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Climate change has resulted in an increase in average temperature and the frequency of extreme weather conditions. The literature has documented a wide array of negative impacts of extreme temperatures, including health harms[1-8], depressed household consumption[9], decreased labor productivity and supply[10-11], decreased agricultural output[12-21] and industrial output[22-24], and reduced economic growth rate[25-30]. All of these impacts make it costlier and less profitable for firms to produce in areas exposed to more frequent extreme temperatures. Although the literature has stressed the production impacts of extreme temperatures at firms' intensive margin, i.e., output and productivity, little is known about the impacts on their extensive margin, i.e., firms may choose to avoid the negative production impacts by not entering or leaving the areas with extreme climatic conditions. Understanding these impacts is important because firms' entry and exit play a crucial role in the dynamics of industries and the growth of the economy[31-32]. Moreover, since the magnitude of climate change substantially differs across regions, such impacts might also reshape the global industrial geography.

This paper aims to fill the knowledge gap by examining the effects of exogenous temperature shocks on firms' entry and exit decisions and projecting the long-term impacts of climate change on the spatial distribution of industries. To identify these impacts, we leverage the Firm Registration Database, an administration database maintained by the State Administration of Industry and Commerce of China. The dataset provides firm-level information for all firms registered in China since 1949, including location, industry, ownership, registration date, paid-in capital, exit date (if applicable), and shareholders. We construct a yearly panel of firm entry, firm exit, and inter-regional equity investments in new firm creation, in terms of number and paid-in capital, for each of the 2818 counties in China during 1991-2019, and match these data with temperature data specified by temperature-day bins. We choose 1991 as the starting year of our study because China's economy has been more market-oriented since the 1990s, when it opened the economy to foreign trade and investment and relaxed the regulation of private investment.

The effects of temperature changes on firm entry, firm exit, and inter-regional equity investments in new firm creation are estimated by the standard panel data regression model (equation (1)). Because firms' extensive margin decisions could be most sensitive to the coldest and hottest temperatures, the temperature-firm entry/exit relationship may be nonlinear. We use temperature-day bins to model such nonlinearities and threshold effects. Specifically, we divide temperature into ten 5°C bins, with less than -10°C and greater than 30°C at the extremes, and construct temperature variables by the yearly number of days that the daily mean temperature of each county falls into each bin. Thus, the estimator of a particular temperature-day bin denotes the average percentage change in the number (or paid-in capital) of firm entry, firm exit, and firm-to-firm equity investments caused by exchanging a day in the reference temperature bin (10°C -15°C) for a day in this particular temperature bin. To alleviate the concern that the temperature variation may be correlated with unobserved economic factors that affect firm entry and exit, our regression model controls for weather conditions (including humidity, sunshine, and precipitation), county fixed effects and province-year fixed effects. The estimates are thus identified from the unpredictable and presumably random differential temperature deviations from local mean conditions between counties within the same province and year.

Our regression results firstly show that extreme cold and hot temperatures reduce firm entry and increase firm exit, and cold temperatures have larger impacts than hot temperatures. The relationships are U-shaped or inverted U-shaped and are robust to different model specifications. Secondly, further heterogeneity analysis shows that the entry and exit of large and long-lived firms are more sensitive to extreme temperatures, and the temperature effects differ across sectors. Finally, we find evidence that, in response to extreme temperatures, firms may choose to migrate across regions through inter-county equity investments in new firms. In particular, when a county is exposed to more cold days, both firms in the county and firms outside of the county respond by reducing equity investments in the county; meanwhile, firms in the county also increase their inter-county equity investments in new firms in other counties, especially counties located in mild and hot climate zones.

Using climate projection data provided by the NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP), we predict the impacts of climate change on firms' entry and exit decisions in China by the end of this century (2080-2099). Our prediction shows that, on average, climate change has no statistically significant impacts on firm entry and firm exit in a county. The distribution of effects, however, is remarkable. As the climate gets warmer, firm entry (exit) in the cold north tends to increase (decrease) and firm entry (exit) in the hot south tends to decrease (increase), resulting in more net entry of firms in northern China. The annual net entry of firms in a county could increase or decrease by more than 40% in the counties that are most affected by climate change. This shows that climate change may reshape the spatial distribution of industries within an economy (and even across economies) and therefore provides important implications for regional development in the long run.

This paper makes three contributions. First, it is among the first to explore temperature effects on firms' location choices and the spatial distribution of industries, shedding light on how climate change may reshape economic geography and regional development. In particular, our results may partially explain why some economic activities have moved from northeastern provinces in China to warmer areas within the country, or why the U.S. Rust Belt has struggled to recover while Texas has experienced growth. Second, compared to studies on households' climate change adaptation strategies (including changes in energy consumption[33-39], geographical mobility,[40-43] and labor supply[44-47]), the evidence on firms' adaptation strategies is limited, and this paper confirms that firms can adapt to climate change through extensive margin decisions. Finally, the long-run projection shows how different areas' firm entry and exit differentially respond to climate change. The projected spatial distribution of industries may help policy-makers decide how and where to invest in infrastructure to facilitate future industrial production.

Temperature effects on firm entry and exit

Figure 1 and Supplementary Table S1-S4 present the temperature effects on firm entry (i.e., the aggregate number and paid-in capital of all newly registered firms) and firm exit (i.e., the aggregate number and paid-in capital of all firms exiting the market) from the estimation of equation (1). Specifically, the figure plots the effects of an additional day in a year in a temperature bin relative to the effect of a day in the reference temperature bin 10°C -15°C.

Figure 1 shows an inverted U-shaped relationship between temperature and firm entry. The results show that firms are less likely to enter counties exposed to the coldest and hottest temperatures. Moreover, the coldest temperatures have a much stronger effect than the hottest temperatures. One additional day with an average temperature above 30℃ (relative to reference temperatures between 10℃ to 15℃) would reduce the annual number and paid-in capital of firm entry by 0.30% (95% confidence interval (CI): 0.03% to 0.57%) and 1.00% (95% CI: 0.53% to 1.47%) respectively, which are equivalent to 2.34 firms and 49.2 million Chinese Yuan (CNY) per year per county. One additional day with an average temperature below -10℃ would reduce the annual number and paid-in capital of firm entry by 0.68% (95% CI: 0.39% to 0.97%) and 2.08% (95% CI: 1.35% to 2.81%) respectively, which are 5.27 firms and 102.4 million CNY per year per county. Evidently, the effect size of the coldest temperature is more than twice the effect associated with the hottest temperature bin. Moreover, the temperature effects on the number or paid-in capital of firm entry are statistically significant in all of the four or five lowest temperature bins, but only statistically significant in the highest or two highest temperature bins, suggesting that the extreme cold temperatures have more profound impacts than extreme hot temperatures. Note that the effect size on the aggregate paid-in capital is much greater than that on the number of firm entry, suggesting that potential large entrants are more likely to be deterred by the extreme temperature shocks.

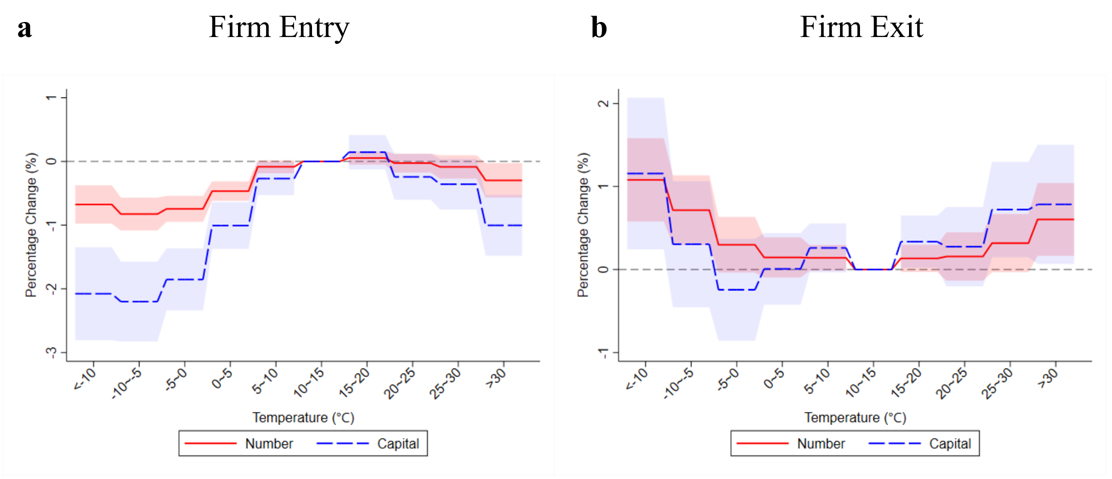


Figure 1. Temperature effects on firm entry and exit. The figure reports temperature effects on the percentage change of firm entry (in **a**) and firm exit (in **b**) measured by number and paid-in capital due to a one-day temperature change from the reference bin of 10°C -15°C to the corresponding temperature bin. The coefficients are estimated by equation (1) and the regression results are reported in the first column in Supplementary Table S1-S4. The 95% CIs are indicated by the shaded areas, and the line measures the estimated change in firm entry and exit.

Contrary to the results presented in Figure 1a, Figure 1b shows a U-shaped relationship between temperature and firm exit. This shows that incumbent firms are more likely to exit the counties exposed to more extreme temperature shocks. Relative to temperatures between 10°C−15°C, one additional day in the temperature bin > 30°C in a county would result in an increase of 0.60% (95% CI: 0.17% to 1.03%, or 1.74 firms) and of 0.79% (95% CI: 0.06% to 1.52%, or 5.4 million CNY), per year per county in the number and paid-in capital of firms exiting the market. One additional day with an average temperature below -10℃ would increase the number and paid-in capital of firm exit by 1.08% (95% CI: 0.57% to 1.59%, or 3.14 firms) and 1.16% (95% CI: 0.24% to2.08%, or 7.9 million CNY) respectively. Similarly to the temperature effects on firm entry, Figure 1b also shows that the cold temperatures have much larger impacts on firm exit than the hot temperatures.

