Climate Conditions and Firm Performance: An Analysis of Temperature and Precipitation Effects on SMEs

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Abstract

Using location-specific annual data of temperature and precipitation, this study examines the impact of climate conditions on the financial performance of SMEs over the period 1987-2022. We find that high temperatures can decrease sales and productivity, particularly in heat-sensitive industries, while ROA remains unaffected. In contrast, precipitation levels show no significant effect on SMEs' performance, except in the energy sector, which is highly sensitive to changes in precipitation. We further explore the differential effects of climate conditions across firm sizes, sectors, extreme climates and the role of adaptation.

Keywords: Climate Change, Temperature, Precipitation, Small and Medium-size Enterprises, Performance, Productivity, Sales, Return on Assets.

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As global temperatures continue to rise and precipitation patterns become increasingly unpredictable due to climate change, understanding their impact on small and medium-sized enterprises (SMEs) is a crucial concern. The SMEs, which often have fewer financial resources and lower adaptive capacities, are particularly vulnerable to climate change. The Intergovernmental Panel on Climate Change (IPCC) noted that SMEs face greater challenges in adapting to climate change compared to larger firms due to their limited ability to invest in adaptation strategies (IPCC, 2000).

The growing concerns about climate change has driven numerous studies to examine the progression of climate conditions and their repercussions on the economic and corporate performances (Dell et al., 2014). Specifically, the climate-economy literature explored the macroeconomic impacts of climate change, focusing on how entire countries or regions, like Sub-Saharan Africa, are affected by temperature fluctuations and changing precipitation conditions (Dell et al., 2012; Barrios et al., 2010; Deschênes and Greenstone, 2007). Furthermore, other studies have also extended beyond the direct effects and have highlighted the risks that climate conditions can cause to humanity, through increased conflicts, migration, heat-related diseases, which can in turn impact the economic and financial systems (Barreca et al., 2016; Kemp et al., 2022; Cattaneo et al., 2019).

However, there is a notable lack of research focusing on smaller firms, particularly SMEs, and how they may be influenced by key climate conditions such as temperature and precipitation. This limit restricts the applicability of the existing findings for SMEs, which operate under different economic and governance conditions compared to larger firms. Thus, the impact of climate conditions on SMEs necessitate a focus into how temperature and precipitation can impact their performance.

This study addresses this gap by examining the impact of both temperature and precipitation, as chronic physical climate risks,[2] on the financial performance of SMEs. We aim to contribute to the existing literature by providing an understanding of how these climate conditions influence SMEs' financial performance. Specifically, we assess how location-specific climate conditions – both temperature and precipitation – affect the performance of SMEs.

The climate-economy literature argues that high temperatures can significantly reduce labor productivity, particularly in jobs requiring physical efforts and outdoor activities (Graff-Zivin and Neidell, 2014). Notably, high temperatures can cause cognitive fatigues and severely reduce the ability of workers to perform effectively their tasks (Graff-Zivin and Neidell, 2014). Additionally, high climate conditions can lead to infrastructure damage and vulnerabilities (water supply, roads, etc.) and increase malfunctions in machines, which in turn can increase the rate of defective products, thus reducing the overall capital productivity (Zhang et al., 2018), especially in industries sensitive to climate conditions.

For instance, the agriculture industry, which is heavily dependent on climatic conditions, can be severely impacted by changes in temperature and precipitation (Dell et al., 2012; Barrios et al., 2010). Fluctuations in climate conditions can lead to reduced crop yields, droughts, or flooding, which can directly damage the agricultural productivity and disrupt food supply chains (Schlenker and Lobell, 2010; Schlenker and Roberts, 2009; Barrios et al., 2010). Similarly, the energy sector can face critical challenges due to its vulnerability to climate fluctuations that can disrupt the energy production and distribution processes (Anton, 2011; Contreras-Lisperguer and de Cuba, 2008; Barrios et al., 2010).

[2] This study focuses on chronic physical risks (temperature and precipitation) which may underestimate broader climate impacts not covered here (i.e. acute risks). This limitation is acknowledged to allow a detailed analysis on chronic risks.

In this study, we use a high-resolution temperature and precipitation data from the Climatic Research Unit Time-Series (CRU-TS) provided by the Centre for Environmental Data Analysis (CEDA). This dataset documents annual average temperature and precipitation across each coordinate of longitude and latitude combination. Our sample focuses on SMEs with 2 to 250 employees, not group-affiliated, to ensure the identification of climate effects, as SMEs -unlike large groups- are less able to shift their financial resources across subsidiaries or relocate their operational activities. Then, we combine the climate data with precise geographic locations of SMEs obtained from Compustat Global and Compustat North America to ensure a global analysis of specific-location climate conditions on the financial performance of SMEs.

We assess the financial performance of SMEs using three variables: sales, productivity and Return on Assets (ROA). These measures are recognized in the finance literature for their effectiveness in reflecting corporate financial performance (Günther and al., 2012; Busch and Lewandowski, 2018). Moreover, the accounting-based measures are particularly relevant to evaluate the corporate financial impacts of environmental and climate conditions, as they are better to translate potential revenue and cost implications (Flammer, 2015; Ambec and Lanoie, 2008). Drawing on the methodology from the climate-economic literature (Dell et al., 2014; Addoum et al., 2020), our analysis focuses on SMEs in various countries from 1987 to 2022, and uses a fixed effects regression model that adjusts for firm-level controls, such as tangibility, liquidity and leverage, and broader economic indicators such as GDP per capita and inflation rates.

Our main findings reveal that temperature exerts a significant impact on SMEs financial performance. Specifically, our results show that an increase in temperature consistently leads to a decrease in sales and productivity, but does not significantly affect ROA. Particularly, we find that a 1-degree Celsius increase in temperature is associated with 1.22% decrease in sales and 1.73% in productivity. This suggests that while operational outcomes – sales and

productivity – are sensitive to changes in temperature, financial returns (ROA) are unresponsive to climate fluctuations, because they are more related to internal fund allocations and managerial policy decisions rather than external responses (Orlitzky et al., 2003; Anton, 2021).

On the other hand, precipitation does not have a significant impact on SMEs' performance. Our results indicates that financial performance of SMEs appear largely resilient to changes in precipitation levels, with no significant effect on operational or financial returns of SMEs. Further, we explored the combined effects of precipitation with temperature. The results revealed that, even in high-temperatures, precipitation continues to have no significant impact on SMEs performance.

This study also explores how SMEs' financial characteristics affect their sensitivity to meteorological conditions. Our findings indicate that firm size can significantly influence the effects of climate conditions. Notably, medium firms (a maximum of 250 employees) demonstrate a capacity to mitigate the negative impacts of rising temperatures, likely due to greater resources and more effective adaptation strategies to mitigate climate impacts. Whereas, small firms (with 10 to 100 employees) and micro (with 2 to 10 employees) firms are more affected, largely due to their limited resources and constrained ability to adapt to high climate conditions.

Our analysis also explores industry-specific sensitivity to temperature and precipitation levels. The results underscore that the negative impact of temperature on sales is more pronounced in heat-sensitive industries, while the impact on productivity is not significant aligning with the findings of Addoum et al., (2020). For precipitation, our study notes that the impact is particularly more pronounced within the energy sector, showing significant negative impacts across all the three performance variables.

Moreover, we looked at climate effects across 11 different two-digit GICs sectors. By defining a subsample for each of the 11 different sectors, our results reveal that temperature can have a negative impact on SMEs performance in some sectors; decreasing the sales of the materials sector by 2.48%, healthcare 2.06% and utilities 6.56%. Moreover, it can reduce productivity of the materials sector by 3.29%, industrials 1.82%, communication services 3.57% and utilities 5.10%. In the other hand, we find that precipitation can decrease sales of SMEs in the materials sector by 0.83% and 0.47% in the consumer discretionary. Whereas, it can be beneficial to SMEs in the communication services by increasing sales by 1.69%, possibly due to increased demand for communication services during rainy periods.

Additionally, we investigate the effects of extreme temperature and extreme dry conditions on SMEs performance. We find that extremes heat conditions can have different impact on the financial performance of SMEs, as firms might implement adaptation strategies to mitigate sales and productivity effects during extreme heat. In contrast, extreme dry conditions can exacerbate the negative impact on sales, while their impact on productivity and ROA remains insignificant.

Furthermore, we examine the role of adaptation strategies in mitigating the effects of climate conditions on SMEs' performance, using Research & Development expenses as a proxy for firms' ability to invest in adaptation strategies. We find that firms with high R/D experience lower impact on their performance compared to low R/D firms, indicating that R/D adaptation can mitigate climate effects.

In robustness checks, we first check for the lagged effects of temperature and precipitation, and we find that their impact on SMEs performance are not strongly persistent over time. Second, we deal with the short-termed fluctuations of temperature and precipitation by averaging all variables over 5-years period, following the approach of Beck and Levine (2004), and we find

that temperature continue to exhibit adverse impact on SMEs' sales and productivity. Third, to address potential endogeneity, we first employ industry-year fixed effects as in Borsuk et al. (2024), to control for unobservable factors influencing both location choices and performance outcomes and second, we employ the 2015 Paris Agreement to examine potential different post-effects of the agreement on SMEs location choices and performance (Ginglinger and Moreau, 2023; Pankratz et al., 2023; Stroebel and Wurgler, 2021). Our findings remain consistent.

Overall, our study aims to contribute to the growing literature on climate finance by providing an analysis of how climate conditions impact SMEs' financial performance. Unlike previous studies that focus on large firms or aggregate economic outcomes, our study specifically examines SMEs, which are more vulnerable to climate shocks due to their limited financial resources and constrained adaptive capacities (IPCC, 2000). First, by focusing on SMEs, our study fills this gap in the literature, highlighting the importance of SMEs' responses to climate risks, and emphasizing the need for tailored adaptive strategies to ensure SMEs' resilience and sustainability. Second, our study extends the literature on physical climate risk by analyzing both temperature and precipitation effects on multiple dimensions of SMEs' performance, including sales, productivity and asset returns. Third, we explore firm heterogeneity by investigating how SMEs are affected differently based on their size, industry sensitivity and sectoral characteristics.

