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Abstract

This paper provides novel evidence of the impact of temperature fluctuations on retirement behavior and underlying mechanisms, combining 30 years of rich longitudinal survey data with granular daily weather information. Exposure to cold and hot temperatures accelerates transitions into retirement, particularly among individuals unaccustomed to such conditions, and the effects are strongest among vulnerable populations facing greater health challenges and limited access to healthcare. Extreme temperatures deteriorate health through a higher incidence of cardiovascular diseases and strokes, reducing individuals' ability to work, while better access to healthcare mitigates the adverse effects of extreme temperatures on retirement behavior.

Keywords: Temperature, Health, Retirement, Healthcare

JEL classification: I14, I18, J26, Q54

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1 Introduction

Extreme temperatures are one of the most common environmental hazards and an increasing global health concern (WHO, 2024). Exposure to extreme cold and heat can impair physical and mental health, leading to serious and long-lasting consequences in some cases. Adverse health influences individuals' labor supply decisions, particularly near retirement when health challenges are more prevalent (see e.g., Blundell et al. (2023), Coile (2016), and Dwyer and Mitchell (1999)). In many countries, including the United States, aging populations and rising shares of retired individuals have increased the pressure on national public finances and challenged the sustainability of their social security systems (OECD, 2023). However, despite these concerns, little is known on whether, and how, temperature conditions impact retirement behavior.

In this paper, we present the first evidence of the effect of temperature on retirement decisions and investigate some of the plausible explanations behind this effect. We use a large panel dataset from the Health Retirement Study (HRS) containing detailed information on labor force participation for individuals aged 50 or older between 1992 and 2020. We combine the HRS data with county-day weather data from the National Oceanic and Atmospheric Administration (NOAA) to assess the effect of weather conditions on retirement behaviors.

We provide several sets of evidence for the age 50+ population. First, we show that cold temperatures increase retirement transitions and reduce labor and total income. The effects are larger in magnitude the colder the temperature is. Hot temperatures also increase the probability of retirement among individuals who reside in counties where extreme heat events occur less frequently. This result is consistent with the prior finding that the adoption of air conditioning in the United States has largely mitigated the health impacts of hot weather and that these health impacts vary by baseline climate (Barreca et al., 2016; Heutel et al., 2021).

Second, we find that the effect of temperature on retirement is strongest for groups of the population with a higher health vulnerability: older (among those around traditional retirement ages), less educated, and low-income individuals. Older individuals have a higher propensity to experience health problems, while less educated and low-income individuals may have less access to affordable healthcare, may adopt less healthy habits, and more often work in physically demanding jobs.

We then explore health as a plausible mechanism behind the impact of temperature on retirement transitions. We show that individuals exposed to cold and hot temperatures are more likely to report having suffered from health issues, especially cardiovascular problems and higher prevalence of stroke incidences. By raising the risk of detrimental health conditions, extreme temperatures may reduce the ability of individuals to continue working, ultimately inducing retirement.

Lastly, we show that a higher availability of hospitals near the place of residence helps counteract some of the negative health implications of extreme temperature conditions, mitigating the impact of extreme temperature on retirement probabilities. Increasing access to healthcare may thus be an important instrument to help individuals stay in the labor force longer and reduce the severity of adverse health shocks.

Our paper contributes to the literature on the impacts of climate on health and labor markets. A growing body of evidence have investigated the effect of extreme temperatures on workplace safety and occupational health, showing that extreme temperatures lead to more work injuries (Dillender, 2021; Park et al., 2021), a higher number of occupational health claims (Ireland et al., 2023) and increased work accidents likely due to insufficient sleep (Drescher and Janzen, 2025). These studies are in line with prior evidence showing that extreme temperatures worsen individuals' overall health status by increasing the incidence of cardiovascular and respiratory illnesses

(Deschenes and Moretti, 2009; White, 2017) and reducing mental health (Baylis, 2020; Mullins and White, 2019; Noelke et al., 2016). The deterioration in the physical and mental health of individuals brought by extreme temperatures has severe long-lasting implications in terms of higher suicide (Burke et al., 2018; Mullins and White, 2019) and mortality rates (Barreca et al., 2016; Deschênes and Greenstone, 2011; Deschenes, 2022; Heutel et al., 2021; Mullins and White, 2020).

Our paper also relates to the literature studying the impact of temperature on labor market engagement and economic production. Prior studies have shown that extreme temperatures decrease rural employment (Jessoe et al., 2018), lead to re-allocations of workers from the agricultural to the non-agricultural sector (Colmer, 2021), and reduce employment and demand in non-agricultural sectors due to decreases in agricultural productivity (Liu et al., 2023). At the intensive margin, extreme temperatures lead to reduced working hours (Graff Zivin and Neidell, 2014; Neidell et al., 2021; Cosaert et al., 2023; Garg et al., 2020), higher worker absenteeism (Somanathan et al., 2021) and lower work effort (Belloc et al., 2025).

We contribute to these literatures by providing the first empirical evidence of how temperature influences retirement behavior, an increasing important labor force transition in many countries where the working-age populations are shrinking, and how the effect distributes across the different groups of the population, which is important to understand inequalities in the labor market. We investigate plausible mechanisms, identifying health as an important driver of the impact of temperature on retirement decisions, and show the importance of healthcare policy to address the detrimental implications of extreme weather conditions, helping individuals stay in the labor market.

Lastly, our paper contributes to the literature on the determinants of retirement decisions. Previous studies have documented that an individual's health status, educational level, and income are key drivers of retirement decisions (Coile, 2016). Poor health, chronic conditions, and long-term illnesses increase the likelihood of retirement (Dwyer and Mitchell, 1999). Financially, higher earnings and strong incentives to delay retirement reduce early exits even among those with health issues (Anderson and Burkhauser, 1985; French, 2005), and less generous health coverage after retirement decreases retirement (Blau and Gilleskie, 2001; French and Jones, 2011; Nyce et al., 2013). As for education, Blundell et al. (2023) find that more educated individuals, who are less likely to work in physically demanding jobs, are less likely to retire when experiencing health deteriorations. We contribute to this literature by demonstrating that adverse climatic conditions raise the probability of retirement, likely through a deterioration in the health status of individuals. Policies addressing retirement should account for the role of climate.

The remainder of the paper proceeds as follows. Section 2 explains the data. Section 3 describes the empirical strategy. Section 4 presents our results on the impact of temperature on retirement transitions. Section 5 explores plausible explanations behind the effect of temperature on retirement and whether policy can address this impact. Section 6 concludes.

2 Data Sources

2.1 Health and Retirement Study

Our primary data are from the Health and Retirement Study (HRS), a nationally representative longitudinal survey of Americans aged 50 and older. The survey has been conducted biennially since 1992. The HRS initially focused on individuals born between 1931 and 1941 and later expanded to younger birth cohorts when they satisfied the age threshold. Data collection involves extensive in-person interviews, supplemented by telephone interviews for follow-ups. The survey contains detailed information on respondents' health (including physical health, functional abilities, psychological well-being, and healthcare utilization), employment biographies and retirement (covering labor force status, retirement timing, pension details, expected retirement age, and work-related transitions), and financial status (including income, wealth, consumption, and financial literacy).

The longitudinal design of the HRS allows for an in-depth analysis of retirement transition decisions, individual health conditions, and their economic consequences. We link restricted geolocation data from the HRS on the county of residence and the dates of the interviews with daily weather data for each county in the United States (discussed in the next section). We use variation in the temperature individuals were exposed to prior to their survey interviews to analyze their impact on retirement behavior and health. Our approach is consistent with methodologies used in previous research on the effect of temperature on health (e.g., Deschênes and Greenstone (2011)).

Given our focus on retirement transitions and possible mechanisms, our sample consists of individuals aged 50 to 90 who reported positive labor income during the previous survey interview (i.e., two years before the current interview). We refer to a transition between employment with positive labor income in the previous survey $(t-1)$ to retirement in the current survey (t) as "retirement". Panel A of Figure 1 displays the retirement probability for individuals working in the last interview as a function of age. The likelihood of retiring increases with age for these individuals, from approximately 10% at age 60 to approximately 50% at age 80. Consistent with these numbers, panel B of Figure 1 shows that working hours decrease for our sample as a function of age.

Column 1 of Table 1 presents descriptive statistics for our primary sample. More than half of individuals are female, and the average age is 62. Moreover, most of the sample is white, married, and has approximately 13 years of education. The average probability of retiring for individuals who were working in the previous interview is around 20% across all ages and 43% for those aged 65 or more. Labor income is larger on average than retirement income (measured as the sum of social security, pension, and annuities income), even in the age 65+ sub-sample. Most individuals suffer from some health problems, most prominently cardiovascular issues. This pattern increases with age for all medical conditions except for mental health problems which remain roughly constant around 15–16%.