The above results are robust to a number of model specifications, regression results of which are reported in Supplementary Tables S1-S6. Column 2 in Tables S1-S4 uses weather variables in the current and previous years and reports the sum of the current and previous years' temperature coefficients, taking into consideration the dynamic effects of temperature. Similarly to other findings in the literature[6,40], we find that the coefficients of the coldest and hottest temperature bins are larger than in the baseline regression, indicating the existence of delayed effects. That means that firms' extensive margin decisions are affected not only by this year's temperature shocks but also by the previous year's temperature shocks. Our main results are also robust to outcome variables in log transformation (Column 3 in Tables S1-S4), dropping the control of the number of incumbent firms in the baseline year 1991 interacted with year dummies (Column 4 in Tables S1-S4) or the weather controls (Column 5 in Tables S1-S4).

Supplementary Tables S4 and S5 report the regression results estimated by using the daily maximum temperature and daily minimum temperature instead of the daily mean temperature to explore the effects of daily peak temperatures on firm entry and firm exit. Because the daily maximum (minimum) temperature is higher (lower) than the daily mean temperature, we shift our original 10 temperature bins to the right (left) by 5℃ in the maximum (minimum) temperature framework, with less than -5℃ (-15℃) and greater than 35℃ (25℃) at the endpoints, and choose the 15℃-20℃ (5℃-10℃) bin as the baseline group, which is 5℃ higher (lower) than the baseline group used in the mean temperature framework. Both regressions show a pattern of temperature and firms' extensive margin decisions that is similar to the baseline regression, with the cold-related effects especially large in magnitude and statistically significant.

Heterogeneous temperatures effects on firm entry and firm exit

We examine the heterogeneous effects of extreme temperatures on firms of different sizes, different lifespans and different sectors by subsample regressions of equation (1). Figure 2 presents the heterogeneous effects of temperature on the numbers of firm entry and firm exit. The results on the paid-in capital of firm entry and firm exit are similar and reported in Supplementary Figure S2.

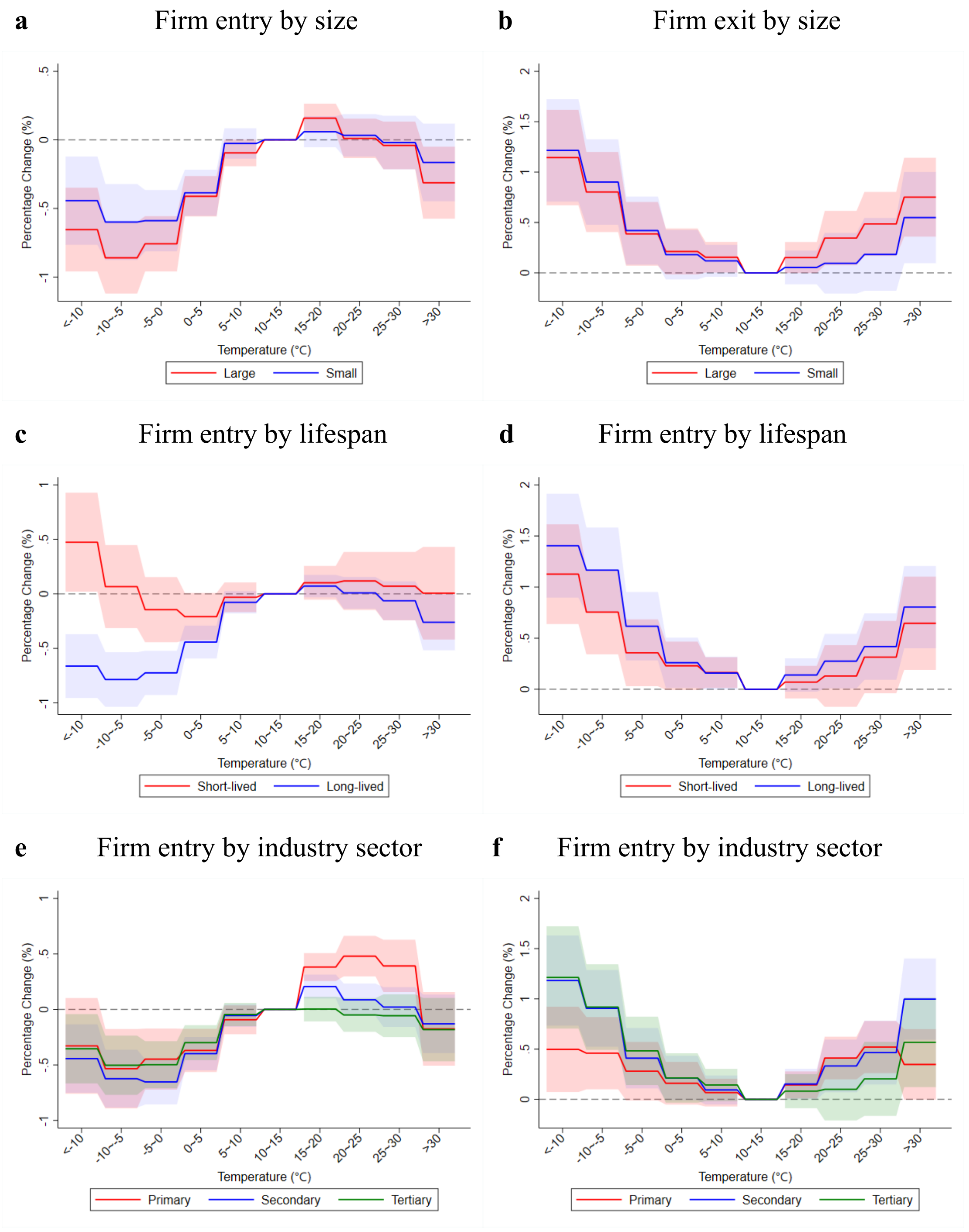


Figure 2. Heterogeneous effects of temperatures on the numbers of firm entry and firm exit. The figure reports subsample regression results of the temperature effects on the numbers of firm entry and firm exit by firm size (in **a, b**), firm's lifespan (in **c, d**) and industry sector

(in **e, f**). The coefficients are estimated by equation (1). The 95% CIs are indicated by the shaded areas, and the line measures the estimated change in the numbers of firm entry and firm exit.

Firstly, we separate firms into two groups, large and small, in terms of their paid-in capital. To make the firm size comparable across industries and years, we first calculate the national median of newly registered firms' paid-in capital, for each industry in each year. We then define a firm as a large (small) firm if its paid-in capital is larger (smaller) than the national median paid-in capital for its industry in the year when it was registered. Figure 2a shows that extremely low and high temperatures statistically significantly reduce firm entry in both size groups. However, the entry of large firms is more adversely impacted than the entry of small firms: exposure to one additional day in the lowest temperature bin reduces the number of large and small entrants by 0.65% (95% CI: 0.34% to 0.96%) and 0.44% (95% CI: 0.13% to 0.75%) respectively; exposure to one additional day with temperature over 30°C would lead to a reduction of 0.31% (95% CI: 0.06% to 0.56%) for the number of large entrants but have a statistically insignificant impact on small entrants. Similarly, regressions on firm exit by firm size (Figure 2b) show that, although extreme temperatures statistically significantly increase the exit of both small and large firms, hot temperatures are more likely to drive large firms out of the market. Since large firms are less likely to enter and more likely to leave the county exposed to more extreme temperatures, the extreme temperatures may affect the local market structure at the margin, i.e., industries may become less concentrated in local markets.

Secondly, Figures 2c and 2d present the heterogeneous effects of extreme temperatures on the entry and exit of firms with different lifespans. The heterogeneous effects by lifespan are important because the entry of a firm that will only survive for a short time has little impact on the economy, compared to the entry of a firm that will last for a long time. Similarly, the exit of a firm that has just recently entered the market has little impact on the economy compared to the loss of an established firm, especially if it has accumulated experience and become more efficient over time. We split the sample of firms entering the market (i.e., newly registered firms) into two groups: short-lived entrants that will survive for four years or less, and long-lived entrants that will survive for more than four years. We also split the sample of firms exiting the market into short-lived firms that exited the market within the first four years of their existence, and long-lived firms that have survived for more than four years. Figures 2c and 2d clearly show that the negative (positive) effects of extreme temperatures on the number of entries (exits) of long-lived firms are not only substantially larger but also more statistically significant than that of short-lived firms. In fact, the lowest temperature statistically significantly increases the number of entries of short-lived firms. These results suggest that the lifespans of firms in a county exposed to more frequent extreme temperatures tend to be shorter.

Thirdly, Figure 2e and 2f show the heterogeneity among three sectors: agricultural, industrial, and service. The inverted U-shaped relationship between temperature and firm entry, as well as the U-shaped relationship between temperature and firm exit, exists in all three sectors. One exceptional result is that, although the coefficient associated with the highest temperature bin is negative for firm entry in the agricultural sector, the coefficients associated with the 2nd, 3rd, and 4th highest temperature bins are statistically significantly positive. On average, exchanging a single day in these three temperature bins for one in the reference 10°C−15°C bin would lead to a 0.42% increase in the number of new entrants in the agricultural sector. This is the only finding of a positive effect of relatively hot temperatures on firm entry in the study. The result may be due to the temperature effects on agricultural production. For example, it has been shown in reference[21] that the yields of corn and soybean in China increase with temperatures up to 29°C and 28 °C, respectively, and temperatures above these thresholds had significant negative impacts on the growth of the two crops.

