# Physical Climate Risk and Foreign Direct Investment: Is China Different?

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**Abstract**
This study deploys newly available data to examine the exposure of multinational companies' overseas investments to physical climate risk. Globally, we find that foreign investment in the agriculture and mining sectors is most associated with physical risk. We also examine China, as it is fast becoming one of the largest centers of both inward and outward foreign investment across the globe. We find that foreign facilities located in China are associated with higher hurricanes and typhoon risk than their domestic counterparts in China. For Chinese firms operating abroad, we find that China's overseas facilities are associated with higher water stress, floods, and hurricanes & typhoon risks across host countries, compared with non-Chinese companies. Within host countries, however, climate risks of Chinese facilities are comparable to that of non-Chinese facilities.

## INTRODUCTION

Physical climate risk, defined as risk arising from the physical effects of climate change, is having impacts on firms across industries[1-4]. Disruptive extreme weather events cause property damages and business interruptions[5-8], while gradual impacts change resource availability and consumer preferences[9-13]. The physical impact of climate change is also influencing systemic risk in the financial sector[14-19].

Faced with these threats, governments, companies, investors, and communities are becoming more active in addressing climate risks in recent years[20]. For instance, France started to require public companies to disclose climate risk information since 2016[21]. The Task Force on Climate-related Financial Disclosures (TCFD) was established in 2015 to improve and increase reporting of climate-related financial information[22]. The Network for Green the Financial System was established in 2017 to share best climate risk management practices among central banks and supervisors on a voluntary basis[23]. The 2020 version of the Equator Principles has incorporated climate risk assessment into its guidelines and called for climate-resilient infrastructure[24]. The Green Investment Principles (GIP) for the Belt and Road also encourage projects to disclose climate risks under the TCFD guidelines[25]. Also, institutional investors are urging companies to disclose and reduce climate risks[26-29].

Despite the importance and increasing awareness of climate risk, little is known about firms' physical climate risk and how firms incorporate the risk into their business strategies. Significant work has been conducted to date focusing on transitional climate risk — that is, risk arising from policy transitions to a low-carbon economy, such as regulatory risk, technology risk, market risk, and reputational risk[30-36]. It is surprising that few studies focus on firms' physical climate risk[37-38].

This paper represents an initial foray into the neglected research area and examines the physical climate risk of multinational companies through the lens of overseas investment. Facility investment is an important business strategy, and at the same time one method firms take in response to the actual or expected physical climate and its effects[39]. We use newly available physical climate risk data of public companies made available from Four Twenty Seven (a Moody's affiliate). We assess the climate exposure of firms' overseas facilities across the industries, host countries, and headquarter countries. Also, we pay attention to Chinese overseas investments. This is because 1) China is now a major investor in least-developed countries and in developing Asia[40,41]; and 2) Chinese overseas investments are perceived as qualitatively unique[42]: they may not be solely profit-seeking[43], and are frequently criticized for bringing negative social and environmental impacts while helping local economic development[44]. *Figure S.1* in the Supplement Information summarizes the framework of the study. We use the term country and jurisdiction interchangeably in this paper for simplicity.

## RESULTS

In this study, we start by documenting a series of stylized facts pertaining to the physical climate risks of multinational companies' overseas facilities across the globe. First, we find that physical climate risks of firm's overseas facilities vary by industry, with agriculture and mining industries having the highest aggregate physical climate risk. Second, overseas facilities located in Mainland China and Hong Kong Special Administration Region (Hong Kong SAR) have higher aggregate physical climate risks, comparing to that in other countries with high Foreign Direct Investment (FDI) inflow stock. Third, overseas facilities owned or operated by Mainland China and Hong Kong firms have higher aggregate physical climate risks across countries, comparing to overseas facilities owned or operated by companies headquartered in other countries with high FDI outflow stock.