The remainder of this paper is structured as follows: first, we present the empirical setting of our study. Second, we discuss our main empirical results. Next, we explore several extensions, including firm size effects, climate-sensitive industries, sector effects, climate extremes and the role of adaptation strategies. Finally, we conduct several tests of robustness.

1. Empirical Setting

1.1. *Literature and Hypotheses*

In this study, we explore the impact of climate conditions on the financial performance of small and medium-sized enterprises (SMEs). Drawing on the climate economy literature, we hypothesize that adverse climate conditions, specifically higher temperatures and high precipitation levels, can negatively affect SMEs' financial performance.

First, we posit that high temperatures can negatively affect SMEs' performance, due to the physical and cognitive fatigues among workers caused by high temperatures (lower time of execution, vigilance, mental arithmetic, etc.), and this can result in lower marginal labour productivity (Graff Zivin and Neidell, 2014). Additionally, high temperatures are also associated with reductions in effective working hours and a rise in health-related absences, subsequently impacting the overall productivity levels (Lesk, Rowhani and Ramankutty, 2016).

Hypothesis 1: SMEs located in areas with higher temperatures have lower financial performance.

Second, we posit that higher precipitation levels can negatively impact SMEs' financial performance. That's because high precipitations can lead to infrastructure damage and vulnerabilities (water supply, roads, etc.) and increased machine malfunctions (Zhang et al., 2018). Notably, such conditions can increase the rate of defective products, and thereby reducing the overall capital productivity, especially in industries highly sensitive to precipitation fluctuations, such as agriculture and energy, where changes in precipitation patterns can have significant consequences and cause real damages to the overall economy in certain countries (Barrios et al., 2010)

Hypothesis 2: SMEs located in areas with higher precipitation levels have lower financial performance.

1.2.*Data Description.*

For the empirical analysis of the impact of climate variables on SMEs' financial performance, we obtain global financial data on SMEs across 69 countries from Compustat Global and Compustat North America databases (the list of countries is available in Appendix B), from 1987 to 2022. We focus on SMEs with 2 to 250 employees as defined by the International Labour Organization[3], and we exclude sole proprietorships (firms with 1 employee) to avoid potential biases related to their specific firm structures and often limited financial data (Bertoni et al., 2023; Galema, 2020).

Further, we use firms with a stock ownership code (stko item in Compustat) of only 0 or 3, referring to non-affiliated firms that do not belong to a group. This criteria aims to enhance the identification of the effects of climate conditions on financial performance, as group-affiliated firms often benefit from financial advantages, which can influence firm performance (Carney et al., 2011), hence confusing the true impact of climate conditions.,

Climate data, including mean annual temperature (in °C) and total annual precipitation (in 100mm), are sourced from the Climatic Research Unit (CRU) Time-Series (TS) version 4.07 of the Centre for Environmental Data Analysis (CEDA) database. This database provides a high-resolution monthly gridded climate data encompassing 379,468,800 data points globally from 1901 to 2022. To match each SME with its corresponding climate data, we geocoded firm addresses (including zip code and country information) using Google API and we obtained precise geographic coordinates (longitude and latitude). These coordinates were then merged

[3] Small and medium-sized enterprises and decent and productive employment creation, Report IV, International Labour Conference, 104th Session, 2015.

with the climate dataset to have the specific temperature and precipitation values to each firm based on its geographic location.[4]

For financial data, we examine the impact of temperature and precipitation on three main financial performance variables: *sales* as the natural logarithm of total sales, *productivity*, presented as the natural logarithm of total sales to the number of employees as in Addoum et al. (2020), and *ROA (Return on Assets)*, as the ratio of before tax income to total assets (see appendix A).

For firm-level controls, *tangibility* is calculated as the ratio of property, plant, and equipment to total assets, *liquidity* as the ratio of cash and short-term investments to current liabilities, and *leverage* as the total debt divided by total assets. For the country-level controls, we sourced GDP per capita and inflation from the World Bank Database. To limit the influence of outliers in the data, all financial and economic variables are winsorized at the 5th and 95th percentiles.

Our panel dataset includes 7,371 SMEs over the period from 1987 to 2022, aligning with the availability of financial data for non-North American firms from Compustat Global and the availability of the latest climate data from CRU-TS database (attrition rate of 11.46% based on initial screening criteria). This geographical and temporal coverage enables a comprehensive investigation of how variations in climate conditions can affect SMEs financial performance across different regions and economic contexts.

As presented in Table 1, the mean annual temperature recorded is 14.05°C, with a standard deviation of 4.68°C. The minimum temperature of -3°C was observed in Sourgout, Russia during 2010, and the maximum temperature of 29.57°C was recorded at Bangkok, Thailand in

[4] Given data limitations, we acknowledge that location data in Compustat is most likely to be the firm's headquarters rather than production locations. However, for non-affiliated SMEs, production activities are generally concentrated in the same location as their headquarters.

2019.[5] For precipitation, the average value stands at 1030.30 mm, with a standard deviation of 438.30 mm. The highest precipitation level is 4433 mm, observed in Mumbai, India in 2010, while the minimal value was recorded in many locations at different countries, such as China, Columbia and the United States[6] (see appendix B and C for descriptive statistics per country and per year, respectively).

1.3. *Empirical Model.*

To investigate the effects of climate factors – temperature and precipitation – on financial performance of SMEs, we use a panel fixed effects model at the firm level. We identify climate effects by adding time fixed effects as in Addoum et al. (2020) and Dell et al. (2012), to control for common global trends and ensure that climate effects are identified from local fluctuations. This specification aims to quantify the impacts of temperature and precipitation on the three financial performance variables (sales, productivity and ROA). The model is as follows:

$$Y_{it} = \alpha + \beta X_{it} + \gamma Z_{it-1} + \delta C_{it} + \mu_i + \tau_t + \epsilon_{it}$$

Where Y_{it} represents the dependent financial variable (e.g. sales, productivity or ROA) for a firm i in year t, X_{it} is a vector of independent variables representing either temperature or precipitation data, matched to the geographic location of each firm in a year t. Z_{it-1} includes firm-specific controls such as tangibility, liquidity, and leverage, all lagged by one year to address potential endogeneity issues. C_{it} encompasses country-specific controls, that are GDP per capita and inflation to capture time-varying economic conditions that might influence firm

[5] All reported temperatures represent mean annual values. The minimum and maximum temperatures correspond to the lowest and highest mean annual temperature recorded in a given location during a year.

[6] All reported precipitations represent the total annual values. The minimum and maximum precipitations correspond to the lowest and highest total precipitation recorded in a given location during a year.

performance. μi, τt and ϵit denote respectively firm-specific fixed effects, year dummies and the error term clustered both by the firm and across time.

2. Main Empirical Results

2.1. *Temperature Effects.*

We begin by examining the effects of mean temperature on the performance of SMEs as reported in Panel A of Table 2. In column 1, the regression of temperature on sales reveals a negative and significant estimated coefficient, indicating that a 1°C increase in temperature is associated with 1.22% decrease in sales. This finding suggests that higher temperature can reduce sales activities due to lower production rates particularly in heat-sensitive industries (Graff-zivin and Neidell, 2004).

In column 2, the regression of temperature on productivity shows a negative and statistically significant coefficient, indicating that a 1°C increase in temperature decreases productivity by 1.73%. This finding suggests that higher temperature not only decreases sales but also reduce the productivity. This is consistent with literature which posits that higher temperatures can reduce working hours and degrade physical and cognitive performances (Graff-Zivin and Neidell, 2014; Hancock et al., 2007).

In column 3, we regress temperature on ROA and find no evidence that temperature is significantly related to this financial variable. This lack of significance indicates that firm-level temperature does not impact the asset returns of SMEs, suggesting that ROA is less directly affected by climate factors compared to productivity and sales. This insignificance is consistent with broader environmental and social finance literature which suggests that the influence of environmental factors on operating profitability is complex and often indirect. Particularly, the impact on the return on assets (ROA) may be more related to internal fund allocations and managerial policy decisions rather than external responses (Orlitzky et al., 2003; Anton, 2021).

2.2. *Precipitation Effects.*

In the second section of our analysis, we examine the effects of precipitation on SMEs' financial performance. Panel B of Table 2 reveals that precipitation has no statistically significant impact on SMEs performance, suggesting that financial performance variables for SMEs are resilient to rainfall conditions. However, when we explore the interaction effect between precipitation and temperature, the results show a different pattern. In Panel C, we introduce an interaction with *High-Temperature* dummy, identifying firms experiencing a temperature higher than the country's median temperature for the corresponding year, to assess how precipitation effects can vary between high and low temperatures. Our results reveal that SMEs' performance continues to be unresponsive to precipitation fluctuations even when interacted with high temperatures.

3. Extensions

In this section, we analyze the differential effects of climate conditions on the performance of SMEs with a focus on firm size, industry sensitivity to climate conditions, sector-specific responses, and climate extremes.

3.1.*Size effects.*

To investigate whether firm size can significantly affect the relationship between temperature, precipitation, and SMEs' performance, we categorize SMEs into three groups according to the International Labour Organization's definition. This categorization corresponds to micro firms with 2 to 10 employees, small enterprises with 10 to 100 employees, and medium enterprises with a maximum of 250 employees. For each group, we create a dummy variable that we interact with either temperature or precipitation.

In Panel A of Table 3, we observe that temperature consistently shows no significant impact on ROA, indicating an inherently resilience within firms. When it comes to sales, the introduction

of the interaction term between temperature and firm sizes shows that there is no differential effect on sales compared to medium firms.

Whereas, the impact of temperature on productivity shows that the temperature effects are more pronounced for micro and small firms compared to medium firms. In contrast, a 1°C increase in temperature leads to a 1.64% decrease in productivity for small firms, and 1.94% for micro firms, compared to medium firms. This highlights that medium-sized firms are less vulnerable to temperature fluctuations, due to larger resources and capacities to mitigate temperature effects. .