In sum, our heterogeneity results show that, when a county is exposed to more extreme temperatures, large and long-lived firms are not only less likely to enter the county but also more likely to exit it. Since these firms are more likely to be competitive in the market, extreme temperatures may depress the competitiveness of industries located in areas exposed to more extreme temperatures. Moreover, temperature effects on firms' entry and exit decisions differ across sectors. It is noteworthy that relatively hot temperatures increase the entry of agricultural firms.

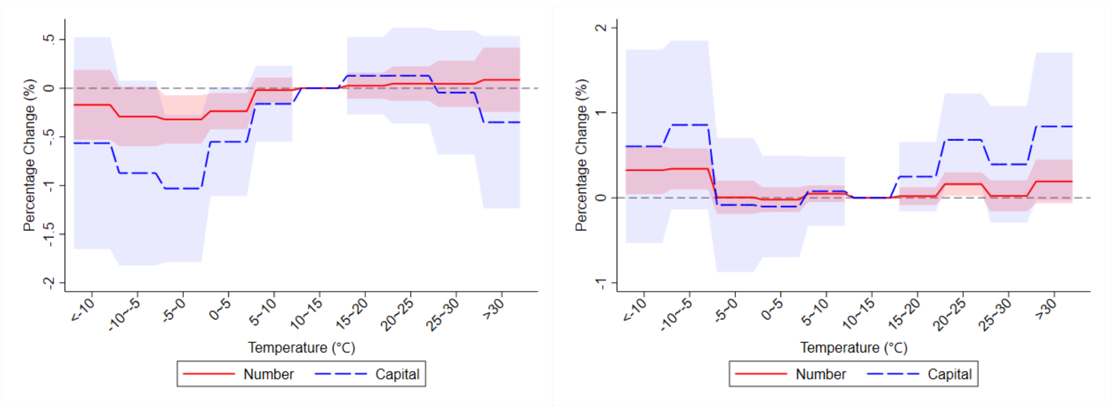
Extreme temperatures and firm migration

We have shown that extreme temperatures deter firm entry, but it remains unclear whether the effect is caused by a permanent reduction of new firm creation or by spatial relocation of firms through inter-region investment in new firm creation. To explore the question, we use firms' shareholder information to calculate firms' equity investments in new firm creation. If a firm buys shares in another newly registered firm with the purchase date within one month after the registration date of the invested firm, we treat the purchase as a firm-to-firm equity investment in new firm creation and use its share of the total paid-in capital to calculate the scale of its investment.

Using the location information of the origin and destination counties of firm-to-firm equity investments in newly registered firms, we construct three dependent variables for equation (1): intra-county investments (i.e., Y_{ct} in equation (1) refers to the aggregate investments from county c to county c in year t), outward inter-county investments (i.e., Y_{ct} in equation (1) refers to the aggregate investments from county c to all counties outside of county c in year t), inward inter-county investments (i.e., Y_{ct} in equation (1) refers to the aggregate investments from all counties outside of county c to county c in year t).

a Intra-county investments

b Outward investments



c Inward investments

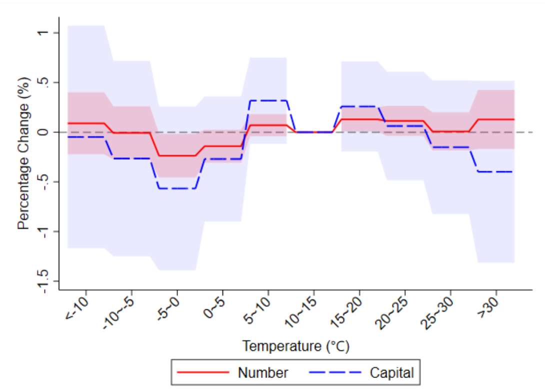


Figure 3. Temperature effects on firm-to-firm equity investment in new firms. The figure reports the temperature effects on the number and paid-in capital of intra-county (in **a**), outward (in **b**) and inward (in **c**) firm-to-firm equity investment in new firms, due to the temperature change from the reference bin of 10°C -15°C to the corresponding temperature bin. The coefficients

are estimated by equation (1). The 95% CIs are indicated by the shaded areas, and the line measures the change in the firm-to-firm equity investments in new firms.

Figure 3 presents the results of temperature effects on the intra-county and inter-county equity investment in newly registered firms. It is evident that these firm-to-firm equity investments in newly registered firms are more sensitive to cold temperatures than hot temperatures. The estimated coefficients of hot temperatures are almost all statistically insignificant. However, when a county is exposed to more cold days, the local incumbent firms statistically significantly respond by reducing intra-county investments and increasing inter-county investments toward other counties, and firms outside of the county also respond by reducing their investments in this county. For example, when exposed to one additional day in the temperature bin between -10°C to -5°C relative to 10-15°C, local incumbent firms would reduce their local equity investment by 0.29% (95% CI: -0.02% to 0.60%) and increase their equity investment toward other counties by 0.34% (95% CI: 0.10% to 0.58%) measured in number of the investment. When a county is exposed to one additional day in the temperature bin between -5°C to 0°C relative to 10-15°C, local firms and firms in other counties reduce their number of equity investments toward this county by 0.32% (95% CI: 0.07% to 0.57%) and 0.24% (95% CI: 0.02% to 0.46%) respectively. The results confirm that firms migrate across regions to avoid extreme temperature exposure. Further subsample regressions reported in Figures S3-S4 show that, compared to small and short-lived firms, large and long-lived firms are more likely to migrate across regions when exposed to extreme temperatures. The results are consistent with our previous findings that the entry and exit of large and long-lived firms are more sensitive to extreme temperatures.

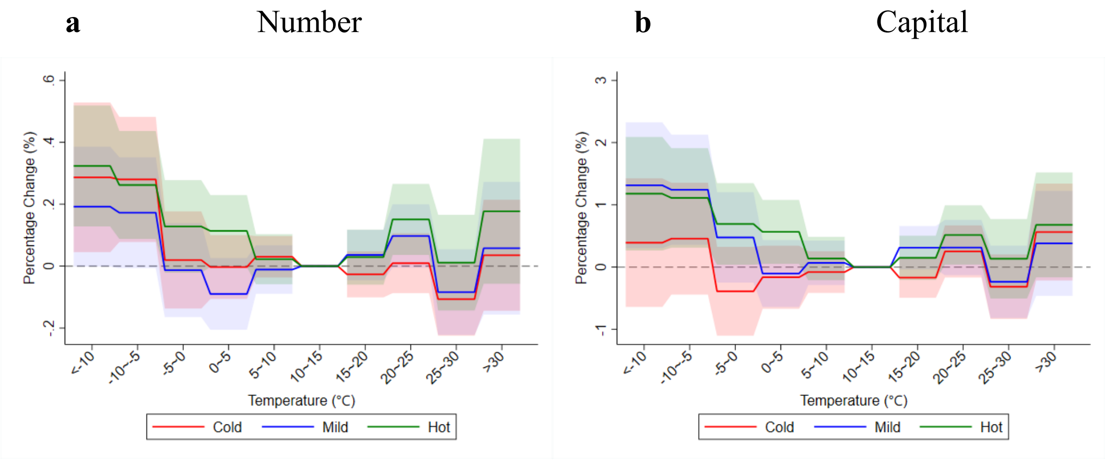


Figure 4 Temperature effects on outward firm-to-firm equity investments in new firms by climate zones. The figure reports the impact of temperature changes in the origin county on the equity investments from the origin county to all destination counties located in cold, mild and hot climate zones respectively. The coefficients are estimated by equation (1). The 95% CIs are indicated by the shaded areas, and the line measures the change in firm-to-firm equity investments in new firms.

The above results show that, in response to the cold temperature, local incumbent firms increase their inter-county investments in other regions. Next, we explore which climate zone they are more likely to move to. We use the 30-year average temperature from 1991 to 2019 to define cold, mild, and hot climate zones. The 30-year average temperatures of these are the lowest 33%, middle 33%, and highest 33% of the distribution. We then split the data sample of outward inter-county investments into three subsamples based on whether the investment destinations are cold, mild, or hot climate zones. The results are presented in Figure 4. As discussed above, the hot temperatures do not have statistically significant impacts on incumbent firms' equity investments directed toward other regions. However, when a county is exposed to more cold days, the local incumbent firms statistically significantly increase both the number and the paid-in capital of inter-county investments in new firm creation directed toward mild and hot climate zones. As for the impacts on the inter-county investments in new firm creation directed toward cold zones, although the cold temperatures have a statistically significant impact on the number of these investments, the impact on the paid-in capital is statistically insignificant. These results show that firms are more likely to move to comfortable climate areas to avoid extreme cold.

Long-run projections

Using equation (2), we obtain a long-run projection of the impact of climate change on firm entry and firm exit for each county in China in 2080-2099. Figure 5 presents the weighted average impacts on all counties, which are calculated by equations (4) and (5). It shows that both entry and exit of firms are predicted to increase in all scenarios, except that the paid-in capital of firm entry is predicted to decrease under RCP8.5. The impacts, however, are not statistically significant in most scenarios. As discussed, extreme cold and hot temperatures both reduce firm entry and increase firm exit. Hence, as climate change leads to more hot days and fewer cold days, the impacts of reduced cold days could be offset by the impacts of increased hot days, leading to the overall effects of future climate change being statistically insignificant. Note that, compared to the results under RCP 4.5, the impacts under RCP8.5 have a larger variance, indicating that climate change will lead to more uncertain economic effects.