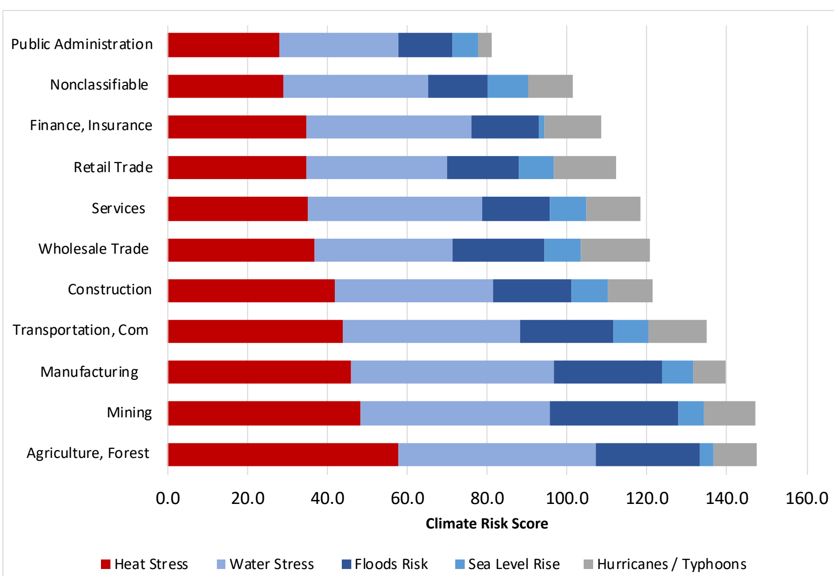
We then examine whether Chinese overseas facilities have statistically higher physical climate risks relative to overseas facilities owned or operated by non-Chinese companies. Based on our firm-level climate risk data set, we estimate a set of fixed-effect cross sectional models. The outcome variables are physical climate risks, which are decomposed into five different climate risk drivers that include heat stress, water stress, floods, sea level rise risk, and hurricanes & typhoons, all in log form and standardized to a mean of 0 and a standard deviation of 1. We have two base model specifications for each climate risk driver analysis. Model 1 tests whether Chinese overseas facilities have different climate risks within industry but across host countries, and Model 2 examines whether Chinese overseas facilities have different physical climate risks within industry and within host countries. Each analysis controls for industry fixed effects, headquarters countries' economic development level, and a set of firm-level control variables. We find that overseas facilities owned or operated by Chinese companies have higher water stress, flood, and hurricane & typhoon risks across countries, compared to those owned or operated by non-Chinese companies. Within host countries, however, climate risks of Chinese facilities are comparable to that of non-Chinese ones.

In addition, we explore whether physical climate risks of facilities located in China and owned by foreign companies are different from those owned by Chinese firms; and whether physical climate risks of Chinese facilities overseas are different from those located in China. We find that climate risks of facilities owned by foreign companies and located in China are comparable to those owned by Chinese companies, with the exception of hurricanes & typhoons risk. Compared with facilities located in China, Chinese overseas facilities have higher heat stress but lower water stress, floods, and hurricanes & typhoons risks.

**Global Landscape of Physical Climate Risks of Public Companies' Overseas Facilities**

**Physical climate risk by industry.** *Figure 1* summarizes the climate risk scores of firms' overseas facilities by industry according to the SIC groups. On average, agriculture and mining industries have the highest aggregate climate risk, while public administration sector has the lowest climate risk. Specifically, agriculture, forest, and fishing industry have the highest heat stress risk; manufacturing industry has the highest water stress; mining industry has the highest floods risk; and whole trade industry has the highest sea level rise and cyclone risks. These make sense as resource-intensive sectors such as agriculture, mining, and manufacturing are more directly affected by chorionic risks [41] such as heat and water stresses, while trade and transportation sectors are more directly affected by sea level rise and cyclone risks as their assets are usually close to seaports.

**Figure 1. Average Climate Risk Scores of Overseas Facilities by Industry**




Analysis is based on physical climate risk scores and facility statistics of 2,233 public companies from Four Twenty Seven.

**Physical climate risk by host country.** *Figure 2.a* compares average climate risk scores of overseas facilities located in different countries, while *Figure 2.b* summarizes climate risk scores of overseas facilities in 15 jurisdictions with the highest FDI inflow stock between 1970 and 2019. *Figure 2.b* suggests that among the 15 jurisdictions, overseas facilities in Hong Kong SAR have the highest aggregated climate risks. Specifically, overseas facilities located in Brazil have the highest heat stress; facilities located in Israel have the highest water stress risk, followed by India; facilities in Japan and mainland China have the highest floods risks; facilities in Hong Kong SAR have the highest sea level rise risks; and facilities located in Hong Kong SAR and Japan have the highest hurricanes & typhoons risks. On top of assessing climate risks of overseas facilities among different host countries, we also compare physical climate risk exposure of overseas and local facilities within the same host countries. As suggested in Table S.2 of the Supplementary Information, physical climate risks of firms' overseas facilities are similar to that of local facilities within the same host countries and same industries. This implies that asset ownership doesn't have strong relationship with facilities' climate risk exposure within countries.