In Panel B of Table 3, we extend the examination of how precipitation affects financial performance across the different size categories of SMEs. We find no significant differential effect across firms for sales and ROA, consistent with the main findings. However, when it comes to productivity, the results reveal that medium firms can benefit from increased precipitations, and that this impact does not significantly differ for small firms. In contrast, micro firms experience a 3.51% lower productivity per 100mm increase in precipitation compared to medium firms. This suggests that micro firms are less able to leverage precipitation conditions into productivity benefits, likely due to their higher vulnerability to climate conditions (IPCC, 2000).

The impact of temperature and precipitation on SMEs' financial performance can vary by firm size. Specifically, while medium firms are somewhat more able to mitigate and adapt to the negative effects of climatic conditions, the ongoing challenges on financial performance, particularly for productivity and sales, remain persistent for micro firms.

3.2.*Industries sensitivity effects.*

In Table 4, we further investigate how climate conditions affect SMEs' financial performance by considering the specific sensitivities of certain industries to temperature and precipitation.

In the climate economy literature, several studies identified that industries like agriculture, manufacturing, mining, construction, mining and transportation, show particularly a higher sensitivity to climate conditions than other industries (Graff-Zivin and Neidell, 2014; Dell et al., 2014; Barrios et al., 2010).

Considering these sensitivities, we introduce a "*Heat-sensitive*" dummy variable in Panel A to identify industries particularly sensitive to heat, based on the 6-digit GICS codes as outlined by Graff-Zivin and Neidell (2014) and Addoum et al. (2020).[7] In Panel B, we focus on industries sensitive to precipitation levels, specifically the Agriculture and Energy, as identified by Barrios et al. (2010). Accordingly, we employ two dummy variables: "*Agriculture*" equal to 1 for firms in the agricultural industry (302020 to 302030) and "*Energy*" for firms in the energy industry (GICs sector 10).

In Panel A of Table 4, the results reveal that the impact of temperature on sales is significantly more pronounced in heat-sensitive industries. Specifically, a 1-degree Celsius increase in temperature results in a 4.46% decrease in sales. In contrast, the same increase in temperature has no significant effect on non-heat-sensitive industries.

On the other hand, the results indicate that temperature has a significant negative impact on productivity for non-heat-sensitive industries, leading to a 2.18% decrease per 1°C increase. However, the impact on heat-sensitive industries is statistically insignificant. This aligns with the findings of Addoum et al. (2020), who reported no significant impact of temperature on establishment productivity within heat-sensitive industries, indicating that these industries may

[7] The heat-sensitive industry indicator is set to one for firms holding a 6-digit GICS industry code as follows: 151050 (Paper & Forest Products), 151040 (Metals & Mining), 201030 (Construction & Engineering), 251020 (Automobile & Motorcycle Manufacturers), 203010 to 203050 (Transportation), 302020 to 302030 (Food Product & Tobacco Producers), and 551010 to 551050 (Utilities).

have adopted adaptation strategies to temperature fluctuations, mitigating the productivity impacts (Dell et al., 2012).

When it comes to precipitation, the results of Panel B indicate that the energy sector is highly sensitive to precipitation, more so than other sectors. This sensitivity is remarkable across the three dimensions of financial performance, showing a negative and significant impact on sales, productivity and asset returns. The energy sector relies now heavily on water supply and is particularly vulnerable to changes in precipitation, affecting energy production systems (Barrios et al, 2010; Contreras-Lisperguer and de Cuba, 2008). Particularly, a 100mm rise in precipitation can decrease sales by 1.40%, productivity by 1.08% and ROA by 0.14%.

For the agricultural sector, our results find no statistical evidence that precipitation has a distinct impact on agricultural SMEs' financial performance. This result can be driven by many factors. First, the agricultural performance is generally influenced to a complex interplay of many climate factors, including not only precipitation, but also temperature, humidity and atmospheric CO2 concentrations (Contreras-Lisperguer and de Cuba, 2008). Second, the impact of precipitation on the agriculture sector is generally more pronounced in developing countries, particularly those in Sub-Saharan Africa, who often rely more directly on precipitation levels (Barrios et al., 2010). Third, agricultural SMEs may have implemented adaptation strategies to mitigate precipitation risks, such as irrigation systems (Barrios et al., 2010). Fourth, this absence of result can also be due to our focus on SMEs, which might experience a different impact of precipitation within the agriculture sector than larger agricultural firms, potentially being less vulnerable to precipitation shortages.

3.3. *Sector Effects*

In our further analysis, we further delve into how temperature and precipitation impact SMEs' financial performance across different sectors using the two-digit GICS classification.[8] Specifically, we define eleven subsamples based on the 11 different GICS sectors to capture the direct effect of climate conditions on the performance of SMEs within each sector.

In Panel A of Table 5, we examine for each sector separately the impact of temperature on the three SMEs' financial performance variables. Our results reveal that temperature affect differently some sectors. For instance, a 1-degree Celsius increase in temperature can decrease sales on the materials sector by 2.48%, healthcare 2.06% and utilities 6.56%, while the impact is statistically insignificant for all other sectors. This indicates that SMEs in these sectors can face significant operational challenges as temperature rises. For productivity, we find that higher temperature can reduce productivity in the materials sector by 3.29%, industrials 1.82%, communication services 3.57% and utilities 5.10%. In contrast, temperature has no significant effect on SMEs' productivity in other sectors. For ROA, temperature has a positive and significant, yet marginal, impacts across the information technology sector 0.25% and financials 1.38%.

When examining the effects of precipitation, the results of Panel B show disparate impacts on sales, productivity and ROA across the different sectors. However, the significant effect observed remain relatively small and marginal. For instance, a 100mm increase in precipitation lead to a 0.83% decrease in sales in the materials sector and 0.47% in the consumer discretionary. In contrast, the same increase in precipitation, can be beneficial to SMEs in the communication services by increasing sales by 1.69%, possibly due to increased demand for

[8] The two-digit GICS sectos are : Energy (10), Materials (15), Industrials (20), Consumer Discretionary (25), Consumer Staples (30), Health-Care (35), Financials (40), Information Technology (45), Communication services (50), Utilities (55), Real estate (60).

communication services during rainy periods. Similarly, precipitation positively affects productivity of SMEs in communication services by 1.79%, while it negatively affect the energy sector by 0.90%. For ROA, precipitation has a marginally positive impact on industrials of 0.058%, while it reduces the asset returns of information technology by 0.094%. The effect on other sectors is statistically insignificant. The impact of precipitation on other sectors is statistically insignificant.

3.4.*Climate Extremes.*

In our analysis of the impact of climate extremes on SMEs' financial performance, we capture periods of unusually high temperature by defining *Extreme Heat* dummy as having a temperature that exceeds the mean of temperature by at least one standard deviation over the previous ten years for each country. Similarly, to capture dry conditions, the dummy *Extreme Dry* is defined as having precipitation levels that fall below the mean by at least one standard deviation over the previous ten years for each country.

In Table 6, our findings reveal that normal temperatures have distinct impacts on SMEs' performance. For sales, normal temperature fluctuations have no significant impact on sales, however during extreme heat periods, temperature can increase sales by 0.97%. Similarly, the results show opposing effects with normal temperature and extreme temperature on productivity. Specifically, a 1°C increase in temperature reduces productivity by approximately 0.53% during normal temperatures, however in extreme temperature conditions, the effect is positive by 0.70%. This indicates that firms may implement adaptation strategies to mitigate the sales and productivity effects during extreme heat (Addoum et al., 2020). For ROA, the results remain consistent with our main findings, showing that temperature, whether normal or extreme, has no significant effect.

On the other hand, our analysis of extreme dry conditions in Panel B shows that both normal and extremely low levels of precipitation negatively affect sales, with reductions of 0.52% and 0.47%, respectively. However, for productivity and ROA, our results reveal no statistical significant effects under both normal and extreme dry conditions.

3.5. *Adaptation.*

In Table 7, we investigate the influence of adaptive strategies in moderating the impacts of climate conditions on SMEs' performance. In our analysis, we consider Research & Development expenses as a proxy for a firm's ability to invest in adaptive technologies that may mitigate the negative effects of climate conditions (Xiao, 2021). We define a *High R/D* dummy for firms with a level higher than the industry median.

We find that temperature negatively affects sales for both *Low* and *High R/D* firms, with High R&D firms experiencing a smaller decline of 1.15% per one degree Celsius increase, compared to 2.16% for *Low R&D* firms, suggesting that R&D adaptive strategies help mitigate climate effects. Similarly, productivity remains significantly affected across both firms, with a 1.61% decline for *High R&D* firms compared to 2.16% decline for *Low R&D* firms, indicating that R&D adaptive strategies can effectively mitigate productivity effects. ROA remains unaffected. For precipitation, the effects continue to be insignificant for all performance variables across both groups.

4. Robustness Checks

4.1. *Lagged effects.*

In Table 8, we explore the persistence of the effects of climate condition on the financial performance of SMEs by introducing lag terms from 1 to 4 years for temperature and

precipitation. Our results indicate that the climate effects are not strongly persistent over time. If climate effects were persistent, we would expect increasingly negative lagged coefficients over multiple year (Dell et al., 2014). However, we find that lagged climate effects weaken over time and, in some cases turn positive, suggesting that SMEs may adopt adaptation strategies to mitigate climate effects. This implies that climate conditions primarily have only short-term, rather than long-term, impacts on SMEs financial performance.

4.2.*5-years Average Models.*

In Table 9, we examine the impact of climate conditions over a five-year period on the financial performance of SMEs to deal with the short-termed fluctuations of temperature and precipitations. All variables in specifications are averaged over 5-year period, following the approach of Beck and Levine (2004).[9] The findings indicate that temperature exhibits consistently and significantly a negative impact on productivity. This indicates that long-term increased temperatures can adversely affect the performance of SMEs. Moreover, the results continue to show no significant impact on ROA.