2.2 Weather Data from the National Oceanic and Atmospheric Administration

To capture climatic conditions at the county-day level, we use data from the National Oceanic and Atmospheric Administration (NOAA), which collects daily weather information for more than 9,000 operational stations in the United States. We have information on the maximum, minimum, and average temperatures, rainfall, and snowfall. We aggregate the station-level information to the county level for each day and then calculate the share of days (within the six months before the interview date) where each respondent in the HRS sample was exposed to certain weather conditions. For maximum temperatures, which are our main variables of interest, we calculate the proportion of days within the six months prior to the HRS interview date in which each respondent in the HRS sample was exposed to temperatures (i.e. maximum daily temperatures) within the following intervals: less than or equal to 0 degrees Celsius, (0,10] degrees Celsius, (10,20] degrees Celsius, the "reference" temperature range (20,30], and hot daily temperatures higher than 30 degrees Celsius.

3 Empirical Approach

We assess the effect of ambient temperature on retirement transitions (and other outcomes) using the standard model in the climate-economy literature (Dell et al., 2014):

$$y_{i,c,s,t} = \alpha + \sum_{\substack{j=1 \\ j\neq 4}}^{5} \beta_j Tmax_{j,c(i),t(i)} + \gamma X_{i,t(i)} + \delta_{c(i)} + g(t(i), s(i)) + \varepsilon_{i,c,s,t}, \qquad (1)$$

where $y_{i,c,s,t}$ is an indicator equal to 1 if individual i, residing in county c and state s, is retired at the time of the interview t. Our primary focus is to investigate the impact of temperature on retirement transitions. Thus, our sample consists of individuals who worked in the previous interview (i.e., in $t-1$).

Our key independent variables of interest, $Tmax_{1,c(i),t(i)}$-$Tmax_{5,c(i),t(i)}$ are a set of continuous measures representing the proportion of days with maximum temperatures within 10°C ranges to which individuals have been exposed in their county of residence during the six months preceding the interview date.[1] We use the following temperature intervals (measured in Celsius): less than or equal to 0 (denoted as $Tmax_{1,c(i),t(i)}$), (0,10] (denoted as $Tmax_{2,c(i),t(i)}$), (10, 20] (denoted as $Tmax_{3,c(i),t(i)}$), (20,30] (denoted as $Tmax_{4,c(i),t(i)}$) and higher than 30 (denoted as $Tmax_{5,c(i),t(i)}$). The reference category is the temperature window between 20 and 30 degrees Celsius. By definition, these temperature variables can take a value from 0 to 100. The coefficients β_j represent the estimated effect of increasing the share of days in the past six months that an

[1] We calculate these numbers at the individual level, taking into account the place of residence of the individual over the previous six months.

individual was exposed to temperatures within bracket j, while simultaneously and symmetrically decreasing the share of days with temperatures in the reference range of 20–30°C, holding constant the total number of days. This approach allows the β_j estimates to be interpreted relative to the omitted or baseline temperature bin. This flexible approach allows for possible nonlinearities in the estimated relationship as the marginal effect of temperature on the outcome changes across temperature category.

$\delta_{c(i)}$ are county fixed effects, and $g(t(i), s(i))$ is a function that includes year-month time fixed effects, state-by-year fixed effects to account for changes in any economic, health, or policy shock that varies by state (or state-year), and state-by-month fixed effects to account for differential seasonality patterns in the outcomes across states. $X_{i,t(i)}$ includes control variables such as gender, age in yearly bins, and ethnicity. This set of covariates controls for composition changes in the counties over time. Finally, $\varepsilon_{i,c,s,t}$ is the idiosyncratic error term over time and individuals. Since our treatment varies by county, we cluster the standard errors at the county level.

The identifying assumption of the paper is that variation in temperature conditions is uncorrelated with unobserved determinants of retirement conditional on our set of covariates and fixed effects. Including county and year-month fixed effects ensures that we exploit exogenous variation in the exposure to different temperature conditions across individuals living in the same county and who are interviewed during the same month. Below, we provide extensive evidence supporting our identification strategy addressing concerns such as our estimates being driven by migration, temperature conditions before the sixth month prior to the interview, by individuals living in specific areas were extreme temperature shocks are frequent, or the functional form of choice in the baseline specification.

4 Temperature and Retirement Transitions

We start by analyzing the effect of temperature variation on retirement transitions. We estimate our baseline model in equation (1), where the dependent variable is a binary variable equal to 1 if an individual working at the time of the previous interview ($t-1$) has retired by the time of the present interview (t). Panel A of Figure 2 shows that cold temperatures increase the probability of individuals retiring and that this effect increases in magnitude as the temperature becomes colder. An increase of 10 percentage-points in the proportion of days in which individuals are exposed to maximum temperatures below 0 Celsius in the previous six months increases their retirement probability by two percentage points relative to a scenario where the individual would have been exposed to temperatures in the reference category (i.e., between 20–30 Celsius). The average probability of individuals retiring in our sample is 21 percent. Thus, our estimate represents an increase of 9.5 percent relative to the average baseline level of retirement. In contrast, hot temperatures do not meaningfully affect retirement decisions in the full sample.

Panels B–D of Figure 2 further examine the impact of extreme temperatures on the labor market outcomes of individuals working at the time of the previous interview. In panel B, we use the number of hours worked per week at t as the outcome variable. Consistent with the evidence in Panel A, we find that extreme cold temperatures reduce working hours. The effect is economically significant and increasing in magnitude as temperatures become more extreme. A 10 percentage-point increase in the proportion of days that individuals were exposed to temperatures below 0 degrees Celsius decreases weekly working hours by 1.2 hours. This impact represents a 5.5% decrease relative to the average weekly hours of work in the sample. Like in panel A, we do not find a statistically significant effect of hot temperatures on working hours in the full sample. In panels C and D, we investigate whether temperature affects income by focusing on the logarithm of individuals' annual labor and retirement income at t as the dependent variable, respectively.[2] Retirement income is measured as the sum of social security, pension, and annuities income. Exposure to cold temperatures decreases labor earnings and increases retirement income. The estimates show that individuals exposed to an increase of 10 percentage-points in the number of days with maximum temperatures below 0 degrees Celsius in the last six months instead of to maximum temperatures between 20 and 30 degrees Celsius (our reference category), experience a drop in labor earnings of about 20% and an increase in retirement income of almost 17%. Consistent with the previous results, we find no impact of hot temperatures on labor earnings and retirement income. The average annual labor earnings of individuals older than 50 during our analysis period was 32,000 dollars, while the average annual retirement income was 7,000 dollars. Therefore, the increase in retirement brought by cold temperatures necessarily decreases total income.[3]

A natural question is whether the effect of temperature on retirement decisions may differ for individuals depending on the temperature conditions they are used to. If adaptation to cold (hot) temperatures help mitigate their negative implications on health and overall wellbeing, we should expect the impact of cold (hot) temperatures on retirement transition to be larger for individuals who experience extreme cold (hot) temperatures less frequently (Barreca et al., 2016; Heutel et al., 2021). Given that the adoption of air conditioning in the United States is considerable, with the cur-

[2]We include in the estimation individuals with an income equal to 0 at the time of the interview. Before implementing the log transformation, and to avoid excluding them from the regression, we add 1 to their original income value of 0.

[3]Panels A and B of Figure A.1 estimate the impact of temperature on total individual and household annual income to further investigate how the financial situation of individuals may change when exposed to different temperature conditions. We find that exposure to extreme cold temperatures seems to reduce total and household income albeit the estimates are not always precise.

rent take-up rate near 90%,[4] adaptation to hot temperatures may explain the small magnitude of our baseline estimates on the effect of hot temperatures on retirement. We investigate whether this is the case by re-estimating our baseline specification for individuals living in counties where the average temperature during the sample period is above and below the average temperature in the US, respectively. We present the results in Figure 3 and find clear evidence of differential response to temperature shocks by baseline climate. An increase of 10 percentage-points in the number of cold days raises retirement transitions by 6 and 0.7 percentage points for individuals living in relatively warm and cold counties, respectively. These estimates represent an increase in the retirement average baseline level of 28.6 and 3.3 percent, respectively. On the other hand, an increase of 10 percentage-points in the frequency of hot days increases retirement transitions by 1.2 percentage points for individuals who live in relatively cold counties (Panel B). This estimate represents an increase in the retirement average baseline level of 5.7 percent.

How important could these estimates be for the US economy in aggregate? In the US, 4.1 million people retire each year on average.[5] Thus an increase of 1 percentage-points in the number of days with exposure to cold and hot temperatures could cause up to 117,260 and 23,370 new retirement episodes per year, respectively. These increases in retirement generate considerable strain for public finances, with important implications for the sustainability of the U.S. social security system.

[4]See https://www.eia.gov/todayinenergy/detail.php?id=52558 (last accessed on the 25th of September of 2024).