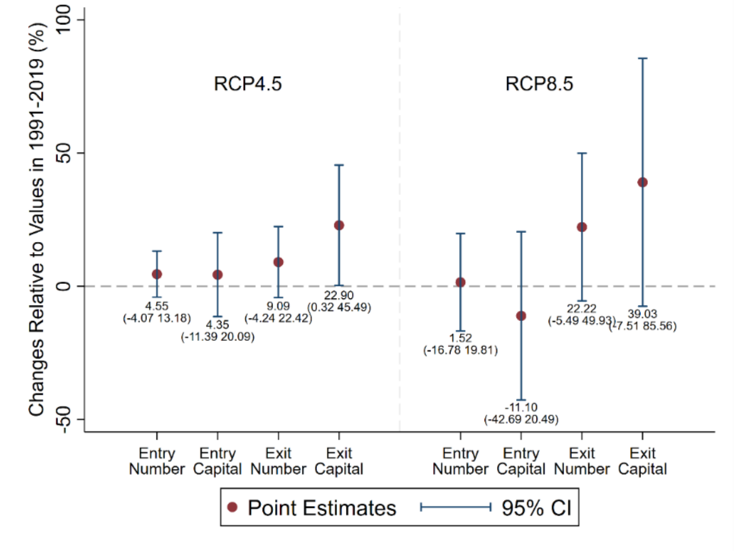


Figure 5. End-of-century projections on the weighted average change of firm entry and firm exit. This figure shows the predicted weighted average percentage change of firm entry and exit by the end of this century (2080-2099) relative to the 1991-2019 level for the national aggregate under two climate scenarios, RCP4.5 and RCP8.5. The points indicate the predicted percentage change, and the error bars show the 95% CIs.

As the climate gradually warms, the climate in the cold north may become more comfortable and the climate in the hot south will be harsher. Therefore, compared to the statistically insignificant national average effects on firm entry and firm exit, there could be striking regional differences in the effects of climate change. Figure 6 shows the heterogeneous effects across counties on the numbers of firm entry and firm exit under RCP8.5 by 2080-2099 (results under RCP4.5 and results on paid-in capital are similar and thus not presented in the paper, but they are available upon request). Figure 6a presents the projected impacts on the number of firms entering by each county. Among all the 2818 counties in China, climate change will lead to an increase in the number of firms entering for 1844 counties, of which 549 counties will experience more than a 20% increase in firm entry. These 549 counties, which are predicted to benefit most from climate change, are concentrated in Northern China (mainly in Hebei and Shanxi provinces) and Northwest China (mainly in Shaanxi, Gansu and Qinghai provinces). On the other hand, 974 counties are predicted to experience a decrease in the number of firm entries, and 269 counties are projected to encounter a drop of more than 20% in the number of firm entries. These 269 counties, which are expected to suffer the most from climate change, are concentrated in Southern China (mainly in Guangdong and Guangxi provinces). In general, the number of firm entries in the north tends to increase, while the number of firm entries in the south tends to decrease. Figure 8b presents the regional distribution of climate change effects on firm exit; the results are exactly opposite to the results on firm entry. That is, the number of firm exits tends to decrease in the north and increase in the south. Evidently, climate change will lead to spatial redistribution of industries through the channel of firm relocation across regions.

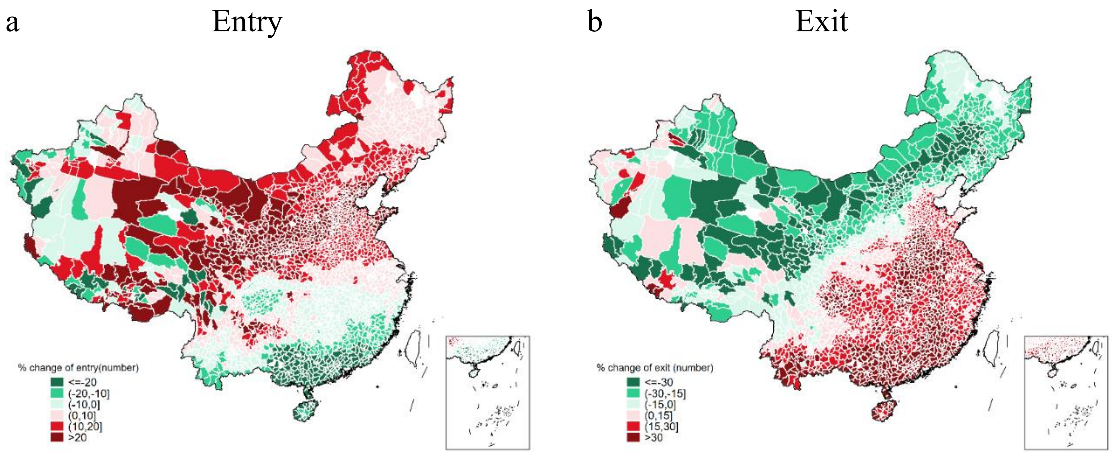


Figure 6. End-of-century projections on the change in the numbers of firm entry and firm exit by county under RCP8.5. This figure shows the predicted percentage change in the numbers of firm entry and firm exit by the end of this century (2080-2099) relative to the 1991-2019 level by county under climate scenario RCP8.5. Green indicates a reduction in firm entry (or firm exit), while red indicates an increase in firm entry (or firm exit).

We next explore the overall effect of climate change on the spatial distribution of firms, by using equation (3) to calculate the effect on the net entry of firms, i.e., the difference between the number/paid-in capital of firm entry and that of firm exit. The results are shown in Figure 7, which has a similar pattern as the effects on the number of firm entry. Overall, about 56% of counties are expected to attract more net entry of firms, of which 422 counties are projected to encounter an increase in the net entry of firms by more than 40%. These 422 counties are concentrated in the north, including Northwest China (mainly in Gansu and Shaanxi provinces), Northeast China (mainly in Liaoning and Inner Mongolia provinces) and Northern China (mainly in Shanxi province). Another 44% of counties are expected to lose firms, among which 453 counties are projected to witness a more than 40% drop of net entry of firms. These 453 counties are concentrated in the south, including Southern China (mainly in Guangdong, Guangxi and Fujian provinces) and Southwest China (mainly in Sichuan province).

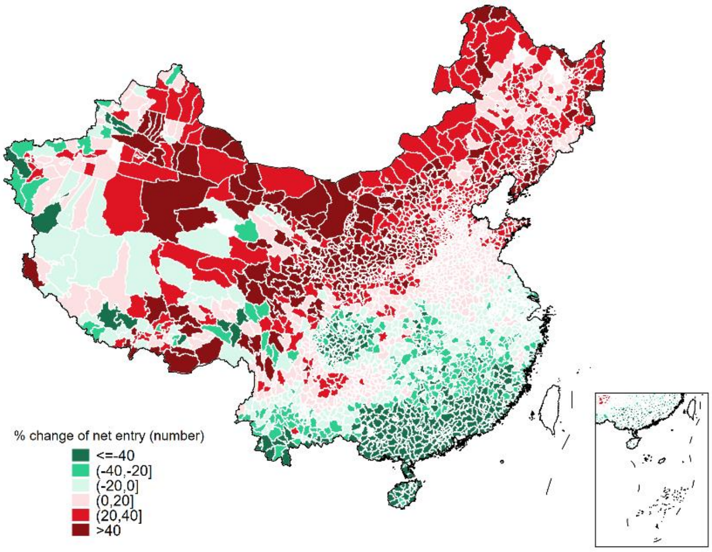


Figure 7 End-of-century projections on the change of the number of net entry of firms by county under RCP8.5. This figure shows the predicted percentage change in the number of net entry of firms by the end of this century (2080-2099) relative to the 1991-2019 level by county under climate scenario RCP8.5. Green indicates a reduction in the net entry of firms, while red indicates an increase in the net entry of firms.

In sum, our projection shows that, as climate change reduces cold temperature days and increases hot temperature days, counties in the cold north of China are expected to attract more firm entry and counties in the hot south of China are expected to lose firms. This suggests that, in the future, industries are likely to shift from the hot south to the north due to a warming climate. As the hot south becomes the economic center of China, future climate change might reshape the geography of industries and economic production in China.

Discussion and Conclusions

Because extreme temperatures generate a wide array of negative impacts on the economy[1-30], they could further depress the competitiveness of firms. This paper shows that firms avoid the negative impacts of extreme temperatures by spatial relocation through extensive margin decisions of entry and exit. Specifically, we find an inverted

U-shaped relationship between temperature and firm entry, and a U-shaped relationship between temperature and firm exit. The findings imply that firms are less likely to enter and more likely to exit the areas exposed to more frequent extreme temperatures. The heterogeneity analysis shows that the entry and exit of large and long-lived firms are more sensitive to extreme temperatures, which may lead to changes of local market structure. In addition, temperature effects on firms' entry and exit decisions differ across sectors, with a noteworthy effect that relatively hot temperature could increase firm entry in the agricultural sector.

This paper also explores how firms respond to extreme temperatures through inter-regional equity investments in new firm creation. Our regression results show that colder temperatures in a county cause local firms to reduce equity investments in the county but increase their inter-county equity investments directed toward other counties, especially counties located in mild and hot climate zones. Moreover, colder temperatures in a county deter inter-county equity investments from other counties to the colder county. These pieces of evidence confirm that firms relocate across regions to avoid exposure to more frequent extreme temperatures.

The projection of long-run impacts of climate change on firm entry and firm exit shows that the average impacts in China are statistically insignificant, but the county-level impacts differ substantially across regions. Our projection shows that firm entry tends to increase in the cold north and decrease in the hot south, while firm exit tends to decrease in the cold north and increase in the hot south. The results show that the cold north might benefit from climate change in terms of firm agglomeration, while the hot south might suffer. Given the non-negligible size of effects on the net entry of firms at the county level, climate change may reshape the spatial distribution of industries in China. Since climate change is expected to differentially affect all countries in the world, the results imply that climate change may also reshape the spatial distribution of global industries across economies.