In contrast, the effects of precipitation over five years do not reveal a significant influence on sales and ROA, suggesting that, fluctuations of precipitation over a longer period do not directly affect the performance of SMEs. However, long-term increased in precipitation shows a positive effect on productivity. This could imply that over longer periods, fluctuations in precipitation levels might affect positively some aspects of SMEs' productivity, potentially benefiting industries that are sensitive to precipitation levels.

[9] The 5-year periods are: 1987-1991, 1992-1996, 1997-2001, 2002-2006, 2007-2011, 2012-2016 and 2017-2022.

4.3. *Endogeneity.*

Potential endogeneity can arise in our study, either because of omitted variables or because SMEs might choose their geographic locations based on expected climate conditions. To address this endogeneity, we first employ industry-year fixed effects as in Borsuk et al. (2024), to control for the unobservable that can influence both location choices and performance outcomes. Second, we employ the 2015 Paris Agreement to examine potential different post-effects of the agreement on SMEs location choices and performance. We define *Paris 2015* as a dummy variable, taking 1 for years following the 2015 Paris Agreement, and 0 otherwise.

Results of Table 10 reveal that the impact of temperature on sales and productivity is consistent with our main findings after accounting for industry-year fixed effects, and that performance outcomes continue to be unresponsive to precipitation fluctuations. Table 11 shows that temperature consistently exhibit a negative and significant impact on SMEs sales and performance after the 2015 Paris Agreement. However, this impact is reduced following the agreement, suggesting a potential change in SMEs' response. This could be related to SMEs increasing the investments in climate adaptation and mitigation strategies and changes in consumer and investor preferences (Ginglinger and Moreau, 2023; Pankratz et al., 2023; Stroebel and Wurgler, 2021; Krueger et al. 2020).

5. Conclusions

This study contributes to the existing climate finance literature by examining the impact of temperature and precipitation on the performance of small and medium-sized enterprises (SMEs). Our findings reveal that high temperatures can reduce sales and productivity, while the Return on Assets (ROA) remain generally unresponsive to climate fluctuations. While precipitation generally does not affect SMEs performance, the energy sector – which is particularly sensitive to precipitation levels (Barrios et al., 2010) – appears to be considerably

impacted by increased precipitation levels, impacting all the three performance variables. In the other hand, we find that heat-sensitive industries can experience greater performance losses with rising temperatures compared to non-heat-sensitive industries.

Additionally, we find that climate effects can vary by firm size and sector activity. Specifically, we find that micro and small firms display a more pronounced vulnerability to climate fluctuations due to their limited adaptive capacities, whereas medium-sized firms exhibit greater resilience and potential positive adaptations. Moreover, while some sectors are negatively impact by climate fluctuations, others, such as communication services, can benefit from these conditions. Furthermore, we find that temperature effects on sales and productivity are less pronounced for SMEs with *High R/D* (research and development level) than those with *Low R/D*, indicating that investing in adaptive strategies can help mitigate climate effects.

By focusing on SMEs, this study underlines the responses of SMEs' performance to climate conditions, an area less explored compared to studies on larger firms, and for which the effect is less identifiable (Addoum et al., 2020). Overall, our findings highlight the importance of investing in tailored adaptive strategies to ensure the sustainability of SMEs in a shifting climate environment.

6. Tables

Table 1 Descriptive Statistics.

Variables	Obsevations	Mean	Std. Dev.	Min	Max
Temperature	90651	14.055	4.683	-3	29.575
Precipitation	90651	10.303	4.383	0	44.33
Sales	90537	7.981	1.76	5.442	12.159
Productivity	90537	5.653	1.293	3.769	9.345
ROA	90578	.059	.076	-.101	.21
Tangibility	89851	.297	.221	.015	.753
Liquidity	81916	.491	.523	.022	1.943
Leverage	90352	.275	.188	.001	.676
GDP per capita	90331	10.477	.495	9.122	11.159
Inflation	90323	2.386	1.622	-.074	7.041

Note: Table 1 reports descriptive statistics for the main variables in our study. Climate variables includes *Temperature* in degrees Celsius and *Precipitation* in hundreds of millimetres. Performance variables include *Sales* (the natural logarithm of total sales), *Productivity* (the natural logarithm of sales to employees) and *ROA* (the ratio of before tax income to total assets). Firm-level control variables include *Tangibility* (the ratio of property, plant, and equipment to total assets), *Liquidity* (the ratio of cash and short-term investments to current liabilities), and *Leverage* (the total debt divided by total assets). Country-level control variables include *GDP per capita* (in log) and *Inflation* (GDP deflator).

Table 2 Main Results.

	Panel A			*Panel B*			*Panel C*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Sales	Productivity	ROA	Sales	Productivity	ROA	Sales	Productivity	ROA
Temperature	-0.0122***	-0.0173***	-5.23e-06						
	(0.00412)	(0.00308)	(0.000444)						
Precipitation				-0.00122	0.000481	4.24e-05	-0.00151	-0.00159	1.31e-05
				(0.00139)	(0.00114)	(0.000144)	(0.00219)	(0.00188)	(0.000225)
High-temperature							-0.0683**	-0.0849***	-0.00255
							(0.0276)	(0.0258)	(0.00224)
Precipitation × *High-temperature*							0.00150	0.00268	4.99e-05
							(0.00208)	(0.00187)	(0.000184)
Tangibility	-0.223**	-0.343***	-0.0153**	-0.223**	-0.343***	-0.0153**	-0.149	-0.318***	-0.0199**
	(0.0970)	(0.0847)	(0.00623)	(0.0970)	(0.0847)	(0.00623)	(0.119)	(0.105)	(0.00774)
Liquidity	-0.156***	-0.0385***	0.00825***	-0.157***	-0.0386***	0.00824***	-0.136***	-0.0457***	0.00568***
	(0.0156)	(0.0108)	(0.00125)	(0.0156)	(0.0108)	(0.00125)	(0.0127)	(0.00999)	(0.00127)
Leverage	-0.0294	-0.0276	-0.100***	-0.0298	-0.0280	-0.100***	-0.128***	-0.0588	-0.103***
	(0.0482)	(0.0387)	(0.00399)	(0.0482)	(0.0387)	(0.00399)	(0.0491)	(0.0407)	(0.00508)
GDP Per Capita	0.0799	-0.302***	-0.0114***	0.0792	-0.304***	-0.0114***	0.271***	0.0103	-0.0133***
	(0.0908)	(0.0959)	(0.00424)	(0.0910)	(0.0961)	(0.00424)	(0.102)	(0.0952)	(0.00454)
Inflation	0.00762	0.00667	0.00245***	0.00765	0.00668	0.00245***	-0.00359	-0.0124**	0.00216***
	(0.00495)	(0.00474)	(0.000317)	(0.00495)	(0.00474)	(0.000317)	(0.00585)	(0.00583)	(0.000343)

Firms FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Years FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Constant	6.632***	8.300***	0.227***	6.486***	8.083***	0.227***	4.692***	5.143***	0.258***
	(0.896)	(0.944)	(0.0423)	(0.890)	(0.936)	(0.0420)	(0.983)	(0.921)	(0.0453)
Number of observations	73,287	73,287	73,309	73,287	73,287	73,309	73,287	73,287	73,309
R-squared	0.325	0.208	0.090	0.325	0.208	0.090	0.293	0.167	0.072
Number of firms	6,038	6,038	6,039	6,038	6,038	6,039	6,038	6,038	6,039

Note: In table 2, we investigate the relationship between temperature and SME's performance. In *Panel* A, the main independent variable is *Temperature* (mean annual temperature) in degrees Celsius. The main independent variable in *Panel B* is *Precipitation* (the annual precipitation) in hundreds of millimetres. In *Panel C*, we investigate the impact of the interaction term of *High-Temperature* (defined as having a temperature that exceeds the median of temperature for each country for the corresponding year) on SME's performance. Performance variables include *Sales* (the natural logarithm of total sales), *Productivity* (the natural logarithm of sales to employees) and *ROA* (the ratio of before tax income to total assets). Firm-level control variables include *Tangibility* (the ratio of property, plant, and equipment to total assets), *Liquidity* (the ratio of cash and short-term investments to current liabilities), and *Leverage* (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include *GDP per capita* and *Inflation* (GDP deflator). Standard errors are clustered by year at the firm level, *** p<0.01, ** p<0.05, * p<0.1

Table 3 Size Effects.

	Panel A			*Panel B*		
	(1)	(2)	(3)	(4)	(5)	(6)
	Sales	Productivity	ROA	Sales	Productivity	ROA
Temperature	-0.00700	0.00210	0.000170			
	(0.00938)	(0.00931)	(0.000691)			
Temperature × *small*	-0.00492	-0.0185**	-0.000103			
	(0.00877)	(0.00937)	(0.000553)			
Temperature × *micro*	-0.00717	-0.0215**	-0.000243			
	(0.00994)	(0.00994)	(0.000613)			
Precipitation				0.00771	0.0314***	-0.000160
				(0.00855)	(0.00855)	(0.000473)
Precipitation × *small*				-0.00800	-0.0301***	0.000287
				(0.00875)	(0.00897)	(0.000467)
Precipitation × *micro*				-0.00857	-0.0351***	0.000141
				(0.00916)	(0.00897)	(0.000509)
Firms FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Years FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Constant	7.737***	7.643***	0.224***	7.584***	7.357***	0.228***
	(0.871)	(0.934)	(0.0433)	(0.861)	(0.921)	(0.0426)
Number of observations	73,287	73,287	73,309	73,287	73,287	73,309
R-squared	0.415	0.221	0.090	0.415	0.222	0.090
Number of firms	6,038	6,038	6,039	6,038	6,038	6,039

Note: In table 3, we investigate the differentials effects of firm size on the relationship between climate conditions and SME's performance. We define three categories of SMEs according to the International Labour Organization's definition. The first category includes *micro* firms with up to 10 employees, the second category represents *small* enterprises with 10 to 100 employees, and the third category includes *medium* enterprises with a maximum of 250 employees. In *Panel A*, the main independent variable is *Temperature*

(mean annual temperature) in degrees Celsius and in *Panel B* the independent variable is *Precipitation* (the annual precipitation) in hundreds of millimetres. In both panels, Performance variables include *Sales* (the natural logarithm of total sales), *Productivity* (the natural logarithm of sales to employees) and *ROA* (the ratio of before tax income to total assets). Firm-level control variables include *Tangibility* (the ratio of property, plant, and equipment to total assets), *Liquidity* (the ratio of cash and short-term investments to current liabilities), and *Leverage* (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include *GDP per capita* and *Inflation* (GDP deflator). Standard errors are clustered by year at the firm level, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 4 Industries Sensitivity Effects.