**Figure 2.a. Average Climate Risk Scores of Overseas Facilities by Host Country**

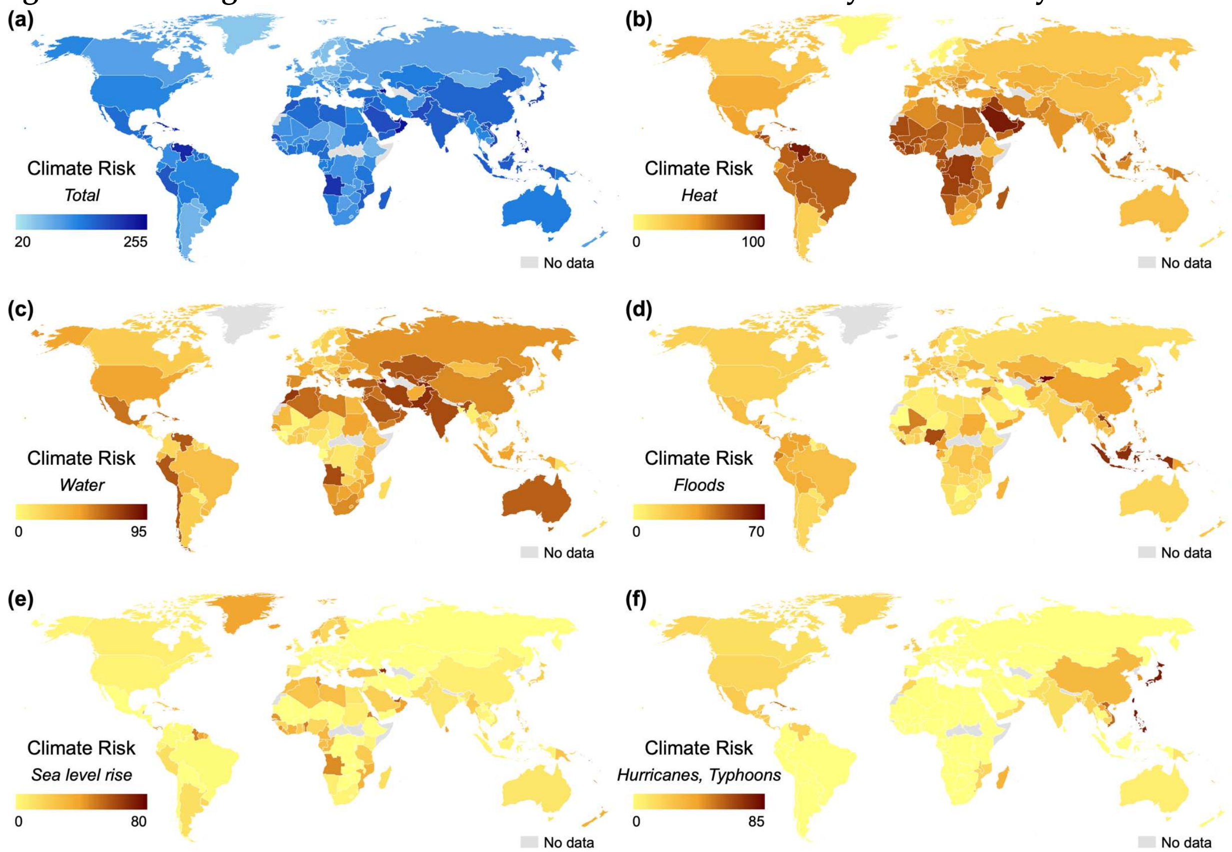
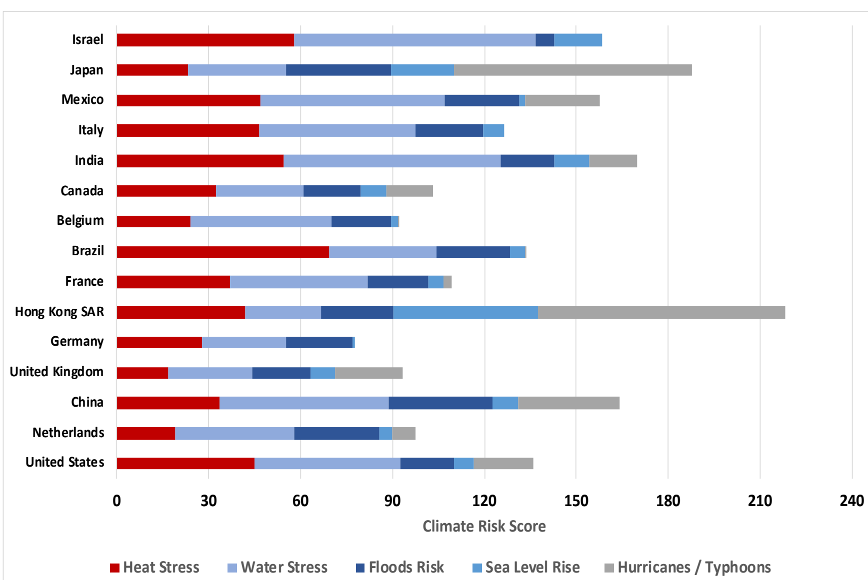



**Figure 2.b. Average Climate Risk Scores of Overseas Facilities by Host Country: Top 15 Countries with Highest FDI Inflow Stock between 1970 and 2019**




Analysis is based on physical climate risk scores and facility statistics of 2,233 public companies from Four Twenty Seven. FDI inflow stocks are based on the World Bank data.