[5]See https://www.cbsnews.com/news/retirement-medicare-401k-what-to-know-peak-65/

4.1 Robustness Analysis

This section implements several sensitivity checks, providing further evidence supporting the identification strategy's and the estimates' robustness. First, one possible concern is that individuals may migrate across regions with different temperature conditions. In our dataset, we can only observe the county of residence at the interview dates, and assume that the individual has been living in their respective county in the previous six months. To address this selective migration concern, we first calculate the proportion of individuals that change county of residence at any point in time during the analysis period (i.e., between 1992 and 2020) and find that only 11% of individuals relocate. To further address the concern of our estimates being possibly impacted by selective migration, Appendix Figure A.2 presents evidence that our results are robust to excluding individuals who migrate at any point in time during the sample period.

Second, a potential concern is whether the estimated baseline effects of temperature exposure during the six months preceding the interview might be confounded by temperature exposures occurring more than six months prior to the survey date. We account for this by re-estimating our baseline specification while controlling for the proportion of days in which individuals have been exposed to temperature conditions within intervals (measured in Celsius) below or equal to 0, (0,10], (10, 20], (20,30] and above 30, in their county of residence between the seventh and twelth months before the survey interview. As shown in Appendix Figure A.3, the estimates are very similar in statistical significance and magnitude to the baseline results.

Third, another possible concern is that our baseline estimates for cold and hot temperatures may be driven by individuals residing in specific areas where extreme temperature shocks are more frequent. To address this concern, we examine the proportion of days in the six months prior to the interview during which individuals in our sample are exposed to the temperature conditions used as explanatory variables in our baseline specification. Appendix Figure A.4 shows that individuals are, on average, exposed to temperatures within all brackets included as independent variables in the main analysis during a non-trivial share of this six-month window. This provides reassurance that the observed variation in temperature exposure has meaningful empirical support in the sample. This evidence helps alleviate the concerns that selective exposure to temperature shocks drives our main estimates.

Lastly, we investigate whether our baseline estimates could be driven by the choice of control variables or fixed effects, or the temperature ranges we used to construct our independent variables of interest. In Appendix Figure A.5, we show that the estimates are robust to using a simpler functional form where we only control for basic covariates and fixed effects: individual characteristics, county fixed effects, and year-month fixed effects. Appendix Figure A.6 shows that using continuous temperature measures representing the proportion of days with maximum temperatures within 5°C ranges during the six months preceding the interview date produces estimates similar to the baseline ones.

5 Mechanisms

To investigate plausible mechanisms, we first explore the population groups whose retirement decisions are most affected by exposure to extreme temperatures. This set of evidence serves as a first point of reference on which the possible drivers behind the effect of temperature on retirement may be and shows potential inequalities in the impact of temperature across different populations.

First, extreme temperature conditions may have different labor supply implications for individuals of various ages. Older individuals may be more vulnerable to extreme temperatures because their health is more fragile; thus, they may be more likely to retire when exposed to extreme temperatures for a prolonged period. We next investigate this hypothesis. Panels A and B of Figure 4 display the estimates of the relative effect of temperature on the probability of retirement for individuals aged 50–64 and individuals aged 65 or older who were working in the prior interview. The age of 65 is interesting because it is the traditional age of retirement, although as shown in Table 1, a sizable share of the population is still working (and then retiring) after the age of 65. The estimates in Figure 4 for exposure to different temperature conditions show smaller responses in below-65 population. For individuals aged 65 or older, we find estimates that are larger in magnitude and statistically significant for cold temperatures. A 10 percentage-points increase in the proportion of days with a maximum temperature of 0 degrees Celsius or lower increases the retirement probability of individuals older than 65 years by more than four percentage points, an increase of 9.3 percent relative to their average baseline retirement level. This suggests that age is an important factor behind the impact of temperature on retirement.

Second, previous evidence has shown that individuals' education level is an important determinant of retirement decisions (Blundell et al., 2023). Better-educated individuals are more likely to be covered by healthcare, to have healthier habits, and to work on less physically demanding jobs that allow them to continue working when they are older. We next investigate whether the effect of temperature on retirement differs across individuals with different levels of education. We provide the results exploring this possibility in Figure 5, where we classify individuals as less educated if they have less than 13 years of school education and as more educated otherwise. We estimate the baseline specification for each of these groups. Cold temperatures increase retirement for both less-educated and better-educated individuals. Yet the magnitude of the estimates is roughly twice as large for lower-educated individuals.[6] An increase of 10 percentage-points in the proportion of days with a maximum temperature below 0 degrees Celsius increases the retirement probability of less educated individuals by more than three percentage points, while the impact is of a magnitude of 1.5 percentage points for more educated individuals. These results underscore important inequalities in the effect of temperature on retirement transitions.

Third, higher-income individuals tend to remain in the labor market longer (Anderson and Burkhauser, 1985). Temperature conditions may affect individuals' retirement decisions differently depending on their income level, as low-income individuals are more likely to work in physically demanding jobs and less likely to be covered by healthcare. Considering these factors, we expect the impact of temperature on retirement transitions to be larger for lower-income individuals. We explore this possibility in Figure 6, where we re-estimate our baseline specification for low-income individuals (defined as those with an income in the first quartile of the income distribution in the previous interview) and higher-income individuals (defined as those in the fourth quartile), respectively. We use the income level in the preceding interview to classify individuals into subgroups because the income level reported in the current interview is likely an outcome of temperature exposure. Cold temperatures increase retirement transitions for low-income and higher-income individuals, but the relative effect is nearly double for low-income individuals. A 10 percentage-point increase in the proportion of days with a maximum temperature below 0 degrees Celsius raises the probability of retiring by 3.8 percentage points for low-income individuals, while only by 2.1 percentage points for higher-income individuals. Extreme temperature thus contributes to widen existing inequalities in the labor market by prior income

[6]In Appendix A.3, we investigate whether there could be differences in the impact of temperature on retirement decisions based on individual socio-demographic characteristics such as gender, ethnicity and marital status. Cold temperatures increase retirement for all these socio-demographic groups, and we do not find statistical differences across groups.

level.

Overall, the results presented in this section show significant inequalities in the impact of temperature on the labor market behaviors in the age 50+ population. The increase in retirement brought by extreme climate is largely driven by the groups of the population who are more vulnerable in terms of health or access to healthcare. The evidence thus suggests that health could be a crucial driver of the effect of temperature on retirement transitions. We next investigate the effects of temperature on the health status of individuals as a plausible explanation behind the impact of temperature on retirement.

5.1 Impact of Temperature Variation on Health Status

Extreme temperature conditions may alter the health status of individuals, ultimately leading to changes in their retirement decisions. If individuals' physical or mental health deteriorates due to exposure to extreme temperatures, they may be less able to continue working. We next examine the effect of temperature on the main health outcomes available in the HRS as a possible explanation behind the effect of temperature on retirement. To begin, we construct a dependent variable taking a value of one if the individual reports having ever suffered from either a cardiovascular, respiratory, stroke, cancer, or mental health problem and zero otherwise. On average, 68% of the population aged 50 and above has experienced a health problem.

We present the results in Figure 7. The estimates of cold temperatures on the likelihood of reporting a health condition are positive and statistically significant, showing that cold temperatures increase the probability of suffering from health problems. We also find positive estimates for hot temperatures, albeit not statistically significant and smaller in magnitude. Our estimates for individuals aged 50 and older are consistent with prior literature showing that extreme temperatures increase the prevalence of health problems in the general population (Deschenes and Moretti, 2009; White, 2017; Baylis, 2020; Mullins and White, 2019; Noelke et al., 2016).[7]

In Figure 8, we provide further evidence of the impact of temperature on health for individuals aged 50 and older by separately investigating which of their health outcomes are most affected by exposure to different temperature conditions. Panels A–D focus on physical health; we use as the dependent variables indicators for whether individuals report having suffered from cardiovascular, respiratory, stroke, or cancer problems, respectively. Panel E examines the probability of an individual reporting having suffered from a mental health problem (i.e., an emotional, nervous, or psychiatric problem). We find that the effect of cold temperatures on the likelihood of suffering from any health issue presented in Figure 7 is mainly driven by an increase in the probability of suffering from cardiovascular conditions (panel A of Figure 8). Cold temperature conditions also increase the likelihood of individuals suffering from other health problems, such as a stroke. However, these estimates are smaller in magnitude and generally not statistically significant. Regarding warm temperatures, we find suggestive evidence that hot temperatures increase the probability of individuals suffering from a heart problem, but again, the estimates are not statistically significant and are half in magnitude compared to the estimates found for cold temperatures.

Overall, extreme temperatures impact health, which may reduce individual ability to work and increase transitions into retirement. One possible question is whether the detrimental effects of extreme temperatures' can be mitigated through policy. For example, better access to the healthcare systems may mitigate existing health problems brought by extreme temperatures and, moderate the implications of extreme

[7] Appendix A.4 re-estimates the analysis of Figure 7 but separately for individuals aged 50–64 and individuals older than 65 years old. As shown, the detrimental effect of extreme temperatures on health is primarily driven by individuals aged 65 or older.

temperatures for retirement. We investigate this possibility in the next section.