	Panel A			*Panel B*		
	(1)	(2)	(3)	(4)	(5)	(6)
	Sales	Productivity	ROA	Sales	Productivity	ROA
Temperature	-0.00472	-0.0218***	-6.99e-05			
	(0.00496)	(0.00370)	(0.000489)			
Temperature × *Heat-sensitive*	-0.0399***	0.0240**	0.000344			
	(0.0130)	(0.0106)	(0.000963)			
Precipitation				-0.000414	0.000982	0.000186
				(0.00148)	(0.00120)	(0.000152)
Precipitation × *Energy*				-0.0136***	-0.0118***	-0.00154***
				(0.00446)	(0.00373)	(0.000592)
Precipitation × *Agriculture*				0.00539	0.00986	-0.000820
				(0.00762)	(0.00631)	(0.000755)
Constant	6.651***	8.288***	0.227***	6.483***	8.082***	0.226***
	(0.896)	(0.944)	(0.0423)	(0.890)	(0.936)	(0.0420)
Number of observations	73,287	73,287	73,309	73,287	73,287	73,309
R-squared	0.326	0.208	0.090	0.325	0.208	0.090
Number of firms	6,038	6,038	6,039	6,038	6,038	6,039

Note: In table 4, we investigate the differentials effects of industries sensitive to temperature and precipitation on the relationship between climate conditions and SME's performance. *Heat-sensitive* industries encompasses Paper & Forest Products (6-digit GICs industry code of 151050), Metals & Mining (151040), Construction & Engineering (201030), Automobile & Motorcycle Manufacturers (251020), Transportation (203010 to 203050), Food Product & Tobacco Producers (302020 to 302030), and Utilities (551010 to 551050), as in Graff-Zivin and Neidell (2014) and Addoum et al. (2020). Industries sensitive to precipitation encompasses Agriculture and Energy as in Barrios et al. (2010); *Agriculture* (302020 to 302030) and *Energy* (GICs sector 10). In *Panel A*, the main independent variable is *Temperature* (mean annual temperature) in degrees Celsius and in *Panel B* the independent variable is *Precipitation* (the annual precipitation) in hundreds of millimetres. In both panels, Performance variables include *Sales* (the natural

logarithm of total sales), *Productivity* (the natural logarithm of sales to employees) and *ROA* (the ratio of before tax income to total assets). Firm-level control variables include *Tangibility* (the ratio of property, plant, and equipment to total assets), *Liquidity* (the ratio of cash and short-term investments to current liabilities), and *Leverage* (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include *GDP per capita* and *Inflation* (GDP deflator). Standard errors are clustered by year at the firm level, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5 Sector Differentials Effects.

	Panel A			Panel B		
	(1)	(2)	(3)	(4)	(5)	(6)
	Sales	Productivity	ROA	Sales	Productivity	ROA
Panel 1 Energy (10)						
Temperature	-0.0176	-0.0134	-0.00368			
	(0.0251)	(0.0224)	(0.00244)			
Precipitation				-0.00587	-0.00904*	0.000698
				(0.00527)	(0.00466)	(0.000613)
Constant	5.155	-0.509	0.348*	4.854	-0.737	0.283
	(3.189)	(2.925)	(0.184)	(3.167)	(2.871)	(0.180)
Number of observations	3,241	3,241	3,241	3,241	3,241	3,241
R-squared	0.332	0.275	0.395	0.332	0.276	0.395
Number of firms	261	261	261	261	261	261
Panel 2 Materials (15)						
Temperature	-0.0248*	-0.0329***	-0.00189			
	(0.0135)	(0.00964)	(0.00140)			
Precipitation				-0.00826*	-0.00266	0.000163
				(0.00425)	(0.00303)	(0.000414)
Constant	10.40***	9.285***	0.218*	10.12***	8.898***	0.194*
	(2.484)	(2.108)	(0.114)	(2.484)	(2.078)	(0.113)
Number of observations	7,422	7,422	7,426	7,422	7,422	7,426
R-squared	0.263	0.267	0.161	0.263	0.267	0.161
Number of firms	530	530	531	530	530	531
Panel 3 Industrials (20)						
Temperature	-0.00844	-0.0182***	-0.00106			
	(0.00772)	(0.00577)	(0.000836)			
Precipitation				-0.00328	0.000188	0.000576*
				(0.00268)	(0.00228)	(0.000309)
Constant	6.774***	8.935***	0.237***	6.685***	8.710***	0.221***
	(1.698)	(1.921)	(0.0717)	(1.679)	(1.902)	(0.0712)
Number of observations	16,550	16,550	16,550	16,550	16,550	16,550
R-squared	0.393	0.252	0.105	0.393	0.252	0.106
Number of firms	1,213	1,213	1,213	1,213	1,213	1,213
Panel 4 Consumer Discretionary (25)						
Temperature	-0.00457	-0.00650	-0.000347			
	(0.00670)	(0.00461)	(0.000985)			
Precipitation				-0.00466*	0.000295	9.71e-05
				(0.00269)	(0.00246)	(0.000336)
Constant	4.721**	7.098***	0.199	4.687**	7.019**	0.194
	(2.002)	(2.747)	(0.133)	(2.002)	(2.738)	(0.133)

Number of observations	16,283	16,283	16,282	16,283	16,283	16,282
R-squared	0.321	0.170	0.130	0.322	0.170	0.130
Number of firms	1,499	1,499	1,499	1,499	1,499	1,499
Panel 5 Consumer Staples (30)						
Temperature	-0.0232	-0.0118	-0.000288			
	(0.0151)	(0.0119)	(0.00130)			
Precipitation				0.00203	0.00302	-0.000411
				(0.00552)	(0.00498)	(0.000467)
Constant	6.164**	6.010**	0.315***	5.872**	5.855**	0.313***
	(2.684)	(2.518)	(0.108)	(2.662)	(2.500)	(0.106)
Number of observations	6,431	6,431	6,432	6,431	6,431	6,432
R-squared	0.305	0.174	0.084	0.305	0.174	0.084
Number of firms	443	443	443	443	443	443
Panel 6 Health Care (35)						
Temperature	-0.0206*	-0.0113	-0.00106			
	(0.0118)	(0.00743)	(0.00142)			
Precipitation				0.00452	0.00107	-0.000339
				(0.00445)	(0.00312)	(0.000536)
Constant	-0.589	2.488	0.400**	-0.925	2.319	0.389**
	(3.167)	(1.697)	(0.171)	(3.121)	(1.644)	(0.171)
Number of observations	6,339	6,339	6,339	6,339	6,339	6,339
R-squared	0.570	0.363	0.075	0.570	0.362	0.075
Number of firms	608	608	608	608	608	608
Panel 7 Financials (40)						
Temperature	-0.0172	0.000731	0.0138***			
	(0.0227)	(0.0180)	(0.00410)			
Precipitation				0.00472	0.000575	-0.00129
				(0.00658)	(0.00507)	(0.00109)
Constant	1.449	-6.997	-0.655	1.274	-6.988	-0.511
	(11.42)	(10.29)	(0.658)	(11.42)	(10.33)	(0.663)
Number of observations	1,123	1,123	1,123	1,123	1,123	1,123
R-squared	0.507	0.171	0.116	0.507	0.171	0.105
Number of firms	139	139	139	139	139	139
Panel 8 Information Technology (45)						
Temperature	0.0174	0.00156	0.00254*			
	(0.0112)	(0.00880)	(0.00146)			
Precipitation				-0.000640	-0.00209	-0.000938*
				(0.00507)	(0.00354)	(0.000483)
Constant	8.522***	16.57***	0.360**	8.740***	16.63***	0.405***
	(2.726)	(3.834)	(0.146)	(2.723)	(3.825)	(0.145)
Number of observations	7,739	7,739	7,739	7,739	7,739	7,739
R-squared	0.396	0.268	0.152	0.396	0.268	0.152

Number of firms	766	766	766	766	766	766
Panel 9 Communication Services (50)						
Temperature	-0.0337	-0.0357*	8.39e-05			
	(0.0252)	(0.0212)	(0.00206)			
Precipitation				0.0169***	0.0179***	0.000177
				(0.00640)	(0.00519)	(0.000521)
Constant	11.89***	11.55***	0.162	11.34***	10.97***	0.161
	(3.327)	(3.281)	(0.137)	(3.268)	(3.219)	(0.135)
Number of observations	4,278	4,278	4,280	4,278	4,278	4,280
R-squared	0.232	0.171	0.119	0.233	0.172	0.119
Number of firms	336	336	336	336	336	336
Panel 10 Utilities (55)						
Temperature	-0.0656***	-0.0510***	-0.000833			
	(0.0226)	(0.0192)	(0.00105)			
Precipitation				-0.00161	-0.00493	-0.000468
				(0.00497)	(0.00436)	(0.000381)
Constant	8.760**	8.416***	0.312***	8.022**	7.819***	0.300***
	(3.587)	(2.761)	(0.109)	(3.591)	(2.832)	(0.108)
Number of observations	3,413	3,413	3,414	3,413	3,413	3,414
R-squared	0.290	0.286	0.154	0.288	0.284	0.154
Number of firms	191	191	191	191	191	191
Panel 11 Real Estate (60)						
Temperature	0.00854	0.00718	-0.00395			
	(0.0352)	(0.0234)	(0.00351)			
Precipitation				-0.00475	-0.00375	0.000357
				(0.0108)	(0.00806)	(0.00108)
Constant	-4.066	-0.788	0.0942	-4.070	-0.787	0.0617
	(7.017)	(4.704)	(0.452)	(6.916)	(4.619)	(0.446)
Number of observations	449	449	464	449	449	464
R-squared	0.577	0.437	0.310	0.577	0.437	0.308
Number of firms	46	46	46	46	46	46

Note: In table 5, we examine the impact of temperature and precipitation on SME's financial performance through separate subsamples for each of the 11 GICs sectors. Each Panel (from 1 to 11) represents a subsample of these sectors. In Panel A, the main independent variable is *Temperature* (mean annual temperature) in degrees Celsius and in Panel B the independent variable is *Precipitation* (the annual precipitation) in hundreds of millimetres. In both panels, Performance variables include *Sales* (the natural logarithm of total sales), *Productivity* (the natural logarithm of sales to employees) and *ROA* (the ratio of before tax income to total assets). Firm-level control variables include *Tangibility* (the ratio of property, plant, and equipment to total assets), *Liquidity* (the ratio of cash and short-term investments to current liabilities), and *Leverage* (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include *GDP per capita* and *Inflation* (GDP deflator). Standard errors are clustered by year at the firm level, *** p<0.01, ** p<0.05, * p<0.1.