Our results have important policy implications for regional economic development. First, since most developed countries are located in the north and most developing and least developed countries are located in the south, the climate change impacts on the spatial distribution of industries may exaggerate the regional inequality between the global north and the global south. This not only requires that the global north take more responsibility in carbon mitigation but also demands immediate attention to North-South technology transfer for climate adaptation. Second, when governments make plans for infrastructure investments to facilitate industrial production, they may need to take into account climate change's impact on the spatial distribution of industries. For example, northern regions benefiting from the inflow of firms may need to increase infrastructure investments to meet market demand, while southern regions suffering from the outflow of firms may need to invest in facilities to help firms adapt to extreme weather.

Two caveats apply here. First, the location choice of firms is influenced by many factors, including prices of input factors (labor, capital, energy and land), the upstream and downstream supply chain, and economic policies. Our results only reveal the effects caused by climate change and should not be considered the final equilibrium results. Second, our projections are based on the patterns found in historical data. As the climate gets warmer, firms may undertake strategies to adapt to extreme temperatures at the intensive margin, such as installing heating or air conditioning in the workplace. Using subsample regressions by cold and hot regions, some literature does find some evidence of adaptation of housholds[8,9], with the negative effects of cold temperatures being greater in hot regions and the negative effects of hot temperatures being greater in cold regions, while others do not[1,6]. We do not find evidence that firm entry and firm exit in hot regions are less sensitive to hot temperatures, or that firm entry and firm exit in cold regions are less sensitive to cold temperatures (the results are available upon request). This may be due to the fact that production, especially manufacturing production, faces global competition and is more sensitive to production costs, and thus is more mobile across regions than households. Hence, instead of making investments to adapt to increases in production costs caused by local extreme weather, firms may choose to enter or relocate to areas with less exposure to extreme weather. However, this does not rule out the possibility of firms' adaptation in the long run.

Methods

Data description. *Firm Registration Database*. The Firm Registration Database is a population dataset providing details of all Chinese firms' registration records. Using each firm's registration date as well as cancellation and revocation date, we firstly aggregate firm-level data at the county-year level to get firm entry and firm exit measured in number and paid-in capital scale during 1991-2019. We then use the shareholder information of each firm to calculate firms' inter-county firm-to-firm equity investments in newly registered firms by following the definitions provided in the section on “Extreme temperatures and firm migration”. We finally obtain balanced county-year panel data of firm entry, firm exit and inter-county firm-to-firm equity investments with 2815 counties and years from 1991 to 2019.

The mean value of the annual numbers of firm entry and firm exit in a county is 775 and 291 respectively during 1991-2019. The mean value of annual aggregate paid-in capital of firm entry and firm exit in a county is 4.92 billion and 0.68 billion CNY respectively during 1991-2019. The mean value of the annual number of intra-county and inter-county firm-to-firm equity investments in new firms is 16.3 and 14.6 respectively in the sample, while the mean value of annual aggregate paid-in capital of intra-county and inter-county firm-to-firm equity investment in new firms is 4.9 and 0.8 billion CNY respectively.

Weather Data. The weather data come from the China Meteorological Data Sharing Service (CMDSS) system, which includes daily mean temperature, precipitation, average relative humidity, and atmospheric pressure from more than 2000 weather stations in China. We construct the county-level weather variables by taking an inverse-distance weighted average of all the valid measurements from stations located within a 50-mile (80-kilometer) radius of the county centroid, where the inverse of the squared distance is used for the weights, so that less distant stations are given greater weight.

Climate Change Prediction Data. We use climate projection data provided by the NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) to predict the impacts of climate change on the spatial distribution of industries by the end of this century (2080-2099). The NEX-GDDP dataset includes downscaled projections for two Representative Concentration Pathways (RCPS), RCP4.5 and RCP8.5, from 21 models conducted under the Coupled Model Inter-comparison Project Phase 5, which were developed in support of the Fifth IPCC report. The dataset contains daily maximum temperature and minimum temperature at a spatial resolution of 0.25 degrees, from which we can obtain future daily mean temperatures for all the counties in our sample. Our projection is based on the median projected temperature and climate from the 21 models.

Figure S1 depicts the historical distribution of daily mean temperatures during our sample period and predicted temperature distribution during 2080-2099. The green bars indicate the number of days in each temperature bin during 1991-2019. The number of days with daily mean temperatures in the five bins between 5℃-30℃ accounts for about 76% of all days during 1991-2019. As for the exposure to the highest (lowest) temperature, the yearly average number of days with daily mean temperatures above 30℃ (below <-10℃) is 7.3 (11.7) during 1991-2019.

The red and blue bars in Figure S1 indicate the predicted average number of days in each temperature bin in 2080-2099 under the RCP4.5 and RCP8.5 scenarios, respectively. The population is likely to be exposed to fewer cold days and more hot days in 2080-2099 relative to 1991-2019 under both pathways. RCP8.5 predicts an increase of 47.9 days in the above 30℃ bin and an increase of 12.5 days in the 25℃-30℃ bin. The number of days in all the bins below 10℃ is expected to decrease. Under RCP4.5, the pattern of temperature change is similar but milder.

Econometric model. We estimate the effects of temperature on firms' entry, exit and inter-county equity investments by fitting the following equation:

$$Y_{ct} = \sum_j \beta_1^j TEMP_{ct}^j + X_{ct} + \theta * stock_c \times Year_t + \lambda_c + \gamma_{pt} + \epsilon_{ct} \qquad (1)$$

where Y_{ct} denotes the outcome variables of interest, including firm entry, firm exit, and inter-county firm-to-firm equity investments in new firms. When measuring firm entry (firm exit), Y_{ct} is the aggregate number or paid-in capital of all newly registered firms (all firms exiting the market) in county c and year t. In the inter-county equity investment regressions, Y_{ct} refers to the aggregate inter-county firm-to-firm equity investments from county c to newly registered firms in destination areas in year t. Since both the aggregate number of firms and their paid-in capital may have extreme values and zero values, we follow recent studies[48-50] in using the inverse hyperbolic sine (IHS) transformation, $\text{IHS}(y) = \log(y + \sqrt{1 + y^2})$, to transform these outcome variables. The interpretation of the IHS function is like that of a logarithmic transformation, but it is well-defined for values of zero.

The variable $TEMP_{ct}^j$ indicates the number of days when the county's daily average temperature is in the jth 5°C bin in year t. Our temperature variable is thus constructed to capture the full distribution of its annual fluctuations. Since the number of days falling into these 10 bins sums to 365 (or 366) in each year, one bin should be dropped in the regression as a baseline group. The existing literature commonly uses the most comfortable temperature bin as the reference group. Therefore, we use the temperature bin $TEMP_{ct}^{6}$ (10°C -15°C), which has the lowest impact on firms' extensive margin decisions, as the baseline group. In this way, the coefficient of $TEMP_{ct}^{j}$, β_1^j, indicates that exchanging a day in the 10°C -15°C bin for a day in the jth bin would cause a $100 * \beta_1^j\%$ change in the number (or paid-in capital) of firm entry, firm exit, and firm-to-firm equity investments.

In addition, X_{ct} denotes other weather control variables, including humidity, sunshine, and precipitation, which are likely to be correlated with temperatures. As with the temperature variables, we use bins to construct these weather variables. We also incorporate the term $stock_c \times Year_t$ in (1) to alleviate potential omitted variables problems, such as the industrial agglomeration effect that varies across county-year levels. $stock_c$ is the number of incumbent firms in county c at the beginning of the year 1991 (the baseline year), while $Year_t$ is a set of year dummies. Taking the two terms together flexibly deals with initial heterogeneous agglomeration effects among counties, allowing them to vary over years.

Finally, equation (1) also includes county fixed effects, λ_c, accounting for time-invariant county characteristics such as geographic location and climate zones, and province-year fixed effects, γ_{pt}, controlling for both observable and unobservable time-varying characteristics across provinces. Hence, our estimator β_1^j illustrates how, compared to other counties within the same province and year, the random deviations of temperatures from local mean conditions affect firms' entry/exit decisions. The standard errors are clustered at the county level because the error terms ε_{ct} within a county may be correlated across years.

Climate projections. As shown in Figure S1, climate projections predict that China will experience more extremely hot days and fewer extremely cold days by the end of this century. These will have opposite effects on firms' extensive margin decisions. For example, the increase in hot days would result in lower entry, the effect of which is likely to be offset by the decrease in cold days. We predict the overall impact of temperature changes based on our regression results for each county as follows:

$$\Delta Y_c(\%) = \left(\sum_j \hat{\beta}_1^j \times \Delta TEMP_c^j\right) \times 100\% \qquad (2)$$

where $\Delta Y_c(\%)$ indicates the temperature change impact on firm entry or firm exit in county c. $\hat{\beta}_1^j$ is the estimated coefficient of the jth temperature bin from our baseline regressions and presented in the first column of Supplementary Tables S1-S4.

$\Delta TEMP_c^j$ is the predicted change in the number of days in the jth temperature bin in county c.

We then use the following equation to calculate the temperature change impact on the net entry of firms in county c,

$$\Delta Net_c(\%) = \frac{Entrynum_c \cdot \Delta Entrynum_c(\%) - Exitnum_c \cdot \Delta Exitnum_c(\%)}{Entry_c - Exit_c} \quad (3)$$

where $Entrynum_c$ and $Exitnum_c$ represent the mean number of firm entry and firm exit respectively in county c during 1991-2019, and $\Delta Entrynum_c(\%)$ and $\Delta Exitnum_c(\%)$ are the projected percentage change of the number of firm entry and firm exit in county c from equation (2).