**Physical climate risk by headquarter country.** *Figure 3.a* compares climate risks of overseas facilities owned or operated by companies headquartered in different countries, while *Figure 3.b* summarizes climate risk scores of overseas facilities owned by 15 jurisdictions with the highest FDI outflow stock between 1970 and 2019. *Figure 3.b* suggests that the differences among physical climate risks of overseas facilities across jurisdictions where companies are headquartered are relatively small. Heat stress exposure of overseas facilities is similar across firms headquartered in different jurisdictions, with overseas facilities owned by Belgium firms having slightly higher risk. Overseas facilities owned by Hong Kong SAR firms have slightly higher water stress and floods risks, while facilities owned by Mainland China firms have higher hurricanes and sea level rise risks. As implied in Table S.3 of Supplementary Information, on average, overseas facilities have higher heat stress and water stress but lower floods, sea level rise, and hurricanes & typhoons risks, comparing to all facilities owned or operated by companies from the same headquarters countries.

**Figure 3.a. Average Climate Risk Score Overseas Facilities by Headquarters Country**

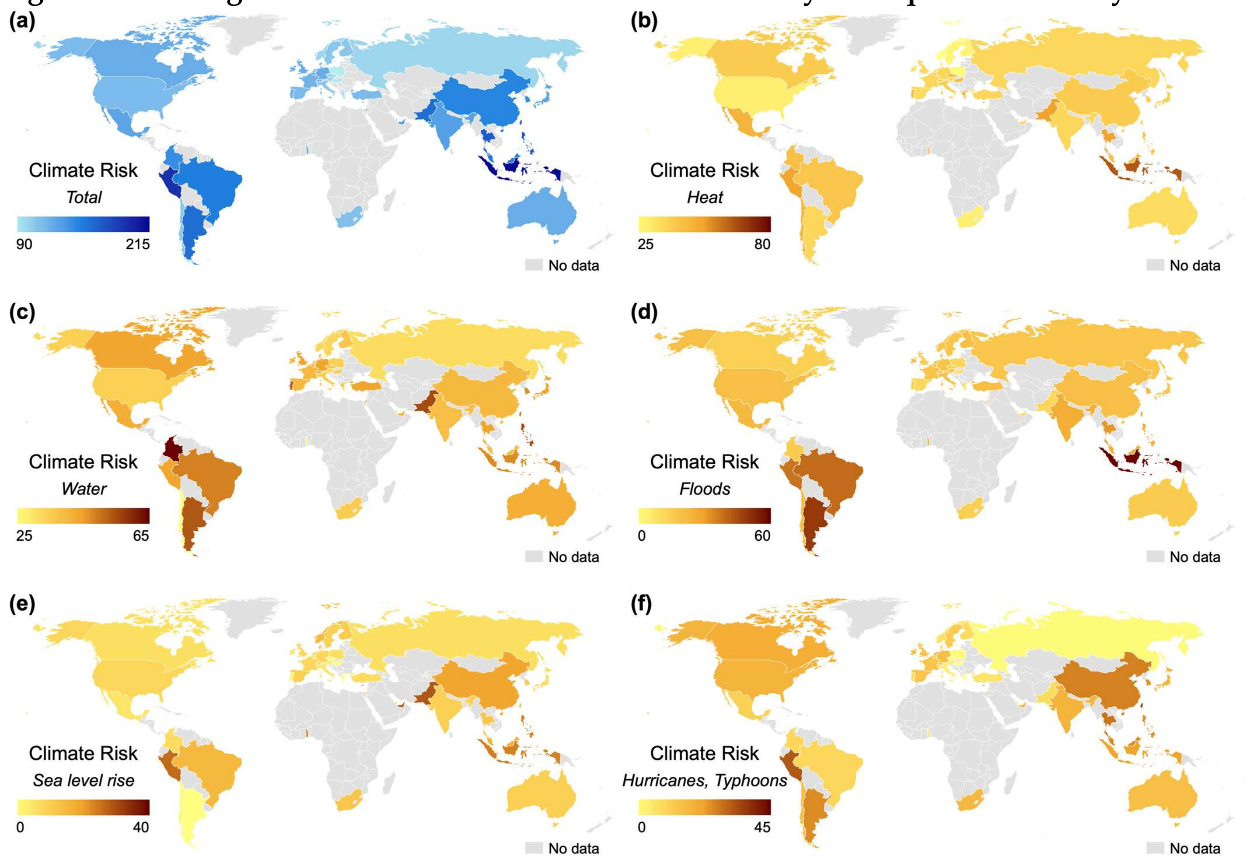
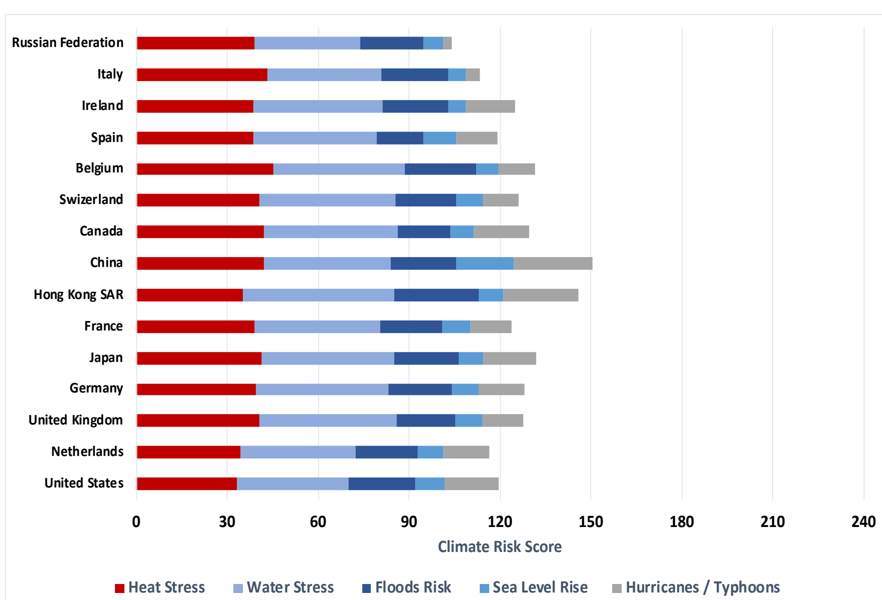