Table 6 Extreme Conditions Effects.

	Panel A			*Panel B*		
	(1) Sales	(2) Productivity	(3) ROA	(4) Sales	(5) Productivity	(6) ROA
Temperature	-0.00242	-0.00528*	-9.74e-05			
	(0.00425)	(0.00311)	(0.000471)			
Temperature × *Extreme Heat*	0.0121***	0.0123***	-0.000152			
	(0.00305)	(0.00257)	(0.000266)			
Precipitation				-0.00522**	-0.00126	-1.85e-05
				(0.00246)	(0.00221)	(0.000217)
Precipitation × *Extreme Dry*				0.000536	-0.000163	-0.000224
				(0.00220)	(0.00198)	(0.000186)
Constant	6.560***	8.203***	0.228***	6.528***	8.101***	0.228***
	(0.895)	(0.935)	(0.0425)	(0.888)	(0.934)	(0.0421)
Number of observations	73,287	73,287	73,309	73,287	73,287	73,309
R-squared	0.327	0.211	0.090	0.326	0.208	0.090
Number of firms	6,038	6,038	6,039	6,038	6,038	6,039

Note: In table 6, we test the effect of extreme temperature and extreme precipitation on SME's financial performance. We define *Extreme Heat* dummy as having a temperature that exceeds the mean of temperature by at least one standard deviation over the previous ten years for each country. Similarly, the dummy *Extreme Dry* is defined as having precipitation levels that fall below the mean by at least one standard deviation over the previous ten years for each country. In *Panel A*, the main independent variable is *Temperature* (mean annual temperature) in degrees Celsius and in *Panel B* the independent variable is *Precipitation* (the annual precipitation) in hundreds of millimetres. In both panels, Performance variables include *Sales* (the natural logarithm of total sales), *Productivity* (the natural logarithm of sales to employees) and *ROA* (the ratio of before tax income to total assets). Firm-level control variables include *Tangibility* (the ratio of property, plant, and equipment to total assets), *Liquidity* (the ratio of cash and short-term investments to current liabilities), and *Leverage* (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include *GDP per capita* and *Inflation* (GDP deflator). Standard errors are clustered by year and at the firm level, *** p<0.01, ** p<0.05, * p<0.1.

Table 7 Adaptation Through Research & Development.

	Panel A			*Panel B*		
	(1) Sales	(2) Productivity	(3) ROA	(4) Sales	(5) Productivity	(6) ROA
Temperature	-0.0154***	-0.0216***	-0.000343			
	(0.00561)	(0.00422)	(0.000505)			
Temperature × *High R/D*	0.00385	0.00553	0.000436			
	(0.00509)	(0.00373)	(0.000322)			
Precipitation				0.00470	0.00358	-6.41e-05
				(0.00376)	(0.00302)	(0.000256)
Precipitation × *High R/D*				-0.00744	-0.00388	0.000132
				(0.00452)	(0.00366)	(0.000269)
Constant	6.604***	8.322***	0.231***	6.388***	8.038***	0.228***
	(0.895)	(0.944)	(0.0424)	(0.889)	(0.934)	(0.0421)
Number of observations	73,287	73,287	73,309	73,287	73,287	73,309
R-squared	0.337	0.212	0.090	0.338	0.211	0.090
Number of firms	6,038	6,038	6,039	6,038	6,038	6,039

Note: In table 7, we explore the effects of adaptation and mitigation strategies to climate change through technological innovation. We define *High R/D* dummy as having a research & development level (the natural logarithm of the lagged total research and development expenses) higher than the industry median. In *Panel A*, the independent variables are Temperature in degrees Celsius and in *Panel B* the independent variables are Precipitation in hundreds of millimetres. In both panels, Performance variables include Sales (the natural logarithm of total sales), Productivity (the natural logarithm of sales to employees) and ROA (the ratio of before tax income to total assets). Firm-level control variables include Tangibility (the ratio of property, plant, and equipment to total assets), Liquidity (the ratio of cash and short-term investments to current liabilities), and Leverage (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include GDP per capita and Inflation (GDP deflator). Standard errors are clustered by year and at the firm level, *** p<0.01, ** p<0.05, * p<0.1.

Table 8 Lagged Effects.

	Panel A			*Panel B*		
	(1) Sales	(2) Productivity	(3) ROA	(4) Sales	(5) Productivity	(6) ROA
Temperature	-0.00594	-0.0141***	0.000580			
	(0.00509)	(0.00358)	(0.000545)			
L1. Temperature	0.00700	9.42e-05	0.000715			
	(0.00448)	(0.00326)	(0.000532)			
L2. Temperature	0.00138	-0.00984***	0.000410			
	(0.00491)	(0.00351)	(0.000581)			
L3. Temperature	0.00214	5.72e-06	0.00141**			
	(0.00448)	(0.00341)	(0.000549)			
L4. Temperature	0.00842*	0.00556*	0.00132**			
	(0.00454)	(0.00326)	(0.000568)			
Precipitation				-0.000933	0.00165	5.61e-06
				(0.00166)	(0.00135)	(0.000171)
L1. Precipitation				-0.00162	0.00127	-8.81e-05
				(0.00167)	(0.00141)	(0.000170)
L2. Precipitation				-0.00346**	-0.000554	-0.000381**
				(0.00174)	(0.00145)	(0.000164)
L3. Precipitation				-0.00269*	-0.00138	-8.15e-05
				(0.00151)	(0.00125)	(0.000163)
L4. Precipitation				-0.00546***	-0.00406***	0.000100
				(0.00152)	(0.00124)	(0.000162)
Constant	5.979***	7.981***	0.113**	6.116***	7.730***	0.162***
	(0.951)	(1.034)	(0.0549)	(0.922)	(1.018)	(0.0494)

Number of observations	54,970	54,970	54,979	54,970	54,970	54,979
R-squared	0.299	0.200	0.087	0.299	0.200	0.087
Number of firms	4,546	4,546	4,547	4,546	4,546	4,547

Note: In table 8, we investigate the lagged effects of temperature and precipitation from 1 to 4 years on SME's financial performance. In *Panel A*, the independent variables are Lagged Temperature in degrees Celsius and in *Panel B* the independent variables are Lagged Precipitation in hundreds of millimetres. In both panels, Performance variables include Sales (the natural logarithm of total sales), Productivity (the natural logarithm of sales to employees) and ROA (the ratio of before tax income to total assets). Firm-level control variables include Tangibility (the ratio of property, plant, and equipment to total assets), Liquidity (the ratio of cash and short-term investments to current liabilities), and Leverage (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include GDP per capita and Inflation (GDP deflator). Standard errors are clustered by year and at the firm level, *** p<0.01, ** p<0.05, * p<0.1.

Table 9 5-years Averages Effects.

	Panel A			*Panel B*		
	(1) Sales	(2) Productivity	(3) ROA	(4) Sales	(5) Productivity	(6) ROA
Five_Temperature	-0.0308*	-0.0491***	7.22e-05			
	(0.0185)	(0.0132)	(0.00186)			
Five_Precipitation				-0.000377	0.0124**	0.000236
				(0.00625)	(0.00531)	(0.000527)
Constant	5.221***	8.048***	0.292***	4.807***	7.398***	0.293***
	(1.029)	(1.069)	(0.0636)	(0.992)	(1.025)	(0.0586)
Number of observations	15,878	15,878	15,881	15,878	15,878	15,881
R-squared	0.328	0.232	0.044	0.328	0.232	0.044
Number of firms	5,238	5,238	5,238	5,238	5,238	5,238

Note: In table 9, we investigate the effect of temperature and precipitation over 5-years period on SME's financial performance. The 5-year periods are: 1987-1991, 1992-1996, 1997-2001, 2002-2006, 2007-2011, 2012-2016 and 2017-2022. All variables are averaged over 5-years. In Panel A, the main independent variable is *Five_Temperature* (the average of mean annual temperature over 5 years) in degrees Celsius and in Panel B the independent variable is *Five_Precipitation* (the total precipitation over 5-years) in hundreds of millimetres. In both panels, Performance variables include Sales (the natural logarithm of total sales), Productivity (the natural logarithm of sales to employees) and ROA (the ratio of before tax income to total assets). Firm-level control variables include Tangibility (the ratio of property, plant, and equipment to total assets), Liquidity (the ratio of cash and short-term investments to current liabilities), and Leverage (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include GDP per capita and Inflation (GDP deflator). Standard errors are clustered by year and at the firm level, *** p<0.01, ** p<0.05, * p<0.1.

Table 10 Endogeneity – Industry-Year Fixed Effects.