When calculating the national average impact of climate change on firm entry or firm exit, we average the impacts on all the counties, using the number of their historical entry or exit as weights:

$$\Delta Entrynum(\%) = \sum_j \hat{\beta}_1^j \times \frac{\sum_c \Delta TEMP_c^j \times Entrynum_c}{\sum_c Entrynum_c} \times 100\% \quad (4)$$

$$\Delta Exitnum(\%) = \sum_j \hat{\beta}_1^j \times \frac{\sum_c \Delta TEMP_c^j \times Exitnum_c}{\sum_c Exitnum_c} \times 100\% \quad (5)$$

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Supplement

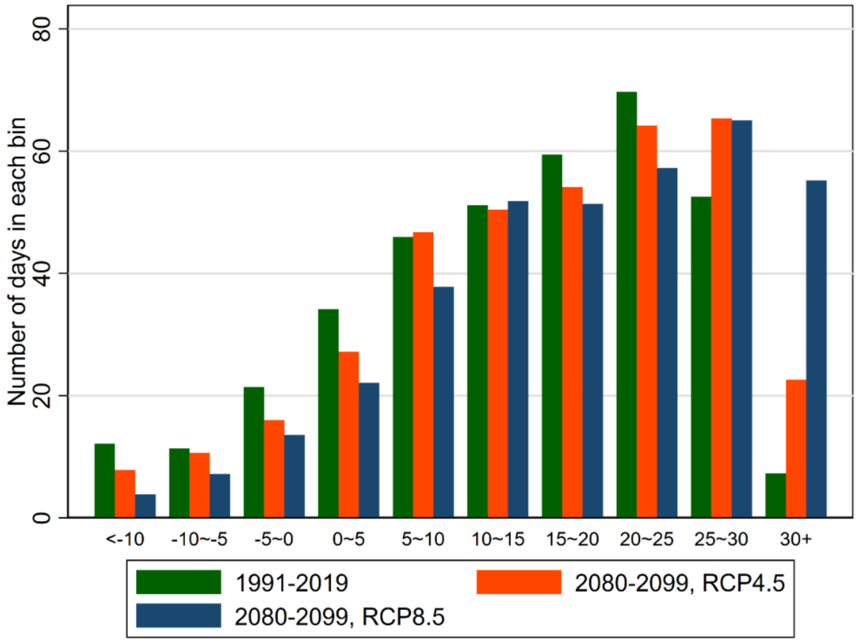
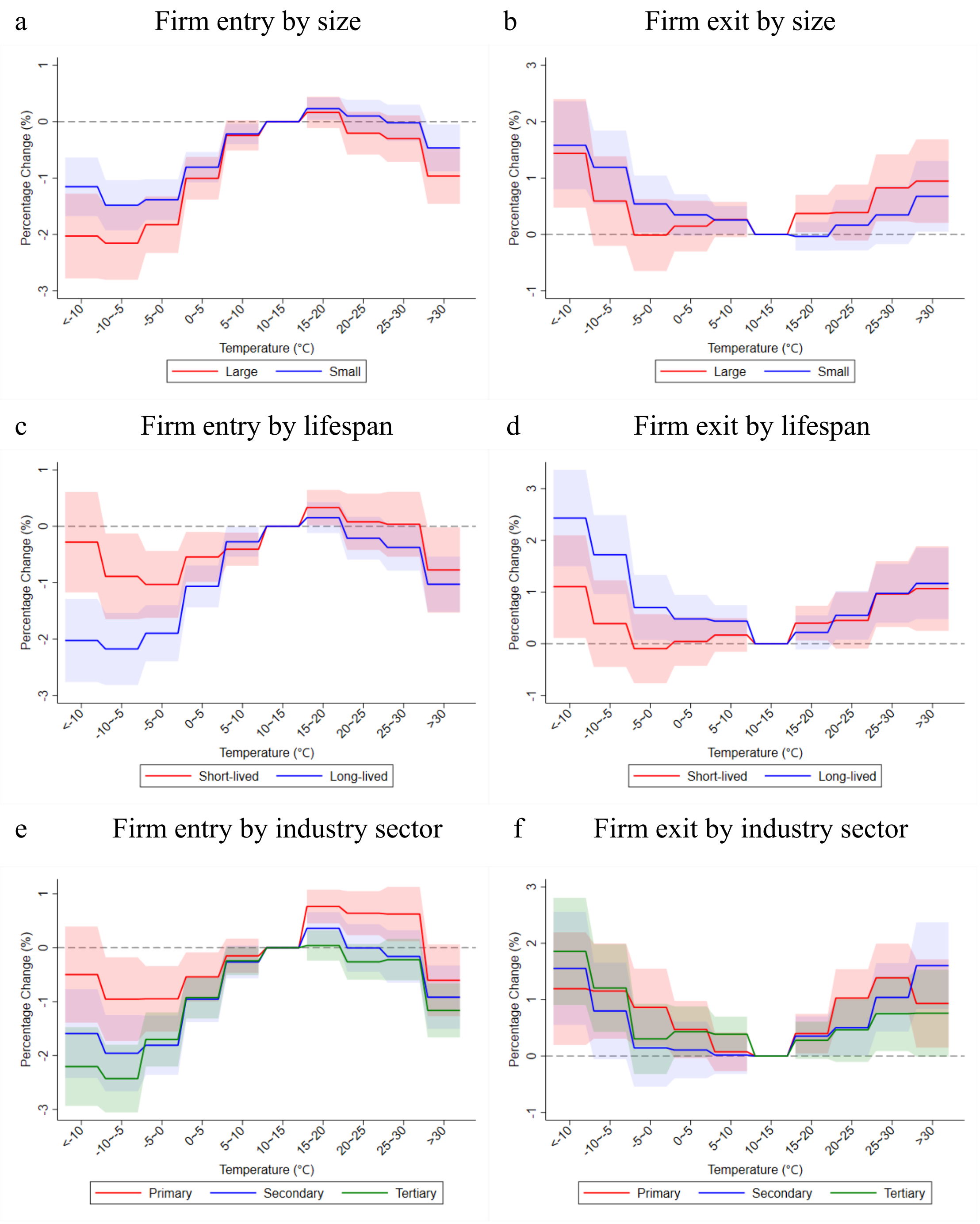


Figure S1 Temperature distribution in 1991-2019 and predicted temperature distribution in 2080-2099. This figure plots the average number of days per year in each temperature bin for all the 2818 counties during 1991-2019 and 2080-2099. The green bars represent the number of days by temperature bin in 1991-2019. The red bars represent the number of days by temperature bin in 2080-2099 under RCP4.5, and the blue bars represent the number of days by temperature bin in 2080-2099 under RCP8.5.


a Firm entry by size

b Firm exit by size

c Firm entry by lifespan

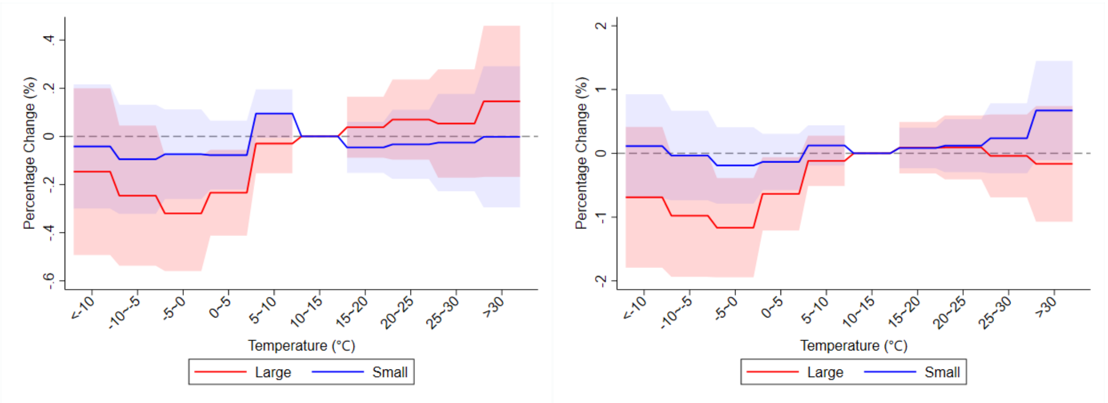
d Firm exit by lifespan

e Firm entry by industry sector

f Firm exit by industry sector

Figure S2 Heterogeneous effects of temperatures on the number of firm entry and firm exit. The figure reports subsample regression results of the temperature effects on the capital of firm entry and firm exit by firm size (in **a, b**), firm's lifespan (in **c, d**) and industry sector (in **e, f**). The coefficients are estimated by equation (1). The 95% CIs are indicated by the shaded areas, and the line measures the estimated change in the capital of firm entry and firm exit.

a Intra-county investments (number) **b** Intra-county investments (capital)



c Outward investments (number) **d** Outward investments (capital)