**Figure 3.b. Average Climate Risk Score Overseas Facilities by Headquarters Country: Top 15 Countries with Highest FDI Outflow Stock between 1970 and 2019**




Analysis is based on physical climate risk scores and facility statistics of 2,233 public companies from Four Twenty Seven. FDI outflow stocks are based on the World Bank data.

**Is China Different?**

In this section we focus on Chinese overseas facilities. There are couple of reasons we select China for the case study. First, China is now the among the largest outward foreign investors globally[42,43]. Second, Chinese overseas projects are perceived as qualitatively unique[44]: they may not be solely profit-seeking[45], and are frequently criticized for bringing negative social and environmental impacts while helping with local economic development [46]. Third, as Chinese firms actively expanded their overseas footprints only recently, it is possible that they may have to invest in some undesirable locations, as the desirable ones have been taken up by earlier investors from other countries[47]. Finally, overseas facilities owned or operated by Chinese companies (including Hong Kong SAR) appear to have higher aggregate physical climate risks, as indicated in Figure 3.b. However, it is not clear whether the difference is statistically significant when we consider industry factors and firm characteristics.

**Physical climate risk of Chinese overseas facilities.** First, we estimate a baseline specification to analyze whether the physical climate risks of overseas facilities owned or operated by Chinese companies are different from those owned or operated by non-Chinese companies. Table 1 presents the results. The statistically significant positive coefficients on *ChinaAssets* in Model 1 suggest that Chinese overseas facilities are exposed to higher water stress, floods, and hurricanes & typhoons risks across host countries (p-values <0.01) compared to overseas assets owned by non-Chinese firms. The difference is particularly large for physical risk related to hurricanes & typhoons: Chinese overseas assets are associated with 60% standard deviation increase of hurricanes & typhoons risk scores across the host countries (p-values <0.01). The heat stress and sea level rise of Chinese overseas facilities, however, are not statistically different from that of non-

Chinese oversea assets. Results in Model 2 suggest that within the host countries, physical climate risks of overseas facilities owned or operated by Chinese companies are not significantly higher than those owned by non-Chinese companies. In fact, Chinese overseas assets are associated with 13% standard deviation decrease of hurricanes & typhoons risk scores within the host countries (p-values <0.1). The results imply that the higher climate risks of Chinese overseas assets across the host countries is driven by the locations they invest. In other words, relative to other global investors, Chinese overseas facilities are located in countries with higher climate risks, but within each country, Chinese facilities do not tend to be located in areas with higher climate risks than other foreign investors.