	Panel A			*Panel B*		
	(1) Sales	(2) Productivity	(3) ROA	(4) Sales	(5) Productivity	(6) ROA
Temperature	-0.0165***	-0.0165***	-0.000391			
	(0.00425)	(0.00327)	(0.000445)			
Precipitation				-0.00108	0.000849	3.90e-05
				(0.00144)	(0.00118)	(0.000144)
Constant	7.272***	8.184***	0.249***	7.071***	7.972***	0.244***
	(0.864)	(0.896)	(0.0419)	(0.859)	(0.889)	(0.0416)
Industry×year FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	73,268	73,268	73,290	73,268	73,268	73,290
R-squared	0.395	0.269	0.208	0.395	0.269	0.208
Number of firms	6,032	6,032	6,033	6,032	6,032	6,033

Note: In table 10, we deal with omitted variables by employing industry-year fixed effects. In *Panel A*, the independent variables are Temperature in degrees Celsius and in *Panel B* the independent variables are Precipitation in hundreds of millimetres. In both panels, Performance variables include Sales (the natural logarithm of total sales), Productivity (the natural logarithm of sales to employees) and ROA (the ratio of before tax income to total assets). Firm-level control variables include Tangibility (the ratio of property, plant, and equipment to total assets), Liquidity (the ratio of cash and short-term investments to current liabilities), and Leverage (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include GDP per capita and Inflation (GDP deflator). Standard errors are clustered by year and at the firm level, *** p<0.01, ** p<0.05, * p<0.1.

Table 11 Endogeneity - The Paris Agreement 2015

	Panel A			*Panel B*		
	(1)	(2)	(3)	(4)	(5)	(6)
	Sales	Productivity	ROA	Sales	Productivity	ROA
Temperature	-0.0129***	-0.0178***	5.53e-05			
	(0.00415)	(0.00310)	(0.000444)			
Temperature × *Paris 2015*	0.00911***	0.00724***	-0.000797***			
	(0.00291)	(0.00209)	(0.000235)			
Precipitation				-0.00138	-0.000525	0.000145
				(0.00142)	(0.00122)	(0.000150)
Precipitation × *Paris 2015*				0.000593	0.00355	-0.000361*
				(0.00289)	(0.00226)	(0.000197)
Constant	6.642***	8.308***	0.227***	6.487***	8.087***	0.227***
	(0.892)	(0.940)	(0.0422)	(0.890)	(0.934)	(0.0421)
Number of observations	73,287	73,287	73,309	73,287	73,287	73,309
R-squared	0.326	0.209	0.090	0.325	0.208	0.090
Number of firms	6,038	6,038	6,039	6,038	6,038	6,039

Note: In table 11, we explore the effects of the 2015 Paris Agreement on the relationship between climate conditions and performance. We include a dummy *Paris 2015* that takes 1 for years following the 2015 Paris Agreement, and 0 otherwise. In *Panel A*, the independent variables are Temperature in degrees Celsius and in *Panel B* the independent variables are Precipitation in hundreds of millimetres. In both panels, Performance variables include Sales (the natural logarithm of total sales), Productivity (the natural logarithm of sales to employees) and ROA (the ratio of before tax income to total assets). Firm-level control variables include Tangibility (the ratio of property, plant, and equipment to total assets), Liquidity (the ratio of cash and short-term investments to current liabilities), and Leverage (the total debt divided by total assets). All firms-level controls are lagged. Country-level control variables include GDP per capita and Inflation (GDP deflator). Standard errors are clustered by year and at the firm level, *** p<0.01, ** p<0.05, * p<0.1.

7. References

- Acemoglu, D., Aghion, P., Bursztyn, L., & Hemous, D. (2012). The environment and directed technical change. *American economic review*, *102*(1), 131-166.
- Addoum, J. M., Ng, D. T., & Ortiz-Bobea, A. (2020). Temperature shocks and establishment sales. *The Review of Financial Studies*, *33*(3), 1331-1366.
- Anton, S. G. (2021). The impact of temperature increase on firm profitability. Empirical evidence from the European energy and gas sectors. *Applied Energy*, *295*, 117051.
- Barreca, A., Clay, K., Deschenes, O., Greenstone, M., & Shapiro, J. S. (2016). Adapting to climate change: The remarkable decline in the US temperature-mortality relationship over the twentieth century. *Journal of Political Economy*, *124*(1), 105-159.
- Barrios, S., Bertinelli, L., & Strobl, E. (2010). Trends in rainfall and economic growth in Africa: A neglected cause of the African growth tragedy. *The Review of Economics and Statistics*, *92*(2), 350-366.
- Beck, T., & Levine, R. (2004). Stock markets, banks, and growth: Panel evidence. *Journal of Banking & Finance*, *28*(3), 423-442.
- Bertoni, F., Colombo, M. G., & Quas, A. (2023). The long-term effects of loan guarantees on SME performance. *Journal of Corporate Finance*, *80*, 102408.
- Borsuk, M., Eugster, N., Klein, P. O., & Kowalewski, O. (2024). Family firms and carbon emissions. *Journal of Corporate Finance*, *89*, 102672.
- Cattaneo, C., Beine, M., Fröhlich, C. J., Kniveton, D., Martinez-Zarzoso, I., Mastrorillo, M., ... & Schraven, B. (2019). Human migration in the era of climate change. *Review of Environmental Economics and Policy*.

- Carney, M., Gedajlovic, E. R., Heugens, P. P., Van Essen, M., & Van Oosterhout, J. (2011). Business group affiliation, performance, context, and strategy: A meta-analysis. *Academy of Management journal*, *54*(3), 437-460.
- Contreras-Lisperguer, R., & de Cuba, K. (2008). The potential impact of climate change on the energy sector in the Caribbean region. *Organization of American States, Washington DC*.
- Dell, M., Jones, B. F., & Olken, B. A. (2012). Temperature shocks and economic growth: Evidence from the last half century. *American Economic Journal: Macroeconomics*, *4*(3), 66-95.
- Dell, M., Jones, B. F., & Olken, B. A. (2014). What do we learn from the weather? The new climate-economy literature. *Journal of Economic literature*, *52*(3), 740-798.
- Deschênes, O., & Greenstone, M. (2007). The economic impacts of climate change: evidence from agricultural output and random fluctuations in weather. *American economic review*, *97*(1), 354-385.
- Deschênes, O., & Greenstone, M. (2011). Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US. *American Economic Journal: Applied Economics*, *3*(4), 152-185.
- Diffenbaugh, N. S., & Burke, M. (2019). Global warming has increased global economic inequality. *Proceedings of the National Academy of Sciences*, *116*(20), 9808-9813.
- Flammer, C. (2015). Does corporate social responsibility lead to superior financial performance? A regression discontinuity approach. *Management science*, *61*(11), 2549-2568.

- Galema, R. (2020). Credit rationing in P2P lending to SMEs: Do lender-borrower relationships matter? *Journal of Corporate Finance*, *65*, 101742.

- Ginglinger, E., & Moreau, Q. (2023). Climate risk and capital structure. *Management Science*, *69*(12), 7492-7516.

- Graff Zivin, J., & Neidell, M. (2014). Temperature and the allocation of time: Implications for climate change. *Journal of Labor Economics*, *32*(1), 1-26.

- Hancock, P. A., Ross, J. M., & Szalma, J. L. (2007). A meta-analysis of performance response under thermal stressors. *Human factors*, *49*(5), 851-877.

- IPCC, 2000 - Bert Metz, Ogunlade Davidson, Jan-Willem Martens, Sascha Van Rooijen and Laura Van Wie Mcgrory (Eds.) Cambridge University Press, UK. pp 432 Available from Cambridge University Press, The Edinburgh Building Shaftesbury Road, Cambridge CB2 2RU ENGLAND

- IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926

- Jones, B. F., & Olken, B. A. (2010). Climate shocks and exports. *American Economic Review*, *100*(2), 454-459.

- Kemp, L., Xu, C., Depledge, J., Ebi, K. L., Gibbins, G., Kohler, T. A., ... & Lenton, T. M. (2022). Climate Endgame: Exploring catastrophic climate change scenarios. *Proceedings of the National Academy of Sciences*, *119*(34), e2108146119.
- Krueger, P., Sautner, Z., & Starks, L. T. (2020). The importance of climate risks for institutional investors. *The Review of financial studies*, *33*(3), 1067-1111.
- Orlitzky, M., Schmidt, F. L., & Rynes, S. L. (2003). Corporate social and financial performance: A meta-analysis. *Organization studies*, *24*(3), 403-441.
- Pankratz, N., Bauer, R., & Derwall, J. (2023). Climate change, firm performance, and investor surprises. *Management Science*, *69*(12), 7352-7398.
- Schlenker, W., & Lobell, D. B. (2010). Robust negative impacts of climate change on African agriculture. *Environmental Research Letters*, 5(1), 014010.
- Schlenker, W., & Roberts, M. J. (2009). Nonlinear temperature effects indicate severe damages to US crop yields under climate change. *Proceedings of the National Academy of sciences*, 106(37), 15594-15598.
- Stroebel, J., & Wurgler, J. (2021). What do you think about climate finance?. *Journal of Financial Economics*, *142*(2), 487-498.
- Xiao, Zhanbing, Labor Exposure to Climate Risk, Productivity Loss, and Capital Deepening (August 1, 2021). Available at SSRN: https://ssrn.com/abstract=4475467 or http://dx.doi.org/10.2139/ssrn.4475467
- Zhang, P., Deschenes, O., Meng, K., & Zhang, J. (2018). Temperature effects on productivity and factor reallocation: Evidence from a half million Chinese manufacturing plants. *Journal of Environmental Economics and Management*, *88*, 1-17.

Appendix A. Variables Definition.

