2.20)
Equity carve-out	0.0195	0.0184	0.0200	0.0202	0.0163	0.0140	0.0148	0.0120	0.0204	0.0118	0.0157
	(1.17)	(1.10)	(1.20)	(1.21)	(0.98)	(0.84)	(0.89)	(0.72)	(1.22)	(0.71)	(0.94)
High tech firm	0.1128***	0.1120***	0.1123***	0.1167***	0.1134***	0.1133***	0.1126***	0.1122***	0.1124***	0.1167***	0.1126***
	(3.10)	(3.07)	(3.08)	(3.20)	(3.10)	(3.10)	(3.08)	(3.06)	(3.08)	(3.20)	(3.08)
Constant	-1.3080***	0.9255***	-0.0339	-0.5681**	-0.4629*	0.6453***	0.4798**	0.4062**	-0.0529	-0.6395**	-0.0625
	(-4.46)	(5.59)	(-0.19)	(-2.29)	(-1.72)	(3.06)	(2.43)	(2.31)	(-0.28)	(-2.54)	(-0.16)

Vulnerability + Interaction	-0.6551	1.5154***	-0.2494	1.9817***	0.1596	0.0807	0.5277	-0.3419	-0.1346	2.0395***	-0.3985
	(-0.82)	(3.12)	(-1.32)	(3.87)	(0.29)	(0.15)	(1.08)	(-0.79)	(-0.41)	(2.72)	(-0.46)
Observations	12,874	12,874	12,874	12,874	12,874	12,874	12,874	12,851	12,874	12,874	12,874
Number of groups	35	35	35	35	35	35	35	34	35	35	35

This table reports the results of HLM regressions that examine the relation between climate vulnerability measures and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. Transparent is an indicator variable set equal to one for IPOs issued in countries in the bottom quartile based on aggregate earnings management, as defined by Leuz, Nanda, and Wysocki (2003). All other variables are defined in the Appendix. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers between parentheses below each coefficient are the *z*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 10 – The Stern review

	Pre-Stern	*Post-Stern*
Vulnerability index	-0.7157	8.1546***
	(-1.19)	(10.12)
Anti-self-dealing	0.1630	-0.1659
	(1.02)	(-0.54)
Economic integration	-0.0147***	0.0244***
	(-5.68)	(8.32)
Price stabilization	0.3275	-0.6238
	(0.27)	(-0.28)
IPO activity	0.7623**	-1.3013***
	(2.22)	(-5.70)
Market return	0.7917***	0.5679***
	(11.35)	(8.85)
Liquidity	0.0661**	-0.0664***
	(2.03)	(-6.06)
Offer size (log)	-0.0395***	-0.0678***
	(-5.55)	(-12.51)
Underwriter rank	0.0073**	0.0201***
	(1.99)	(6.83)
VC backed	0.1431***	-0.0392***
	(6.19)	(-2.78)
Lockup length	-0.0201***	-0.0246***
	(-4.59)	(-8.59)
Bookbuilt	-0.0865***	-0.0906***
	(-2.60)	(-5.35)
Firm commitment	-0.0301	-0.0276
	(-1.30)	(-1.51)
Equity carve-out	0.0323	0.0080
	(0.78)	(0.49)
High tech firm	0.1372**	0.0890**
	(2.18)	(2.14)
Constant	1.5175***	-3.8869***
	(4.43)	(-10.13)
Observations	5,803	7,071
Number of groups	33	35

This table reports the results of HLM regressions that examine the relation between climate vulnerability measures and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. Pre-Stern (Post-Stern) includes all IPOs issued before (on or after) October 30, 2006, the date the Stern Review was released. All other variables are defined in the Appendix. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers between parentheses below each coefficient are the *z*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 11 – Additional robustness