**Table 1. Difference of physical climate risks of overseas facilities owned or operated by Chinese companies**

| | Model 1 - Across Country | | | | | Model 2 - Within Country | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Heat** | **Water** | **Floods** | **Sea Level Rise** | **Hurricanes/ Typhoons** | **Heat** | **Water** | **Floods** | **Sea Level Rise** | **Hurricanes/ Typhoons** |
| ChinaAsset | -0.05 | 0.24 | 0.28 | 0.03 | 0.61 | 0.00 | -0.08 | -0.06 | -0.09 | -0.13 |
| | [0.07] | [0.07]*** | [0.03]*** | [0.09] | [0.10]*** | [0.03] | [0.04]* | [0.06] | [0.09] | [0.07]* |
| *Controls* | | | | | | | | | | |
| *GDPPerCapita* | -0.11 | -0.05 | 0.01 | 0.01 | -0.02 | -0.01 | 0 | 0 | 0.01 | 0 |
| | [0.04]*** | [0.03] | [0.01] | [0.01] | [0.01] | [0.00]** | [0.00] | [0.00] | [0.01] | [0.00] |
| Cash | 0.08 | 0.33 | -0.01 | 0.37 | -0.52 | -0.08 | 0.32 | -0.07 | 0.37 | -0.17 |
| | [0.19] | [0.21] | [0.06] | [0.18]* | [0.14]*** | [0.03]** | [0.15]* | [0.05] | [0.20]* | [0.08]* |
| Size | 0.01 | 0.01 | 0.02 | 0.05 | 0.02 | 0 | 0 | 0.02 | 0.05 | 0 |
| | [0.02] | [0.02] | [0.01]* | [0.02]** | [0.03] | [0.00] | [0.01] | [0.01]* | [0.02]** | [0.00] |
| ROA | -0.21 | -0.47 | 0.14 | -0.1 | 0.51 | -0.08 | -0.23 | -0.11 | 0.03 | 0.1 |
| | [0.60] | [0.36] | [0.09] | [0.41] | [0.31] | [0.14] | [0.18] | [0.09] | [0.30] | [0.05]* |
| Leverage | -0.03 | 0 | 0.01 | 0 | -0.08 | 0 | 0.07 | 0.07 | -0.02 | -0.02 |
| | [0.08] | [0.05] | [0.04] | [0.04] | [0.06] | [0.01] | [0.02]*** | [0.02]*** | [0.03] | [0.02] |
| Host Country FE | N | N | N | N | N | Y | Y | Y | Y | Y |
| Industry FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| N | 40931 | 40534 | 40104 | 40931 | 40931 | 40931 | 40534 | 40104 | 40931 | 40931 |
| r2 | 0.07 | 0.11 | 0.12 | 0.04 | 0.03 | 0.94 | 0.75 | 0.36 | 0.44 | 0.89 |

Unit of analysis: firm-industry-host country. Standard errors clustered at industry level. Outcome variables are climate risk scores in log form and standardized to a mean of 0 and a standard deviation of 1. ***P<0.01, **P<0.05, *P<0.1

**Facilities located in China owned and operated by non-Chinese companies.** Further, we compare physical climate risks of facilities located in China owned or operated by Chinese companies and those owned by foreign companies. Table 2 reports the results. The statistically significant positive coefficient on *Foreign* for hurricanes & typhoons risk suggests that facilities located in China owned by foreign firms are associated with 22%

standard deviation increase of hurricanes & typhoons scores (p-value < 0.01). Other climate risk drivers, however, are similar between facilities owned and operated by Chinese and foreign companies. With the exception of hurricanes & typhoons risk, the results are consistent with the global picture in that climate risks of facilities owned and operated by foreign firms are similar to those owned by local firms in the same host country and same industry (see Table S.2 of the Supplementary Information).

**Table 2. Physical climate risks of facilities located in China: difference of facilities owned or operated by foreign companies**

| | Heat | Water | Floods | Sea Level Rise | Hurricanes/ Typhoons |
|---|---|---|---|---|---|
| Foreign | 0.01 | 0.00 | 0.01 | 0.12 | 0.22 |
| | [0.02] | [0.06] | [0.03] | [0.14] | [0.06]*** |
| Controls | Y | Y | Y | Y | Y |
| Industry FE | Y | Y | Y | Y | Y |
| N | 2850 | 2850 | 2850 | 2850 | 2850 |
| r2 | 0.34 | 0.27 | 0.19 | 0.08 | 0.16 |

Unit of analysis: firm-industry. Standard errors clustered at industry level. Outcome variables are climate risk scores in log form and standardized to a mean of 0 and a standard deviation of 1. ***P<0.01, **P<0.05, *P<0.1

**Chinese overseas and local facilities.** We also examine whether the physical climate risks of overseas facilities owned and operated by Chinese companies are different from their assets located in China. As presented in Table 3, the statistically significant positive coefficients on *Overseas* suggest that Chinese overseas facilities have higher heat stress (p-values <0.1), but lower water stress, floods, and hurricanes & typhoon risks (p-value<0.01), compared with facilities in China owned by these Chinese companies. The differences are economically and statistically significant, and the difference is particularly large for floods and hurricanes & typhoons risks: assets overseas are associated with 57% standard deviation decrease of floods risk scores (p-values <0.01) and 52% standard deviation decrease of hurricanes & typhoons risk scores (p-values <0.01). The results imply that physical climate risks of overseas assets owned by Chinese companies are lower than that of Chinese facilities located in China, except for heat stress and sea level rise risks. This is probably because climate risks of facilities in China are high (except for heat stress), as shown in Figure 2.b. Also, with the exception of water stress, the results are consistent with the global average as presented in Table S.3 of Supplementary Information.