5.2 Policy: Can Healthcare Mitigate Retirement Responses to Extreme Temperatures?

In the previous sections, we have shown that extreme cold temperatures increase retirement transitions and that one possible explanation is a deterioration in individuals' health status. An important question that follows is whether policy interventions can alleviate these adverse effects. Although sudden health problems caused by extreme temperatures are difficult to prevent, access to healthcare may facilitate recovery and thereby soften the retirement response. We next examine whether healthcare availability mitigates the impact of extreme temperatures on retirement decisions.

To do so, we collect data from the U.S. Centers for Medicare and Medicaid Services on the available Medicare-certified hospitals in the United States and their location and calculate the number of hospitals in each county relative to its population.[8] We then estimate our baseline model, including interactions between our temperature variables and a dummy indicating whether individuals live in a county with high healthcare availability, defined as counties having a number of hospitals per capita above the US median.

We present the estimates of these interactions in Figure 9. Panel A indicates that higher healthcare availability does not meaningfully lower the incidence of health problems caused by exposure to extreme temperatures. However, Panel B shows that the effect of cold temperatures on retirement transitions is remarkably smaller in counties with higher hospital density: The estimate of the interaction between living in a high

[8] We collect this data from https://data.cms.gov/provider-data/topics/hospitals (last accessed on the 9th of December of 2024).

healthcare availability county and being exposed to cold temperatures has roughly the same magnitude as the "main effect" estimate we found for cold temperatures in Figure 2, but with the opposite sign.[9] This evidence thus suggests that the presence of healthcare facilities is effective in mitigating the adverse labor supply implications of extreme temperatures.

6 Conclusion

This paper investigates the effects of extreme temperatures on retirement behavior and underlying mechanisms for individuals aged 50 or older in the United States. We combine three decades of panel data from the Health Retirement Study (HRS) with granular data on the temperature history to which individuals have been exposed in the months prior to the HRS interview from the National Oceanic and Atmospheric Administration (NOAA).

We document that cold temperatures increase retirement transitions and decrease labor and total income. The effect is non-linear and intensifies the colder the temperature is. Hot temperatures only increase retirement for individuals who live in relatively cold counties and are not used to warm temperatures. This finding is consistent with prior literature showing that the adverse health effects of hot temperatures have been mitigated with the adoption of air conditioning in the United States and that baseline climate matters in shaping the health response to temperature shocks (Barreca et al., 2016; Heutel et al., 2021).

We then examine differences in the effect of temperature on retirement behavior

[9] Appendix Figure A.11 re-estimates the analysis of Figure 9 but separately for individuals aged 50–64 and individuals older than 65 years old. As shown, a higher hospital density primarily reduces the increase in retirement transitions in the presence of extreme temperatures for individuals aged 65 or older.

across subgroups of the population, and whether extreme temperatures may aggravate existing inequalities in the labor market. We show that the impact of temperature on retirement is primarily driven by groups of the population with higher health vulnerability: older, less educated, and lower-income individuals.

Building on the previous set of findings, we investigate health as a plausible mechanism behind the effect of temperature on retirement decisions, and show that exposure to extreme temperature conditions deteriorates health, primarily by increasing the prevalence of cardiovascular and stroke health conditions. By worsening individuals' health status, extreme temperatures reduce their ability to continue working, leading to higher retirement rates.

Our last set of evidence shows that a higher availability of healthcare in individuals' area of residence helps counteract the negative health implications of extreme weather, mitigating the negative impact of extreme temperatures on retirement.

Over the last decades, more than 38% and 28% of the US population have experienced extremely cold days with a maximum temperature below 0 degrees Celsius and extremely hot days with a maximum temperature above 35 degrees Celsius on a frequent basis-on more than 30 days per year. Moreover, climate change has increased the frequency of heat waves and extreme cold events in the US due to stratospheric polar vortex disruption (Cohen et al., 2021). At the same time, the proportion of individuals aged 65 or older in OECD countries has doubled from less than 9% in 1960 to 18% in 2021. Given the prevalence of extreme temperature conditions and aging populations, it is critical to better understand whether climate conditions may impact health and retirement and how policymakers may address the implications of extreme weather. This paper is a first step towards a better understand of the complex interplay between environmental conditions and retirement decisions.

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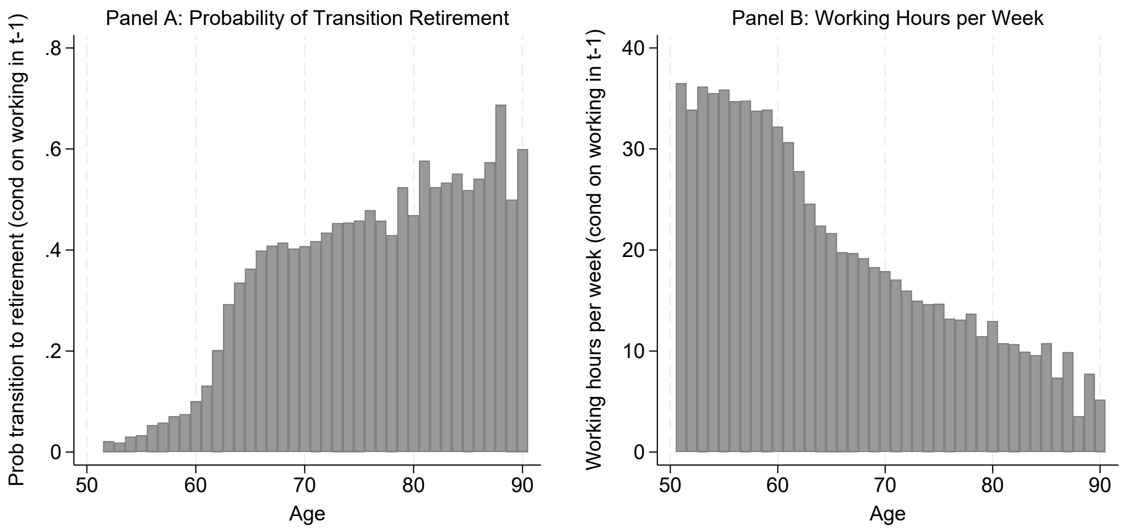
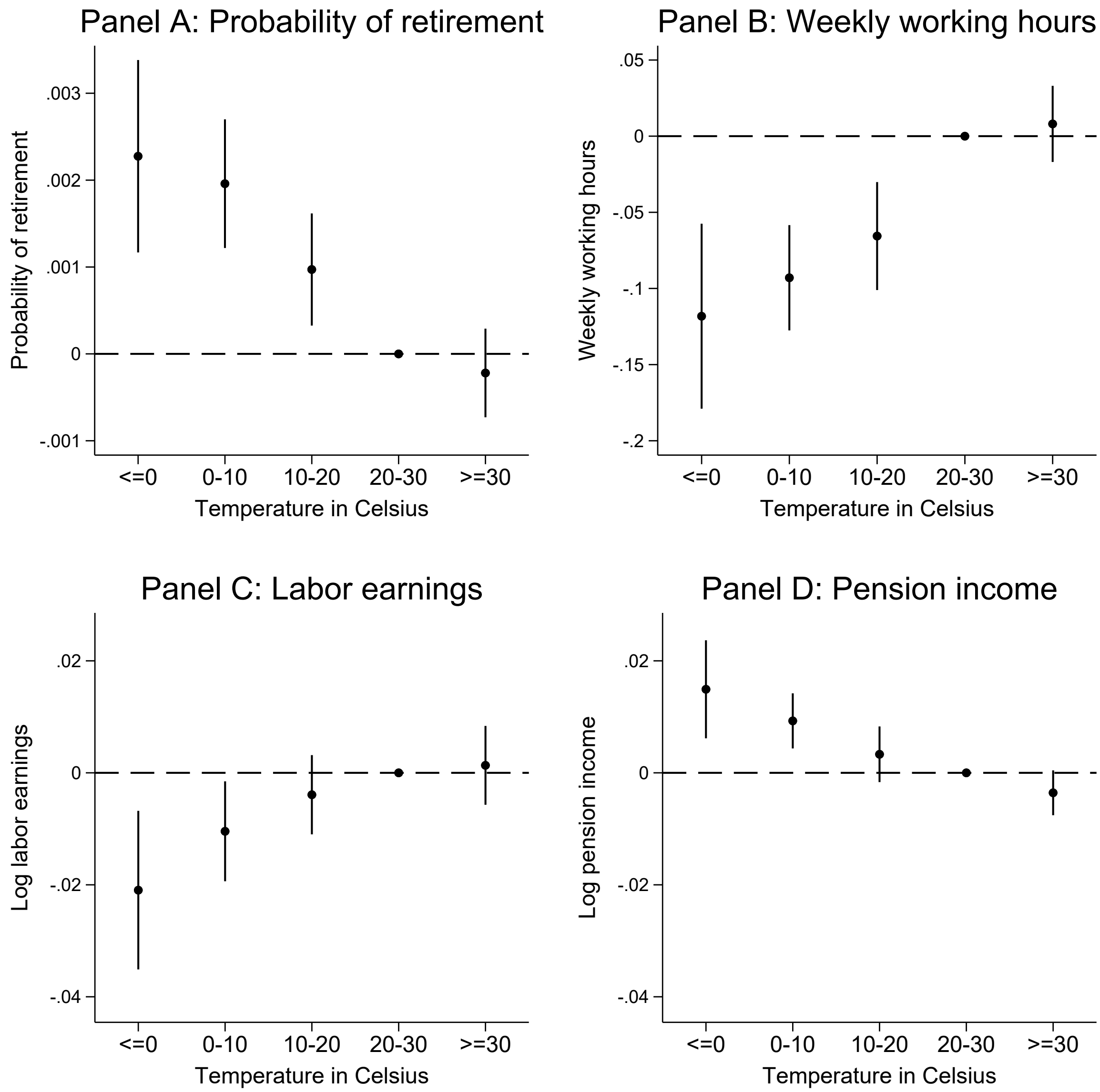
7 Figures