	OLS	Country FE	ESG risk management	Exclude Australia	Exclude China	Exclude India	Exclude Japan	Exclude South Korea	Exclude UK	Exclude US
Vulnerability index	0.4349***	4.3690***		2.7324***	1.3060***	2.2581***	1.5930***	2.3929***	2.5945***	4.8601***
	(3.23)	(5.54)		(5.02)	(3.06)	(4.15)	(3.41)	(4.60)	(4.70)	(7.07)
Residual vulnerability			5.0130***							
			(6.92)							
Environmental RM			-0.2001***							
			(-7.38)							
Anti-self-dealing	0.1683***		-0.0804	-0.0715	0.0233	-0.0588	0.0065	-0.0535	-0.0919	-0.1822
	(6.55)		(-0.39)	(-0.39)	(0.19)	(-0.35)	(0.05)	(-0.31)	(-0.48)	(-0.74)
Economic integration	-0.0119***	0.0005	0.0125***	0.0009	0.0014	-0.0006	-0.0029*	0.0007	0.0017	0.0004
	(-20.84)	(0.23)	(4.17)	(0.50)	(0.82)	(-0.33)	(-1.69)	(0.37)	(0.91)	(0.22)
Price stabilization	-1.7695***		-1.3212	-0.3304	-0.3482	0.4396	-0.1896	-0.2537	-0.2717	-1.0459
	(-7.39)		(-0.87)	(-0.25)	(-0.40)	(0.35)	(-0.18)	(-0.20)	(-0.21)	(-0.59)
IPO activity	0.8897***	-0.6657***	-1.0969***	-0.6513***	0.0095	-0.4144**	-0.5606***	-0.7772***	-0.6637***	-0.5378***
	(6.52)	(-3.81)	(-4.42)	(-3.49)	(0.04)	(-2.33)	(-3.41)	(-4.41)	(-3.67)	(-2.96)
Market return	0.7125***	0.7451***	0.2744***	0.7304***	1.0443***	0.7398***	0.6729***	0.7767***	0.7407***	0.7581***
	(14.64)	(15.86)	(4.10)	(15.06)	(17.59)	(15.32)	(14.96)	(15.68)	(15.21)	(15.58)
Liquidity	-0.0089	-0.0884***	-0.0092	-0.0882***	0.0396**	-0.0925***	-0.0895***	-0.0759***	-0.0861***	-0.1033***
	(-1.04)	(-8.92)	(-0.82)	(-8.65)	(2.48)	(-9.21)	(-9.65)	(-7.32)	(-8.22)	(-9.53)
Offer size (log)	-0.0463***	-0.0496***	-0.0669***	-0.0503***	-0.0429***	-0.0519***	-0.0378***	-0.0446***	-0.0488***	-0.0578***
	(-11.06)	(-11.28)	(-12.24)	(-11.02)	(-9.58)	(-11.64)	(-8.99)	(-9.77)	(-10.27)	(-12.39)
Underwriter rank	0.0260***	0.0133***	0.0188***	0.0143***	0.0083***	0.0140***	0.0110***	0.0136***	0.0144***	0.0116***
	(11.25)	(5.71)	(6.13)	(5.90)	(3.35)	(5.93)	(4.84)	(5.62)	(5.83)	(4.39)
VC backed	0.0901***	0.0279**	-0.0289**	0.0297**	0.0931***	0.0254*	0.0146	0.0292**	0.0304**	-0.0406**
	(7.27)	(2.19)	(-2.09)	(2.27)	(6.43)	(1.96)	(1.21)	(2.22)	(2.28)	(-2.56)
Lockup length	-0.0258***	-0.0294***	-0.0149***	-0.0306***	-0.0178***	-0.0290***	-0.0289***	-0.0295***	-0.0313***	-0.0267***
	(-10.66)	(-12.14)	(-4.94)	(-11.81)	(-6.90)	(-11.68)	(-12.38)	(-11.77)	(-11.86)	(-10.24)
Bookbuilt	-0.0762***	-0.1146***	-0.0142	-0.1261***	0.0047	-0.1454***	-0.1234***	-0.1514***	-0.1351***	-0.0801***
	(-5.97)	(-7.76)	(-0.79)	(-8.68)	(0.31)	(-9.92)	(-9.45)	(-10.24)	(-8.32)	(-5.52)
Firm commitment	0.0288**	-0.0325**	-0.0461**	-0.0347**	-0.0330**	-0.0308**	-0.0367***	-0.0273*	-0.0278*	-0.0129
	(2.13)	(-2.27)	(-2.40)	(-2.09)	(-2.32)	(-2.14)	(-2.72)	(-1.85)	(-1.78)	(-0.82)
Equity carve-out	-0.0017	0.0234	0.0004	0.0256	0.0277	0.0200	0.0250	0.0187	0.0185	0.0243
	(-0.10)	(1.40)	(0.03)	(1.44)	(1.50)	(1.18)	(1.57)	(1.10)	(1.04)	(1.30)
High tech firm	0.1207***	0.1171***	0.0623	0.1162***	0.1505***	0.1178***	0.0866**	0.1134***	0.1242***	0.0846**
	(3.17)	(3.20)	(1.47)	(2.90)	(3.65)	(3.13)	(2.51)	(3.05)	(3.19)	(2.23)
Constant	0.9601***	-0.9067***	0.7647***	-0.4493*	-0.3016	-0.1824	0.1132	-0.3206	-0.4399*	-1.0015***
	(10.79)	(-3.06)	(2.80)	(-1.71)	(-1.32)	(-0.71)	(0.48)	(-1.25)	(-1.68)	(-3.23)

Observations	12,874	12,874	5,926	11,696	10,517	12,379	12,255	11,917	11,797	10,462
R-squared	0.178	0.144								
Number of groups		35	35	34	34	34	34	34	34	34

This table reports the results of HLM regressions that examine the relation between climate vulnerability measures and IPO underpricing. The dependent variable is IPO underpricing, which is calculated as the difference between the first-day secondary market closing price and the IPO offer price, divided by the IPO offer price. Environmental RM (risk management) is from Baker et al. (2021). Residual vulnerability is the residual from a regression of the climate vulnerability index on Environmental RM. Regressions include unreported industry controls based on Dyck and Zingales (2004) and issue year fixed effects. The numbers between parentheses below each coefficient are the *z*-statistics. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.