**Table 3. Physical climate risks of facilities owned or operated by Chinese companies: difference of overseas facilities**

| | Heat | Water | Floods | Sea Level Rise | Hurricanes/ Typhoons |
|---|---|---|---|---|---|
| Overseas | 0.11 | -0.31 | -0.57 | -0.12 | -0.52 |
| | [0.06]* | [0.10]*** | [0.10]*** | [0.12] | [0.09]*** |
| | | | | | |
| Controls | Y | Y | Y | Y | Y |
| Industry FE | Y | Y | Y | Y | Y |
| N | 1371 | 1345 | 1347 | 1371 | 1371 |
| r2 | 0.2 | 0.22 | 0.27 | 0.1 | 0.19 |

Unit of analysis: firm-industry-host country. Standard errors clustered at industry level. Outcome variables are climate risk scores in log form and standardized to a mean of 0 and a standard deviation of 1. ***P<0.01, **P<0.05, *P<0.1

**Robustness check.** In the Supplementary Information, we provide several robustness checks. The results are robust 1) when we remove resource-intensive industries such as mining, transportation, communications, electric, and gas (Table S.4); 2) when we change control variables (Table S.5); and 3) when we focus on different regions such as Latin America and South and Southeast Asia (Table S.6).

## DISCUSSION

This paper fills in the research gap by assessing physical climate risk exposure at the firm level. Specifically, it empirically examines the physical climate exposure of multinational companies' overseas facilities. We document the heterogeneities of physical climate risks of firms' overseas facilities across the industries, host countries, and headquarters countries. We also compare the climate risks of firms' overseas facilities with local ones in the same host country or from the same headquarters country. Specifically, we focus on the case of China and explore whether facilities operated and owned by Chinese companies are different from that of non-Chinese companies regarding climate risk. Our findings suggest that Chinese overseas assets have higher water stress, floods, and hurricanes & typhoon risks across countries, compared to overseas facilities owned or operated by non-Chinese companies. Within host countries, however, climate risks of Chinese facilities are comparable with that of non-Chinese facilities, both overseas and in China. There are a couple of reasons that may explain why Chinese overseas facilities are located in jurisdictions with higher climate risks. One possible reason is that facilities in China have high climate risks in general (see Figure 2.b), and thus companies are willing to take higher than average climate risks when investing overseas. As suggested in Table 3, although the average climate exposures of Chinese overseas facilities are high, they are lower than that of facilities located in China, except for heat stress and sea level rise. Another possible factor contributing to the difference is that some Chinese companies may not be solely profit-seeking[45], and they may be willing to invest in some countries for political or strategic reasons, regardless of their climate risks. It is also possible that Chinese companies have to invest in some undesirable locations with higher physical climate risk exposure because the desirable locations have been taken by earlier investors or China is investing in strategic assets for non-commercial reasons [47,48].

This study has several contributions. To the best of our knowledge, this is the first paper systematically examining physical climate risks of firms' overseas facilities. It establishes several facts about the variation across the industries, host countries, headquarters countries, and climate risk drivers. It also explores the difference of physical climate risks between assets owned or operated by Chinese companies and those owned by non-Chinese companies. Second, the insights of this paper shed light upon the multidisciplinary dialogue on multinational firm location and the environment[49] by adding the consideration of physical climate constraints. When investing and operating overseas, multinational companies are trying to manage and reduce their risks, such as political and environmental risks. As physical climate risk is already having an impact on firms with respect to resource availabilities and increased extreme weather events, companies need to add climate risk into their cost function. Finally, the research has policy implications. Understanding the physical climate risk baseline of firms' global assets can help policymakers and international organizations in setting up effective climate related policies or guidelines [50-53].

This study has a few limitations. First, the analysis is cross sectional as data on time specific information regarding when companies build or acquire each of their individual facilities is not available. Future research can collect panel data of firms' overseas projects certain industries and examine the extent to which climate risk may be a factor in firm location choice. Second, there are uncertainties inherited in firms' climate risk data predicted by geospatial, historical, and projection models [54,55], but it is the best available data we can obtain at this stage as a first attempt to examine physical climate risks of firms' overseas investment. Lastly, this study focuses only on public firms mainly headquartered in North America, Europe, Asia, and Australia. It would be interesting for future research to explore the climate risks of private firms and other organizations.