Figure 1: Probability of Retirement Transition and Working Hours by Age



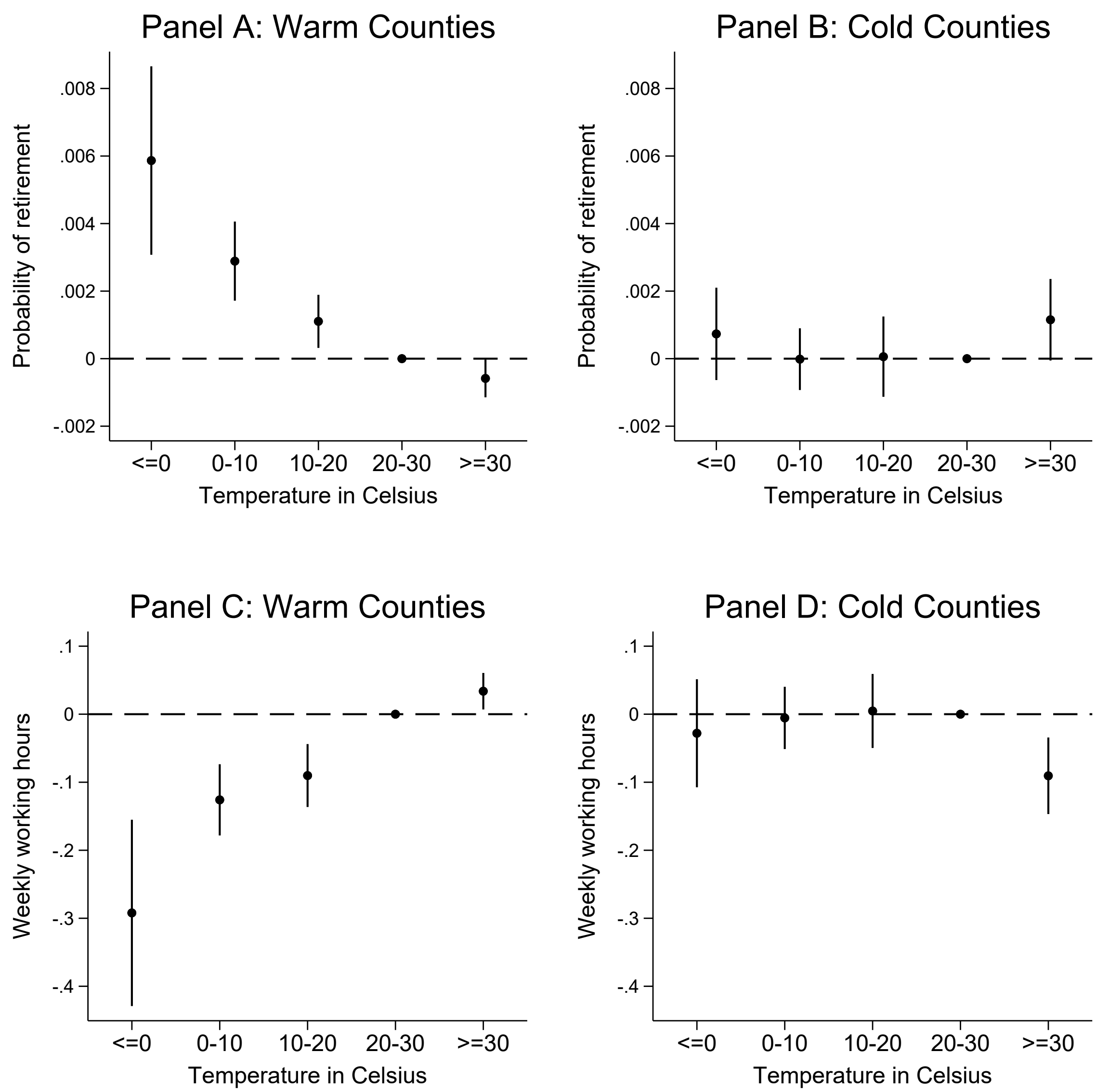
Panels A and B of the figure display the average probability of retirement and the average number of working hours per week over the life-cycle for our sample, which consists of individuals working in the prior survey interview, to study the evolution of transitions to retirement by age.

Figure 2: Effect of Temperature on Retirement, Working Hours, and Income



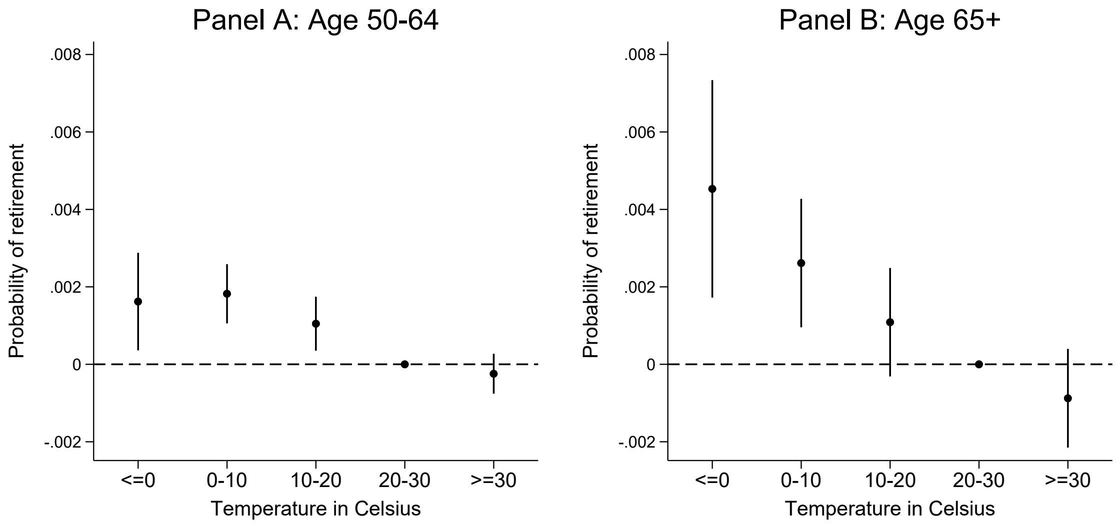
The figure displays the estimates of our baseline specification and their 95% confidence intervals. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. Panels A and B use the probability of retirement and the number of working hours per week as the dependent variables, respectively. Panels C and D use as the dependent variable the logarithm of individuals' annual labor earnings plus one and the logarithm of individuals' annual retirement income plus one, respectively.