Variable	Description of variables	Source
	Climate Variables	
Temperature	Mean Annual Temperature. It is based on monthly average of the minimum and maximum surface temperature each day in degree Celsius.	CEDA
Precipitation	Total Annual Precipitation. It is the sum of precipitation in millimetres per year.	CEDA
	Performance Variables	
Sales	the natural logarithm of total sales (item *sale* in Compustat).	Compustat
Productivity	the natural logarithm of sales to employees (item *emp*).	Compustat
ROA	the ratio of before tax income (item *pi*) to total assets (item *at*).	Compustat
	Firm-level Controls	
Tangibility	the ratio of property, plant, and equipment (item *ppent*) to total assets.	Compustat
Liquidity	the ratio of cash and short-term investments (item *che*) to current liabilities (item *lct*).	Compustat
Leverage	the total debt (item *dlc* plus item *dltt*) divided by total assets.	Compustat
	Country-level Controls	
GDP per Capita	GDP per Capita.	WDI
Inflation	Inflation based on GDP deflator.	WDI
	Dummy Variables	
Heat-sensitive	*Heat-sensitive* industries encompasses Paper & Forest Products (6-digit GICs industry code of 151050), Metals & Mining (151040), Construction & Engineering (201030), Automobile & Motorcycle Manufacturers (251020), Transportation (203010 to 203050), Food Product & Tobacco Producers (302020 to 302030), and Utilities (551010 to 551050)	Authors, based on Graff-Zivin and Neidell (2014) and Addoum et al. (2020).
Agriculture	The *Agriculture* industry corresponds to the 6-digit GICs industry code from 302020 to 302030.	Authors, based on Barrios et al. (2010)
Energy	The *Energy* sector corresponds to the two-digit GICs sector code of 10.	
Extreme Heat	Dummy taking 1 for a temperature that exceeds the mean of temperature by at least one standard deviation over the previous ten years for each country, and 0 otherwise.	Authors.
Extreme Dry	Dummy taking 1 for precipitation levels that fall below the mean precipitation by at least one standard deviation over the previous ten years for each country, and 0 otherwise.	Authors.
Paris 2015	Dummy taking 1 for years following the 2015 Paris Agreement, and 0 otherwise.	Authors.

Appendix B. Descriptive Statistics by country.

	SMEs	N	Temperature	Precipitation	Sales	Productivity	ROA
Antigua and Barbuda	2	30	28.262	178.577	6.084	4.177	.062
Argentina	24	262	17.279	2781.42	7.963	6.012	.052
Australia	54	810	16.848	7336.444	8.667	6.093	.069
Austria	7	190	10.645	1332.583	8.728	6.468	.051
Bahamas (the)	1	14	24.993	180.625	6.180	4.592	.125
Barbados	1	4	26.66	47.447	7.668	6.146	.018
Belgium	12	265	11.189	2244.298	9.399	6.63	.068
Belize	1	7	26.719	96.432	7.068	3.769	.043
Bermuda	30	311	21	4398.791	7.538	5.503	.025
Brazil	74	976	21.07	16046.338	8.933	6.215	.049
Cambodia	1	15	28.299	236.894	6.111	4.366	.148
Canada	132	1023	7.558	10585.649	7.708	5.533	.039
Cayman Islands (the)	9	68	18.835	802.614	7.351	4.796	.029
Chile	26	367	14.276	1273.899	9.237	6.912	.057
China	230	1793	16.04	18478.478	7.810	5.475	.057
Columbia	9	88	16.253	1504.155	9.685	6.757	.046
Cyprus	3	16	20.091	71.454	6.354	4.396	.03
Czechia	1	27	9.743	142.967	11.751	8.744	.064
Denmark	16	384	9.381	2499.172	9.728	7.12	.103
Finland	14	283	5.393	1862.381	8.814	6.115	.075
France	71	1605	12.152	10195.645	9.473	5.837	.053
Germany	76	1516	10.402	11357.207	8.919	5.696	.062
Ghana	1	8	26.957	72.405	6.252	3.863	.023
Gibraltar	1	5	18.303	29.469	6.434	5.511	-.045
Greece	6	66	17.407	319.99	8.656	5.776	.043
Guernsey	1	1	13.267	7.548	7.231	5.872	.21
Hong Kong	80	1039	23.283	22066.002	8.912	6.306	.075
Hungary	2	45	12.293	254.411	11.951	9.135	.069
India	25	324	26.886	6376.007	10.282	7.452	.075
Indonesia	11	179	27.567	4559.569	10.962	8.365	.098
Ireland	43	788	9.67	8602.684	8.329	5.461	.065
Isle of Man	1	7	10.046	91.549	7.783	5.455	-.002
Israel	43	441	20.077	2528.144	7.462	5.709	.062
Italy	26	444	14.035	3985.69	9.377	6.553	.055
Jamaica	1	2	23.879	62.765	6.226	5.319	.043
Japan	182	4071	16.093	60385.421	11.907	9.032	.058
Jersey	4	32	12.603	302.766	7.610	5.646	.07
Jordan	1	2	19.075	4.011	5.442	3.815	.106
Kazakhstan	2	5	9.378	12.65	7.799	6.131	.108
Korea (the Republic of)	12	212	12.649	2871.479	9.383	6.371	.034
Luxembourg	29	311	10.408	2636.937	7.743	5.339	.048
Macao	4	56	23.121	1093.324	8.258	5.981	.094
Malaysia	4	68	26.983	1733.39	8.952	5.903	.069

Mexico	49	730	16.305	6837.368	9.267	6.493	.066
Netherlands (the)	66	1023	10.681	8519.302	8.678	5.66	.053
New Zealand	7	99	15.128	1262.755	7.698	5.685	.084
Norway	17	304	6.599	3560.23	9.691	7.477	.061
Panama	4	36	26.411	814.14	6.916	5.022	.072
Papua New Guniea	1	3	25.758	62.406	6.610	5.634	.037
Peru	6	83	18.489	19.345	7.681	5.566	.046
Philippines (the)	7	83	26.215	2290.618	9.036	6.516	.06
Poland	1	2	9.221	9.886	7.442	6.726	.006
Portugal	6	125	17.252	1033.049	9.409	6.782	.051
Russia	29	229	5.923	1557.861	9.538	6.436	.091
Singapore	35	451	27.74	11418.447	8.234	5.482	.051
South Africa	39	698	17.195	4757.089	9.120	6.32	.098
Spain	25	509	14.649	3287.078	9.518	6.461	.049
Sweden	36	798	7.781	4505.807	10.147	7.186	.081
Switzerland	50	986	9.408	10599.7	8.821	5.773	.081
Taiwan	15	206	21.545	4305.803	8.597	5.792	.07
Thailand	5	32	28.98	465.923	9.898	8.279	.112
Turkiye	7	114	14.458	892.463	9.747	6.691	.071
Ukraine	1	14	9.566	80.141	7.270	3.967	.047
United Arab Emirates (the)	1	7	28.083	4.045	6.313	4.447	.019
United Kingdom	257	4415	10.626	32240.159	8.093	5.162	.077
United States	5426	61486	14.007	623199.2	7.431	5.324	.057
Uruguay	2	23	17.356	239.138	7.789	4.503	.055
Venezuela	5	29	24.254	337.543	8.650	6.372	.052
Zambia	1	6	21.525	39.805	10.567	7.456	-.014

This table provides descriptive statistics by country in our study. We report mean values by country of main variables, except for precipitation where we report the total value by country.

Appendix C. Descriptive Statistics per year.

	SMEs	N	Temperature	Precipitation	Sales	Productivity	ROA
1987	1716	1716	13.376	16206.608	6.816	4.697	.068
1988	1742	1742	12.923	14829.061	6.912	4.76	.071
1989	1907	1907	12.528	18810.629	7.118	4.908	.065
1990	1883	1883	13.658	19552.885	7.180	4.962	.06
1991	1942	1942	13.45	18538.245	7.210	5.006	.051
1992	2032	2032	12.819	20212.681	7.213	5.03	.058
1993	2146	2146	12.786	21910.366	7.233	5.058	.06
1994	2283	2283	13.318	22571.869	7.248	5.088	.069
1995	2382	2382	13.356	23015.227	7.297	5.145	.067
1996	2512	2512	12.803	26392.564	7.341	5.193	.069
1997	2638	2638	12.97	25593.761	7.391	5.231	.07
1998	2664	2664	14.168	27906.769	7.444	5.25	.062
1999	2795	2795	13.916	26696.471	7.670	5.426	.06
2000	2808	2808	13.652	28117.617	7.742	5.488	.055
2001	2706	2706	13.911	26725.689	7.795	5.511	.038
2002	2694	2694	14.097	27424.538	7.822	5.535	.046
2003	2696	2696	13.712	28317.625	7.898	5.602	.057
2004	2718	2718	14.015	28989.097	7.991	5.683	.07
2005	2687	2687	14.216	26585.106	8.092	5.752	.073
2006	2720	2720	14.681	28962.148	8.180	5.829	.079
2007	2694	2694	14.517	26948.443	8.256	5.881	.073
2008	2644	2644	14.068	27892.027	8.300	5.923	.05
2009	2621	2621	14.021	27904.572	8.246	5.877	.051
2010	2657	2657	14.164	27691.934	8.338	5.945	.069
2011	2675	2675	14.564	28032.241	8.407	5.988	.067
2012	2684	2684	14.918	27248.281	8.440	5.999	.061
2013	2705	2705	14.073	29118.288	8.476	6.026	.062
2014	2721	2721	14.191	28674.005	8.519	6.053	.06
2015	2728	2728	14.725	29585.513	8.515	6.041	.053
2016	2682	2682	15.03	28674.458	8.533	6.052	.055
2017	2677	2677	14.93	28553.972	8.548	6.084	.057
2018	2692	2692	14.793	30891.28	8.567	6.099	.055
2019	2679	2679	14.779	29993.662	8.625	6.143	.046
2020	2687	2687	15.111	29182.322	8.523	6.078	.029
2021	2726	2726	14.805	29431.537	8.623	6.181	.056
2022	2708	2708	14.708	26807.49	8.712	6.259	.052

This table provides descriptive statistics per year in our study. We report mean values per year of main variables, except for precipitation where we report the total value per year.