## METHODS

**Data.** We use the physical climate risk scores at the firm-risk-host country-industry level collected from Four Twenty Seven (an affiliate of Moody's) in January 2020. The sample covers 2,233 public companies headquartered in 47 jurisdictions. It covers more than 1 million facilities across 200 jurisdictions and 10 Standard Industrial Classification (SIC) groups. Around 28.8% of the facilities are located overseas. Facility is defined as any operational legal entity that it is owned or operated by a company. This definition includes a wide range of operating activities, such as manufacturing facilities, offices, ports, logistics, and retail establishments, but does not include sites that are being developed and not yet operational. 10% of the companies in the dataset are headquartered in Mainland China or Hong Kong SAR.

Four Twenty Seven evaluates the climate risk by utilizing several geospatial, historical, and projection models at specific locations where risk factors are measured. The criteria for the analysis include detailed climate hazard projections that measure the relative degree of change in extreme events such as intensity and frequency of rainfall, high temperatures, historical cyclone activity, coastal flooding, drought and water stress, and wildfire potential. Its analysis focuses on extreme weather impacts (e.g., tropical cyclones) today and other climate impacts at a mid-term projection period, 2030-2040. Table S.7 in the Supplementary Information provides more methodology details for analyzing different climate exposures. Raw indicators of physical climate risk exposures for each of the climate hazards are translated into a standardized score ranging from 0 to 100, providing a relative ranking of global exposure. Higher climate risk scores reflect higher climate risk exposure. Different hazards include heat stress, water stress, floods, sea level rise, and hurricanes & typhoons. Note physical climate risk exposure captures the disruption potential at varies locations, and is not the same as climate impact.

Companies' financial information is collected from Compustat. Country level GDP per capita and FDI outflow and inflow data are from the World Bank.

**Model specifications.** To assess the difference of physical climate risks of overseas facilities owned or operated by Chinese companies across countries, we estimate Model 1 for different physical climate risk drivers:

$$ClimateRisk_{ijc} = \alpha_j + \beta 1 \times ChinesesAsset + \gamma' Controls_{ih} + \varepsilon_{ijch} \qquad (1)$$

To assess the difference of physical climate risks of overseas facilities owned or operated by Chinese companies within countries, I estimate Model 2 for different physical climate risk drivers:

$$ClimateRisk_{ijc} = \alpha_j + \alpha_c + \beta 2 \times ChinesesAsset + \gamma' Controls_{ih} + \varepsilon_{ijch} \quad (2)$$

where i indexes firm, j indexes industry, c indexes host country, h indexes headquarters country. $\alpha_j$ are industry fixed effects. $\alpha_c$ are host country-fixed effects. The unit of analysis is firm - industry - host country. The regression is estimated by analytical weighted least squares, where the weight is the total facility count of a firm's operation in one industry and in one host country. The standard errors are clustered at the industry level as the firm-industry-host country observations may not be independent. The coefficient of interest is β1 and β2, which measures the association between Chinese ownership and physical climate risks of overseas assets. Model 1 has the industry-fixed effects which account for unobserved heterogeneity of the industry. Model 2 has both the industry fixed effects as well as host country fixed effects, which accounts for the unobserved heterogeneity of the industry and the country where the overseas facilities are located.

Outcome variables are physical climate risk scores for different climate risk drivers. Different physical climate risks include heat stress, water stress, floods, sea level rise, and hurricanes & typhoons. The climate risk scores are transformed into log forms and standardized to a mean of 0 and a standard deviation of 1 for easy interpretation. Firm level control variables are constructed from Compustat. Size is the natural logarithm of the book value of total assets. Return on Assets (ROA) is the ratio of operating income before depreciation to the book value of total assets. Leverage is the ratio of debt (long-term debt plus short-term debt) to the book value of total assets. Cash holding is the ratio of cash and short-term investments to the book value of total assets. We also include GDP per capita of headquarters countries as a control variable as headquarters countries' economic development level may have impact on firms; overseas location choice.

We also test the difference of physical climate risks of facilities located in China owned or operated by non-Chinese companies using the following specification.

$$ClimateRisk_{ij} = \alpha_j + \beta 3 \times Foreign + \gamma' Controls_{ih} + \varepsilon_{ijh} \quad (3)$$

where i indexes firm, j indexes industry, h indexes headquarters country. $\alpha_j$ are industry fixed effects. The coefficient of interest is β3, which measures the relationship between non-Chinese ownership and physical climate risks of facilities located in China.

In addition, we explore whether the physical climate risks of overseas facilities owned and operated by Chinese companies are different from their assets located in China using the following regression.

$$ClimateRisk_{ij} = \alpha_j + \beta 4 \times Overseas + \gamma' Controls_i + \varepsilon_{ij} \quad (4)$$

where i indexes firm, j indexes industry. $\alpha_j$ are industry fixed effects. The coefficient of interest is β4, which measures the relationship between overseas facilities and physical climate risks of facilities owned or operated by Chinese companies.

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**Competing interests**
The authors declare no competing interests.

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