Figure 3: Difference in the Effect of Temperature on Retirement and Working Hours Across Baseline Climates



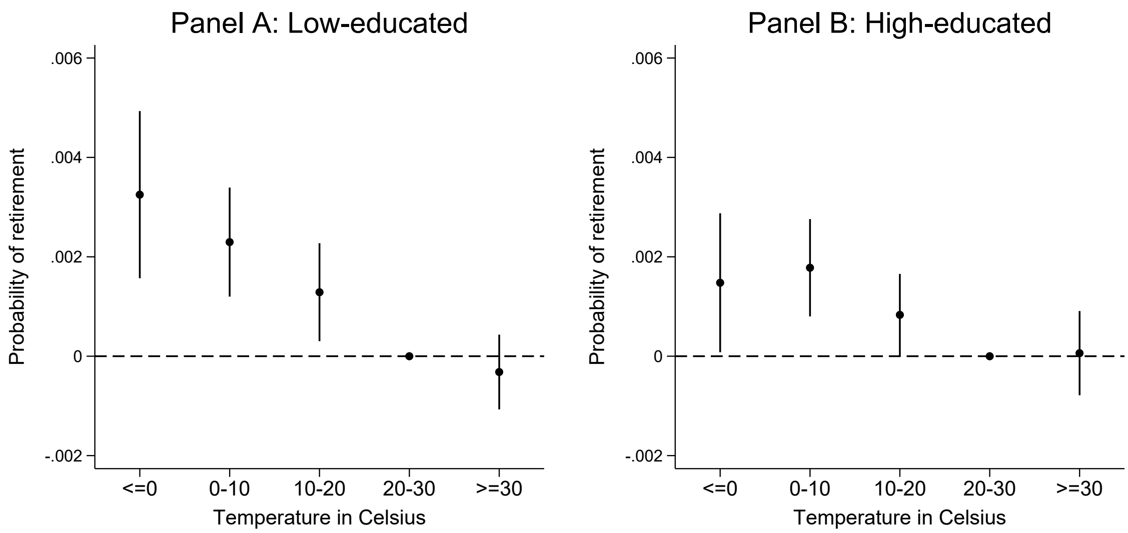
The figure displays the estimates of our baseline specification and their 95% confidence intervals. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. Panels A and B use the probability of retiring for individuals as the dependent variable, while panels C and D use the number of working hours per week as the dependent variable. In panels A and C, our sample is individuals living in relatively warm counties, while our sample in panels B and D is individuals living in relatively cold counties.

Figure 4: Effect of Temperature on Retirement Transition by Age



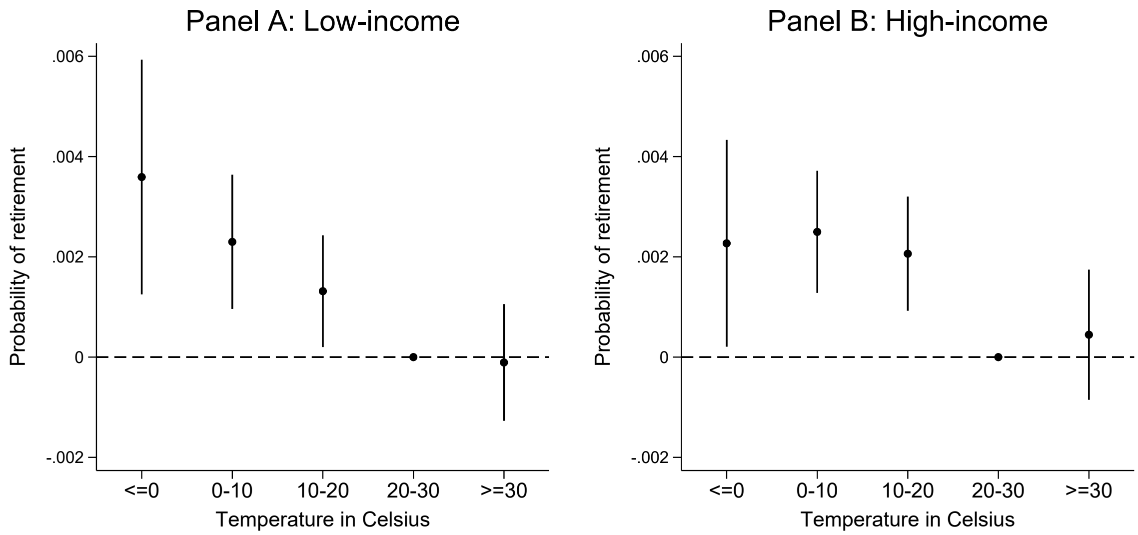
Panels A and B of the figure display the estimates of our baseline specification and their 95% confidence intervals for the samples of individuals aged 50–64 and 65 or more years old, respectively. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The dependent variable is the probability of retiring.

Figure 5: Effect of Temperature on Retirement Transition by Educational Level



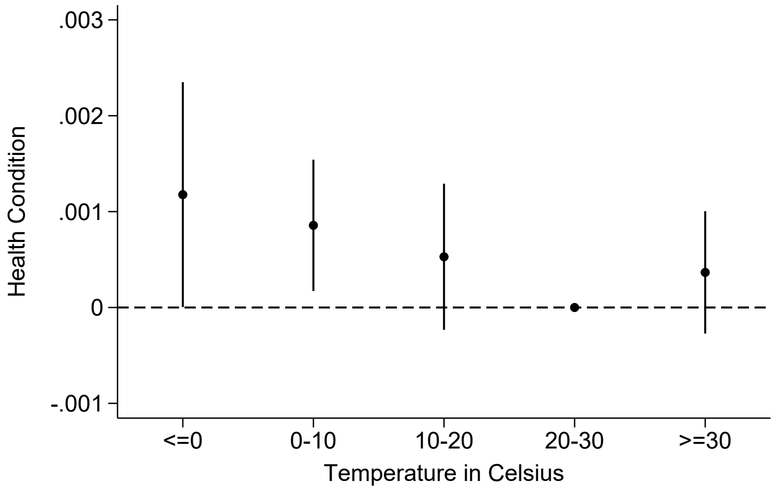
Panels A and B of the figure display the estimates of our baseline specification and their 95% confidence intervals for the sample of individuals with less than 13 years of education and for the sample of individuals with 13 or more years of education, respectively. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The dependent variable is the probability of retiring.

Figure 6: Effect of Temperature on Retirement Transition by Prior Income



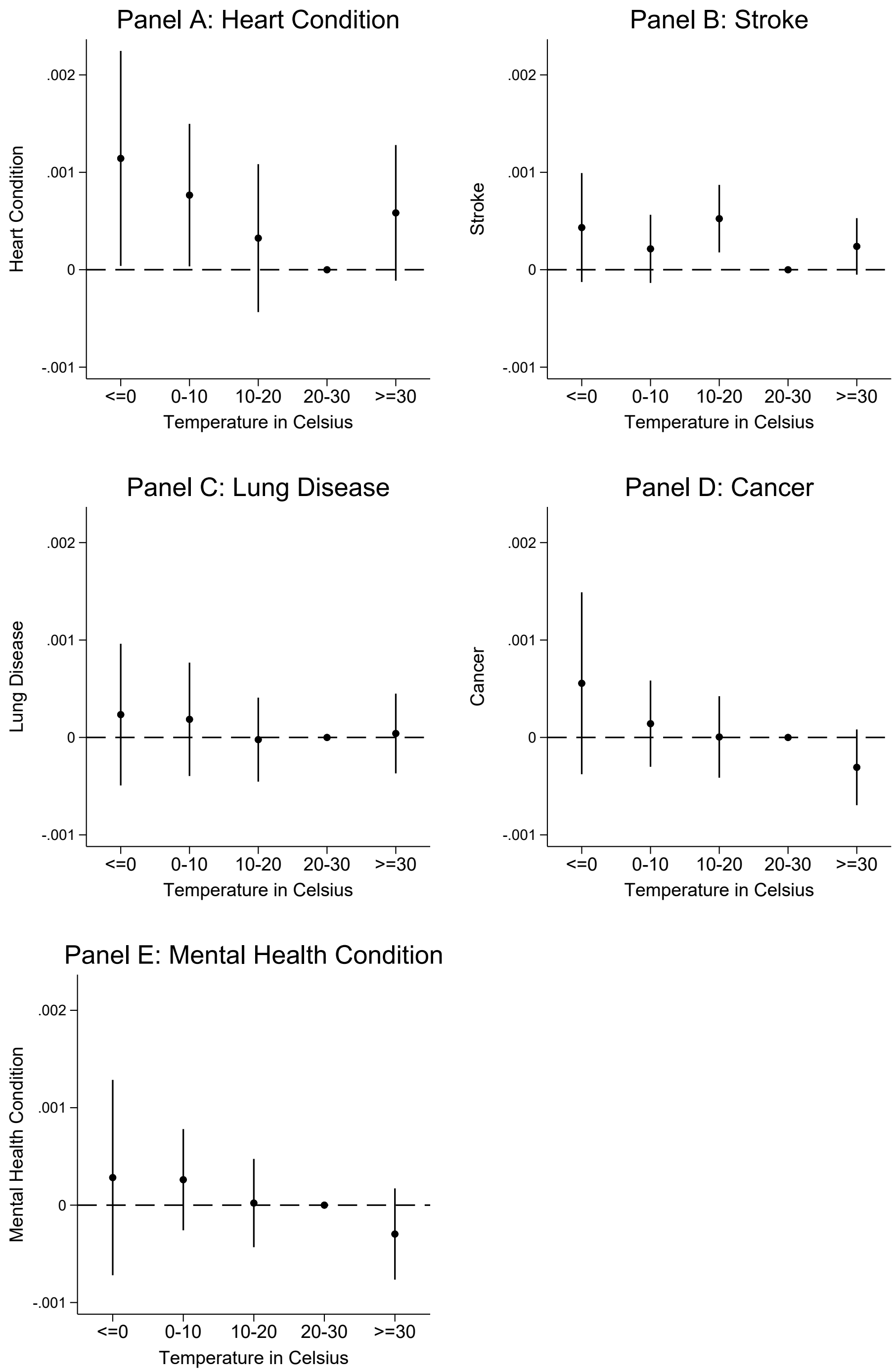
Panels A and B of the figure display the estimates of our baseline specification and their 95% confidence intervals for the sample of individuals with an income in the first quartile of the income distribution in the previous interview and for the sample of individuals with an income in the fourth quartile of the income distribution in the previous interview, respectively. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The dependent variable is the probability of retiring.