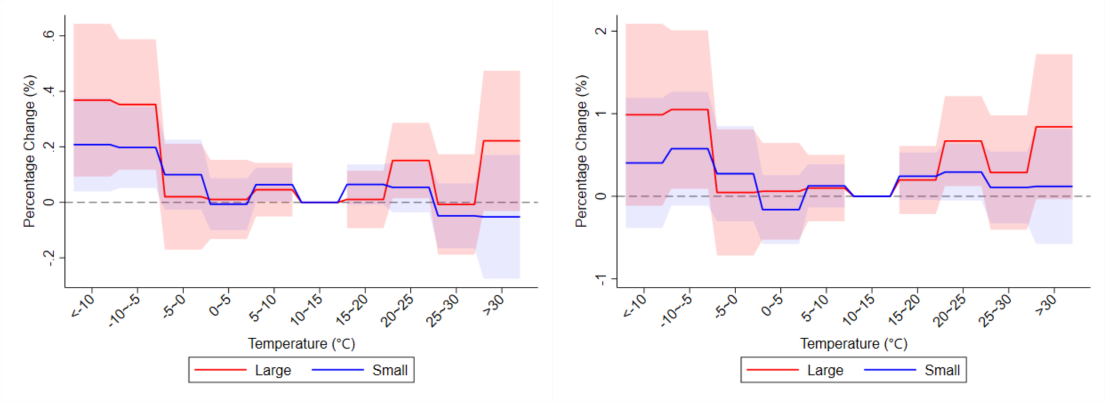
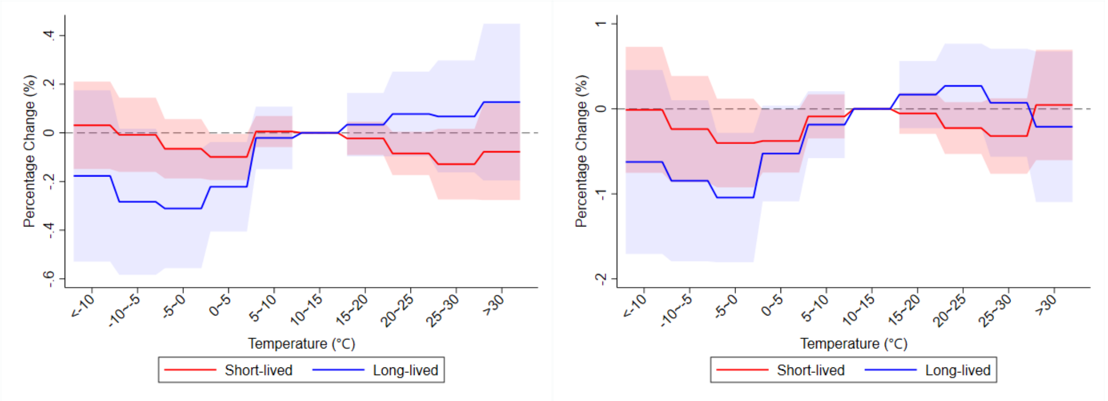


Figure S3 **Temperature effects on firm-to-firm equity investments in new firms by the size of investors.** The figure reports the temperature effects on the number and paid-in capital of intra-county (in **a** and **b**) and outward (in **c** and **b**) inter-county firm-to-firm equity investment in new firms by the size of investors. The coefficients are estimated by equation (1). The 95% CIs are indicated by the shaded areas, and the line measures the change in the firm-to-firm equity investments in new firms.

a Intra-county investments (number) **b** Intra-county investments (capital)



c Outward investments (number) **d** Outward investments (capital)

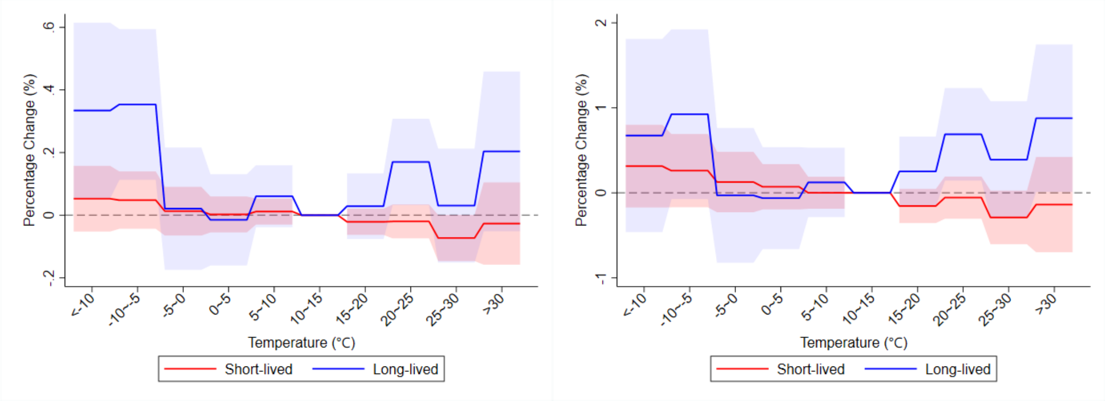


Figure S4 **Temperature effects on firm-to-firm equity investments in new firms by the lifespan of investors.** The figure reports the temperature effects on the number and paid-in capital of intra-county (in **a** and **b**) and outward (in **c** and **b**) inter-county firm-to-firm equity investments in new firms by the lifespan of investors. The coefficients are estimated by equation (1). The 95% CIs are indicated by the shaded areas, and the line measures the change in the firm-to-firm equity investments in new firms.

Table S1 Baseline Result and Robustness Checks on Firm Entry (Number)

	(1) Baseline	(2) Cumulative Effects	(3) Log	(4) No Firm Controls	(5) No Weather Controls
<=-10℃	-0.0068***	-0.0123***	-0.0050***	-0.0079***	-0.0062***
	(0.0015)	(0.0025)	(0.0014)	(0.0016)	(0.0015)
-10~-5℃	-0.0083***	-0.0162***	-0.0067***	-0.0094***	-0.0079***
	(0.0013)	(0.0021)	(0.0012)	(0.0014)	(0.0013)
-5~0℃	-0.0074***	-0.0137***	-0.0063***	-0.0082***	-0.0072***
	(0.0010)	(0.0017)	(0.0009)	(0.0011)	(0.0010)
0~5℃	-0.0047***	-0.0086***	-0.0041***	-0.0049***	-0.0044***
	(0.0008)	(0.0013)	(0.0007)	(0.0008)	(0.0008)
5~10℃	-0.0008	-0.0013	-0.0007	-0.0008	-0.0007
	(0.0005)	(0.0009)	(0.0005)	(0.0005)	(0.0005)
15~20℃	0.0005	0.0007	0.0007	0.0006	0.0004
	(0.0005)	(0.0010)	(0.0005)	(0.0006)	(0.0005)
20~25℃	-0.0003	-0.0010	0.0001	-0.0006	-0.0005
	(0.0008)	(0.0013)	(0.0007)	(0.0008)	(0.0007)
25~30℃	-0.0009	-0.0027*	-0.0005	-0.0012	-0.0011
	(0.0009)	(0.0015)	(0.0008)	(0.0010)	(0.0009)
>30℃	-0.0030**	-0.0062***	-0.0023*	-0.0051***	-0.0034**
	(0.0014)	(0.0022)	(0.0013)	(0.0014)	(0.0013)
Firm Controls	YES	YES	YES	NO	YES
Weather Controls	YES	YES	YES	YES	NO
County FE	YES	YES	YES	YES	YES
Province-Year FE	YES	YES	YES	YES	YES
R-squared	0.9254	0.9257	0.9289	0.9213	0.9254
Obs.	81,722	81,722	81,722	81,722	81,722

Notes: The table reports the temperature effects on firm entry measured in number. The reported standard errors are clustered at the county level. *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. Column 1 reports the baseline results. Column 2 presents the results including temperature bins of both the current year and the previous year in equation (1) and the coefficients are the cumulative effects from two years rather than the contemporaneous effect from the current year. Column 3 shows the results using Log(1+Entry Number) as the outcome instead of IHS(Entry Number). Columns 4 and 5 report the results without firm controls and weather controls respectively. The firm controls refer to the number of incumbent firms in 1991 interacted with year dummies, while weather controls include the set of bins of humidity, sunshine and precipitation.

Table S2 Baseline Result and Robustness Checks on Firm Entry (Capital)

	(1) Baseline	(2) Cumulative Effects	(3) Log	(4) No Firm Controls	(5) No Weather Controls
<=-10℃	-0.0208***	-0.0344***	-0.0189***	-0.0222***	-0.0167***
	(0.0037)	(0.0055)	(0.0035)	(0.0038)	(0.0036)
-10~-5℃	-0.0220***	-0.0391***	-0.0205***	-0.0234***	-0.0191***
	(0.0032)	(0.0046)	(0.0030)	(0.0032)	(0.0031)
-5~0℃	-0.0185***	-0.0302***	-0.0174***	-0.0194***	-0.0163***
	(0.0025)	(0.0038)	(0.0023)	(0.0025)	(0.0024)
0~5℃	-0.0101***	-0.0159***	-0.0094***	-0.0104***	-0.0085***
	(0.0019)	(0.0029)	(0.0018)	(0.0019)	(0.0018)
5~10℃	-0.0027**	-0.0034	-0.0025**	-0.0026*	-0.0019
	(0.0013)	(0.0022)	(0.0012)	(0.0013)	(0.0013)
15~20℃	0.0014	0.0007	0.0016	0.0016	0.0006
	(0.0014)	(0.0022)	(0.0013)	(0.0014)	(0.0014)
20~25℃	-0.0024	-0.0066**	-0.0021	-0.0028	-0.0040**
	(0.0018)	(0.0031)	(0.0017)	(0.0019)	(0.0019)
25~30℃	-0.0036*	-0.0083***	-0.0032*	-0.0039*	-0.0058***
	(0.0020)	(0.0032)	(0.0019)	(0.0021)	(0.0020)
>30℃	-0.0100***	-0.0189***	-0.0095***	-0.0126***	-0.0133***
	(0.0024)	(0.0038)	(0.0023)	(0.0024)	(0.0022)
Firm Controls	YES	YES	YES	NO	YES
Weather Controls	YES	YES	YES	YES	NO
County FE	YES	YES	YES	YES	YES
Province-Year FE	YES	YES	YES	YES	YES
R-squared	0.8464	0.8469	0.8518	0.8438	0.8462
Obs.	81,722	81,722	81,722	81,722	81,722

Notes: The table reports the temperature effects on firm entry measured in paid-in capital. The reported standard errors are clustered at the county level. *: p < 0.10; **: p < 0.05; ***: p < 0.01. Column 1 reports the baseline results. Column 2 presents the results including temperature bins of both the current year and the previous year in equation (1) and the coefficients are the cumulative effects from two years rather than the contemporaneous effect from the current year. Column 3 shows the results using Log(1+Entry Number) as the outcome instead of IHS(Entry Number). Columns 4 and 5 report the results without firm controls and weather controls respectively. The firm controls refer to the number of incumbent firms in 1991 interacted with year dummies, while weather controls include the set of bins of humidity, sunshine and precipitation.