Figure 7: Effect of Temperature on Health Status



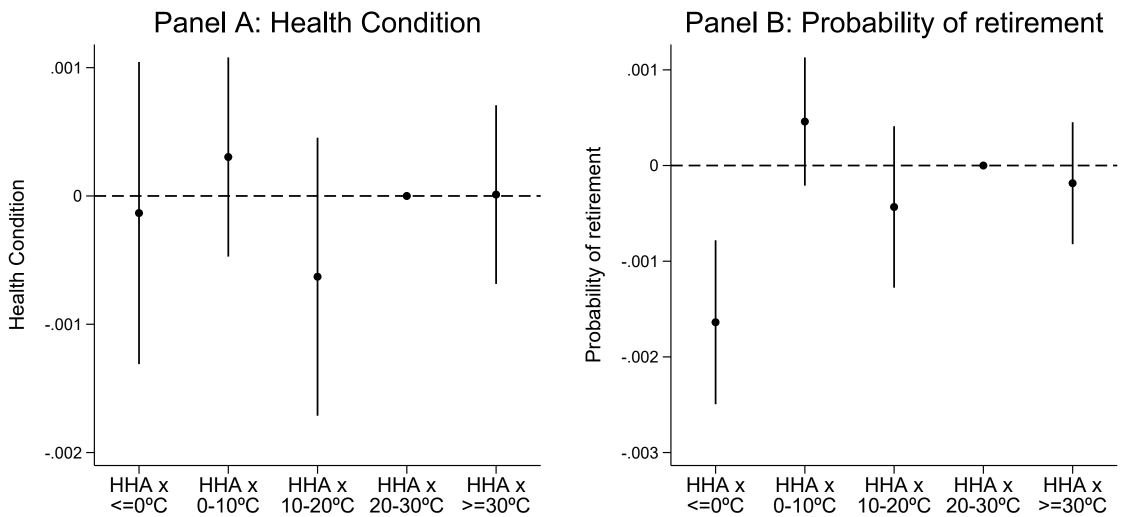
The figure displays the estimates of our baseline specification and their 95% confidence intervals. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The figure uses the probability of individuals having suffered from any health problem as the dependent variable.

Figure 8: Effect of Temperature on Specific Health Conditions



The figure displays the estimates of our baseline specification and their 95% confidence intervals. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. Panels A–E of the figure use as the dependent variable the probability of individuals having suffered from heart, stroke, lung, cancer, and mental health problems, respectively.

Figure 9: Effect of Temperature on Health Status and Retirement Transition by Local Availability of Healthcare



The figure displays the estimates and 95% confidence intervals of the interactions between a dummy of value one if the individual lives in an area with a high density of hospitals and a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. Panels A and B use the probability of individuals having suffered from a health problem and the likelihood of retiring as the dependent variable, respectively.

8 Tables

Table 1: Summary Statistics

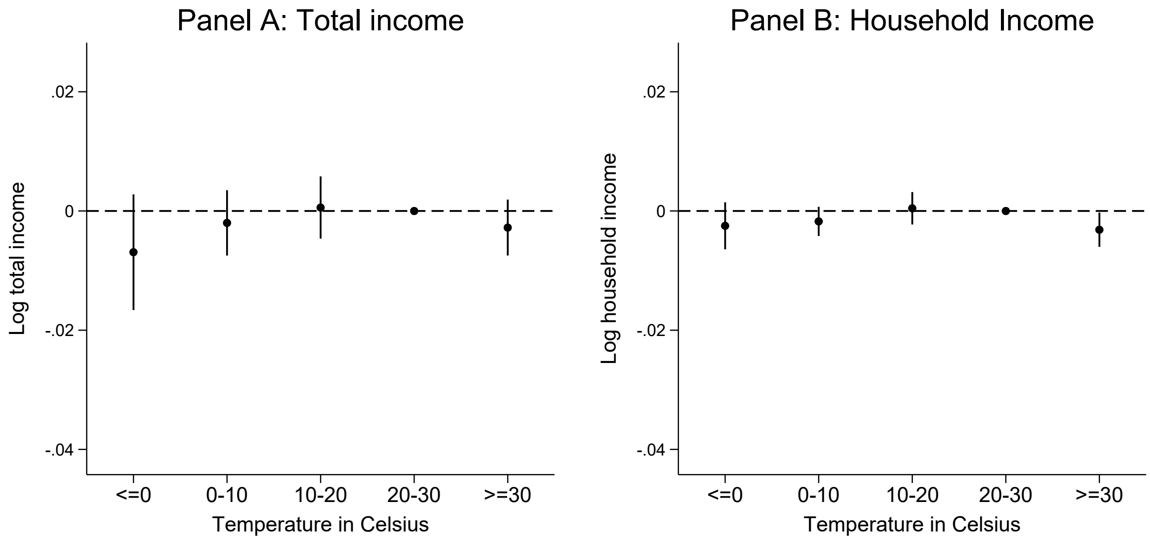
	Full Sample N=79,500		**Sample < 65 years old** N=57,381		**Sample ≥ 65 years old** N=22,119	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Woman	0.53	0.50	0.54	0.50	0.49	0.50
Age	62.16	6.62	58.84	3.41	70.76	4.99
Non-white	0.24	0.42	0.25	0.43	0.19	0.39
Years of Education	13.10	2.96	13.14	2.92	13.01	3.04
Married	0.67	0.47	0.68	0.46	0.63	0.48
Any Health Condition	0.68	0.47	0.64	0.48	0.79	0.41
Heart Condition	0.58	0.49	0.53	0.50	0.70	0.46
Stroke	0.04	0.20	0.03	0.17	0.06	0.24
Respiratory Condition	0.08	0.28	0.07	0.26	0.11	0.32
Mental Health Condition	0.16	0.36	0.16	0.36	0.15	0.36
Cancer	0.11	0.31	0.08	0.28	0.17	0.37
Prob Retirement	0.21	0.41	0.12	0.33	0.43	0.49
Annual Labor Income	31,960	56,490	36,677	60,867	19,723	40,636
Annual Pension Income	6,983	17,186	3,053	13,613	17,178	20,900
Share Days with Temp ≤0	5.76	9.89	5.69	9.77	5.93	10.17
Share Days with Temp 0–10	17.40	17.22	17.17	17.10	18.01	17.49
Share Days with Temp 10–20	26.25	14.56	26.13	14.53	26.57	14.64
Share Days with Temp 20–30	34.59	19.40	34.76	19.20	34.17	19.91
Share Days with Temp ≥30	15.99	20.29	16.25	20.41	15.33	19.98

The table presents summary statistics of several socio-demographic characteristics, health outcomes, labor outcomes, and weather exposure for our sample of interest. Column 1 focuses on the full sample, while columns 2 and 3 focus on individuals younger than 65 and individuals aged 65 or more, respectively.

A Appendix

A.1 Additional outcomes

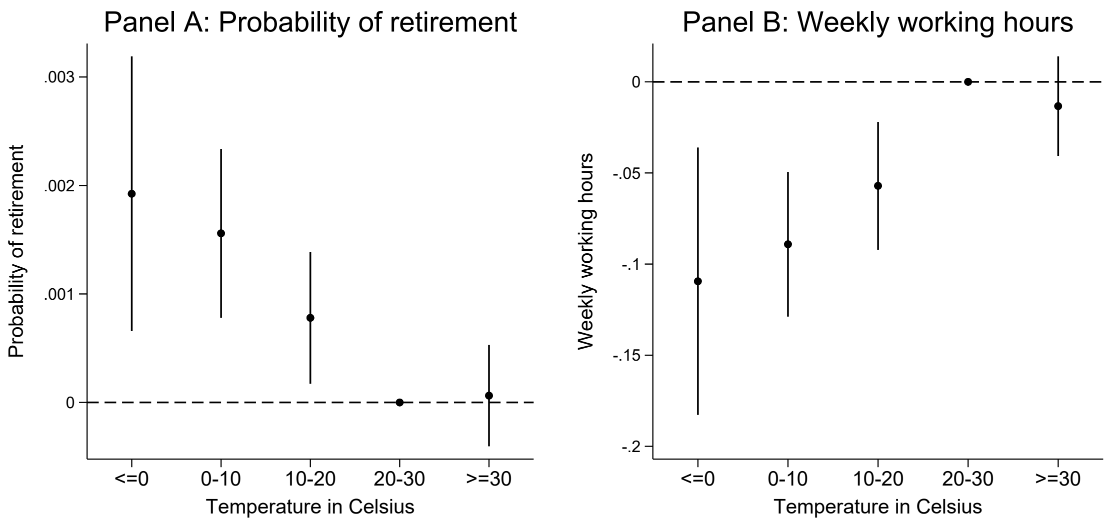
Figure A.1: Income



The figure displays the estimates of our baseline specification and their 95% confidence intervals. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. Panels A–B use the logarithm of individuals' total income plus one and the logarithm of individuals' household income plus one as the dependent variable, respectively.