Table S3 Baseline Result and Robustness Checks on Firm Exit (Number)

	(1) Baseline	(2) Cumulative Effects	(3) Log	(4) No Firm Controls	(5) No Weather Controls
<=-10℃	0.0108***	0.0182***	0.0111***	0.0097***	0.0123***
	(0.0026)	(0.0041)	(0.0024)	(0.0026)	(0.0026)
-10~-5℃	0.0072***	0.0125***	0.0078***	0.0064***	0.0085***
	(0.0021)	(0.0034)	(0.0020)	(0.0021)	(0.0022)
-5~0℃	0.0030*	0.0053*	0.0037**	0.0024	0.0041**
	(0.0017)	(0.0028)	(0.0016)	(0.0017)	(0.0017)
0~5℃	0.0015	0.0039*	0.0018	0.0013	0.0022*
	(0.0012)	(0.0022)	(0.0011)	(0.0013)	(0.0012)
5~10℃	0.0014*	0.0030**	0.0013*	0.0016**	0.0018**
	(0.0008)	(0.0014)	(0.0007)	(0.0008)	(0.0008)
15~20℃	0.0013	0.0027*	0.0011	0.0015*	0.0010
	(0.0008)	(0.0015)	(0.0008)	(0.0008)	(0.0008)
20~25℃	0.0016	0.0026	0.0016	0.0017	0.0007
	(0.0015)	(0.0024)	(0.0014)	(0.0015)	(0.0014)
25~30℃	0.0032*	0.0037	0.0030*	0.0035**	0.0022
	(0.0018)	(0.0027)	(0.0016)	(0.0018)	(0.0017)
>30℃	0.0060***	0.0071**	0.0062***	0.0043*	0.0044**
	(0.0022)	(0.0034)	(0.0021)	(0.0022)	(0.0021)
Firm Controls	YES	YES	YES	NO	YES
Weather Controls	YES	YES	YES	YES	NO
County FE	YES	YES	YES	YES	YES
Province-Year FE	YES	YES	YES	YES	YES
R-squared	0.8447	0.8448	0.8443	0.8406	0.8445
Obs.	81,722	81722	81,722	81,722	81,722

Notes: The table reports the temperature effects on firm exit measured in number. The reported standard errors are clustered at the county level. *: p < 0.10; **: p < 0.05; ***: p < 0.01. Column 1 reports the baseline results. Column 2 presents the results including temperature bins of both the current year and the previous year in equation (1) and the coefficients are the cumulative effects from two years rather than the contemporaneous effect from the current year. Column 3 shows the results using Log(1+Entry Number) as the outcome instead of IHS(Entry Number). Columns 4 and 5 report the results without firm controls and weather controls respectively. The firm controls refer to the number of incumbent firms in 1991 interacted with year dummies, while weather controls include the set of bins of humidity, sunshine and precipitation.

Table S4 Baseline Result and Robustness Checks on Firm Exit (Capital)

	(1) Baseline	(2) Cumulative Effects	(3) Log	(4) No Firm Controls	(5) No Weather Controls
<=-10℃	0.0116**	0.0186**	0.0121***	0.0094**	0.0164***
	(0.0047)	(0.0074)	(0.0044)	(0.0047)	(0.0046)
-10~-5℃	0.0030	0.0063	0.0043	0.0013	0.0068*
	(0.0039)	(0.0062)	(0.0036)	(0.0039)	(0.0039)
-5~0℃	-0.0024	-0.0045	-0.0014	-0.0037	0.0006
	(0.0031)	(0.0051)	(0.0029)	(0.0032)	(0.0031)
0~5℃	0.0001	0.0002	0.0004	-0.0003	0.0021
	(0.0022)	(0.0037)	(0.0021)	(0.0022)	(0.0022)
5~10℃	0.0026*	0.0032	0.0025*	0.0029*	0.0036**
	(0.0015)	(0.0025)	(0.0014)	(0.0015)	(0.0015)
15~20℃	0.0034**	0.0073***	0.0032**	0.0036**	0.0024
	(0.0016)	(0.0027)	(0.0015)	(0.0016)	(0.0016)
20~25℃	0.0028	0.0046	0.0030	0.0026	0.0006
	(0.0024)	(0.0040)	(0.0023)	(0.0024)	(0.0023)
25~30℃	0.0072**	0.0103**	0.0072***	0.0074**	0.0048*
	(0.0029)	(0.0045)	(0.0028)	(0.0029)	(0.0028)
>30℃	0.0079**	0.0078	0.0081**	0.0041	0.0046
	(0.0037)	(0.0054)	(0.0034)	(0.0037)	(0.0034)
Firm Controls	YES	YES	YES	NO	YES
Weather Controls	YES	YES	YES	YES	NO
County FE	YES	YES	YES	YES	YES
Province-Year FE	YES	YES	YES	YES	YES
R-squared	0.8134	0.8135	0.8180	0.8099	0.8131
Obs.	81,722	81,722	81,722	81,722	81,722

Notes: The table reports the temperature effects on firm exit measured in paid-in capital. The reported standard errors are clustered at the county level. *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. Column 1 reports the baseline results. Column 2 presents the results including temperature bins of both the current year and the previous year in equation (1) and the coefficients are the cumulative effects from two years rather than the contemporaneous effect from the current year. Column 3 shows the results using Log(1+Entry Number) as the outcome instead of IHS(Entry Number). Columns 4 and 5 report the results without firm controls and weather controls respectively. The firm controls refer to the number of incumbent firms in 1991 interacted with year dummies, while weather controls include the set of bins of humidity, sunshine and precipitation.

Table S5 Robustness Checks Using Daily Maximum Temperature

	(1) IHS(entrynum)	(2) IHS(entrycap)	(3) IHS(exitnum)	(4) IHS(exitcap)
<=-5	-0.0043***	-0.0093***	0.0091***	0.0141***
	(0.0013)	(0.0032)	(0.0022)	(0.0043)
-5~0	-0.0055***	-0.0125***	0.0071***	0.0073**
	(0.0012)	(0.0028)	(0.0020)	(0.0036)
0~5	-0.0057***	-0.0117***	0.0033**	0.0024
	(0.0009)	(0.0022)	(0.0015)	(0.0027)
5~10	-0.0041***	-0.0074***	0.0000	-0.0020
	(0.0007)	(0.0017)	(0.0011)	(0.0020)
10~15	-0.0022***	-0.0022	0.0013	0.0008
	(0.0006)	(0.0015)	(0.0009)	(0.0017)
20~25	0.0010*	0.0037***	-0.0000	0.0011
	(0.0006)	(0.0013)	(0.0008)	(0.0015)
25~30	0.0005	0.0032**	-0.0010	0.0009
	(0.0007)	(0.0015)	(0.0013)	(0.0022)
30~35	0.0004	0.0026	-0.0018	-0.0008
	(0.0008)	(0.0017)	(0.0014)	(0.0025)
>35	-0.0006	0.0017	0.0006	0.0034
	(0.0010)	(0.0019)	(0.0018)	(0.0031)
Observations	81,722	81,722	81,722	81,722
R-squared	0.9254	0.8464	0.8447	0.8134

Notes: The table reports the robustness checks using 10 temperature bins constructed based on daily maximum temperature. Same as the baseline regression, all columns include firm controls, weather controls, county fixed effects and province-year fixed effects. The reported standard errors are clustered at the county level. *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$.

Table S6 Robustness Checks Using Daily Minimum Temperature

	(1) IHS(entrynum)	(2) IHS(entrycap)	(3) IHS(exitnum)	(4) IHS(exitcap)
<=-15	-0.0045***	-0.0132***	0.0073***	0.0100**
	(0.0014)	(0.0030)	(0.0024)	(0.0044)
-15~-10	-0.0066***	-0.0163***	0.0012	-0.0026
	(0.0012)	(0.0027)	(0.0020)	(0.0038)
-10~-5	-0.0039***	-0.0097***	0.0023	0.0009
	(0.0010)	(0.0022)	(0.0017)	(0.0031)
-5~0	-0.0022***	-0.0053***	0.0003	-0.0010
	(0.0008)	(0.0018)	(0.0013)	(0.0024)
0~5	0.0001	0.0003	0.0014	0.0041**
	(0.0005)	(0.0013)	(0.0009)	(0.0016)
10~15	0.0005	0.0016	0.0018**	0.0042**
	(0.0005)	(0.0013)	(0.0009)	(0.0017)
15~20	0.0007	-0.0020	0.0023*	0.0052**
	(0.0007)	(0.0016)	(0.0012)	(0.0022)
20~25	-0.0003	-0.0052***	0.0031*	0.0077***
	(0.0010)	(0.0020)	(0.0016)	(0.0028)
>25	-0.0026**	-0.0108***	0.0036**	0.0040
	(0.0011)	(0.0021)	(0.0018)	(0.0032)
Observations	81,722	81,722	81,722	81,722
R-squared	0.9254	0.8464	0.8447	0.8134

Notes: The table reports the robustness checks using 10 temperature bins constructed based on daily minimum temperature. Same as the baseline regression, all columns include firm controls, weather controls, county fixed effects and province-year fixed effects. The reported standard errors are clustered at the county level. *: p < 0.10; **: p < 0.05; ***: p < 0.01.