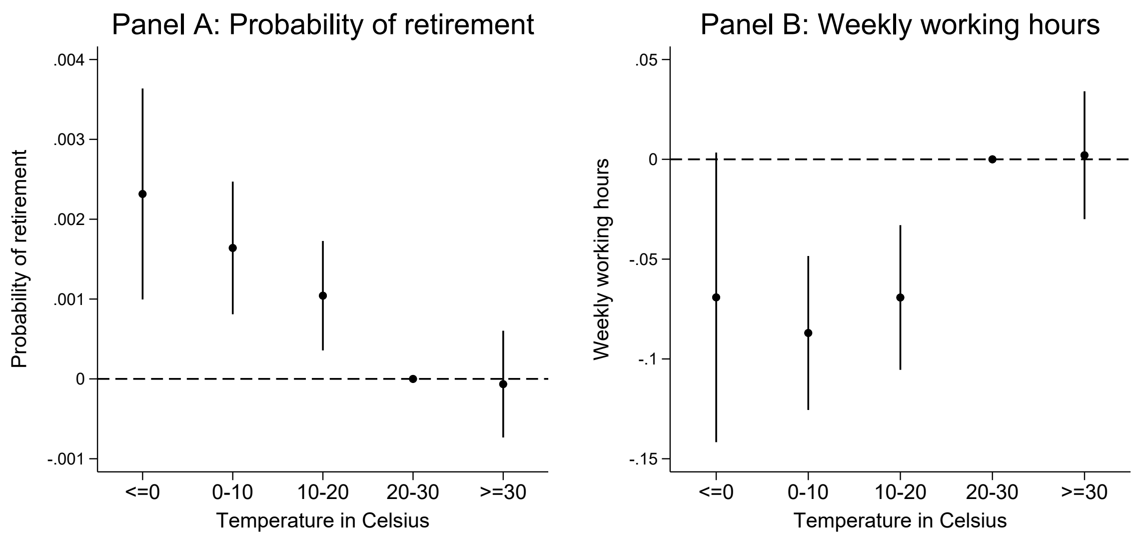
A.2 Robustness tests

Figure A.2: Excluding individuals who migrate



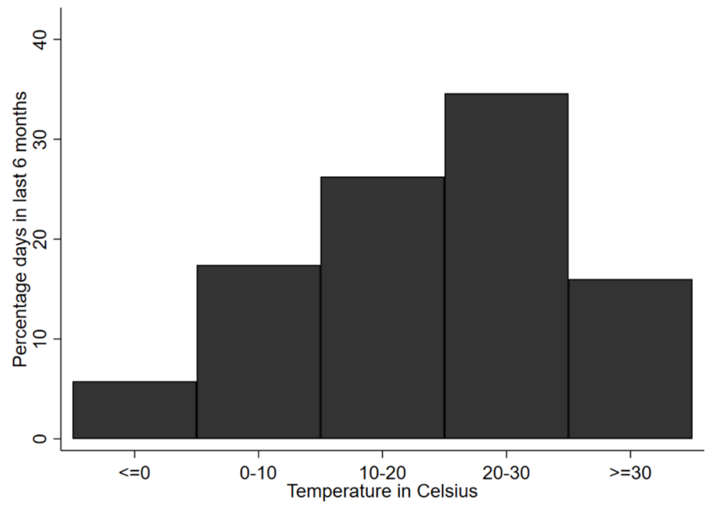
The figure displays the estimates of our baseline specification and their 95% confidence intervals. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. Panels A and B use as the dependent variable the probability of retirement and the number of working hours per week, respectively. Our sample is the sample of interest, excluding individuals who migrate at some point in time during the analysis period.

Figure A.3: Controlling for prior temperatures



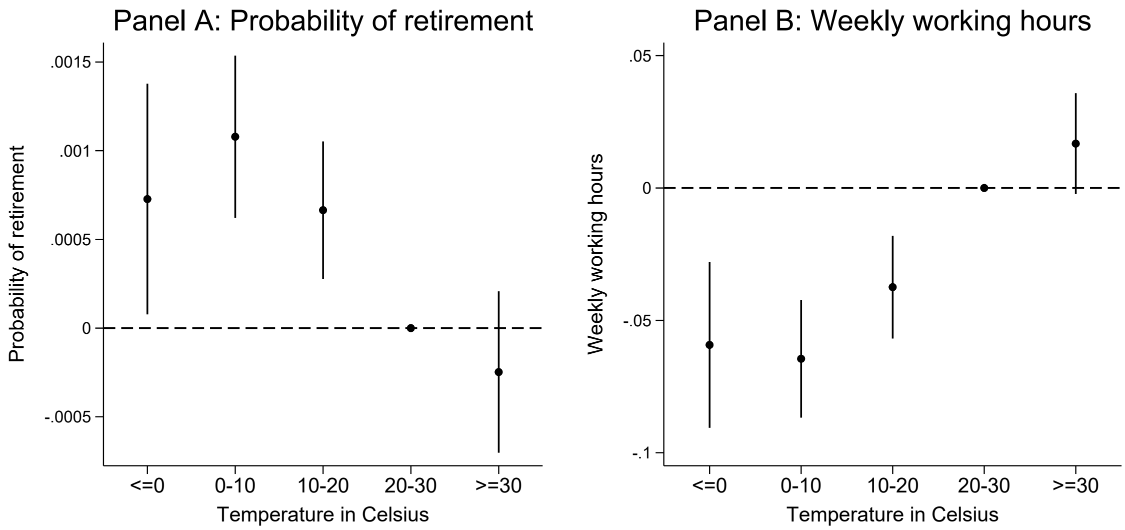
The figure displays the estimates of a specification similar to the baseline one, but that also controls for exposure to temperature conditions between 7 and 12 months before the interview. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. We present their estimates and 95% confidence intervals. Panels A and B use as the dependent variable the probability of retirement and the number of working hours per week, respectively.

Figure A.4: Percentage of Days in the Last Six Months Exposed to Different Temperature Conditions



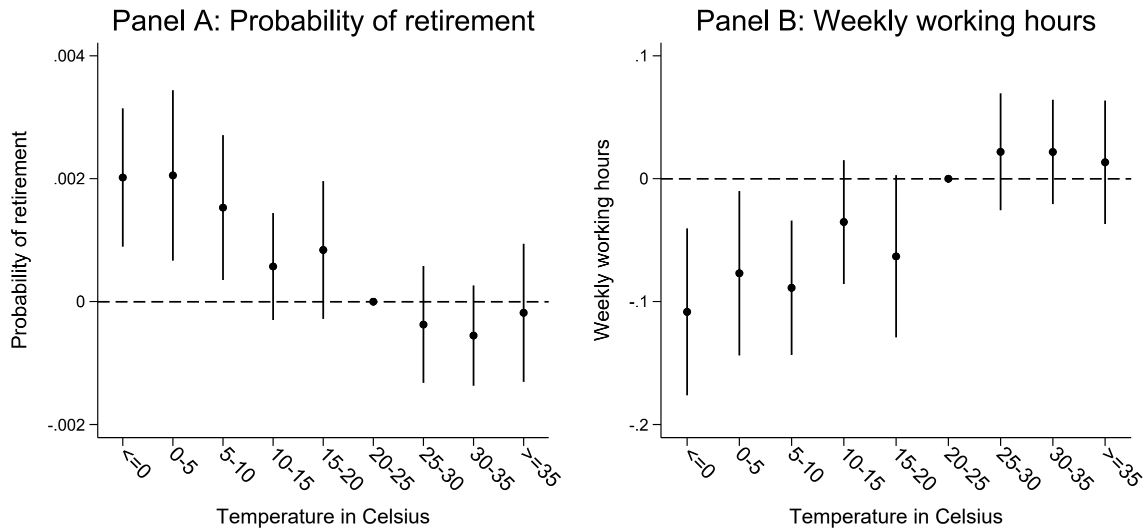
The figure displays the percentage of days during the six months preceding the interview date in which individuals were exposed to maximum temperatures within 10°C ranges in their county of residence.

Figure A.5: Simplified functional form



The figure displays the estimates of a specification similar to the baseline one but that only controls for the basic covariates: individual characteristics, county fixed effects, and year-month fixed effects. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. We present their estimates and 95% confidence intervals. Panels A and B use as the dependent variable the probability of retirement and the number of working hours per week, respectively.

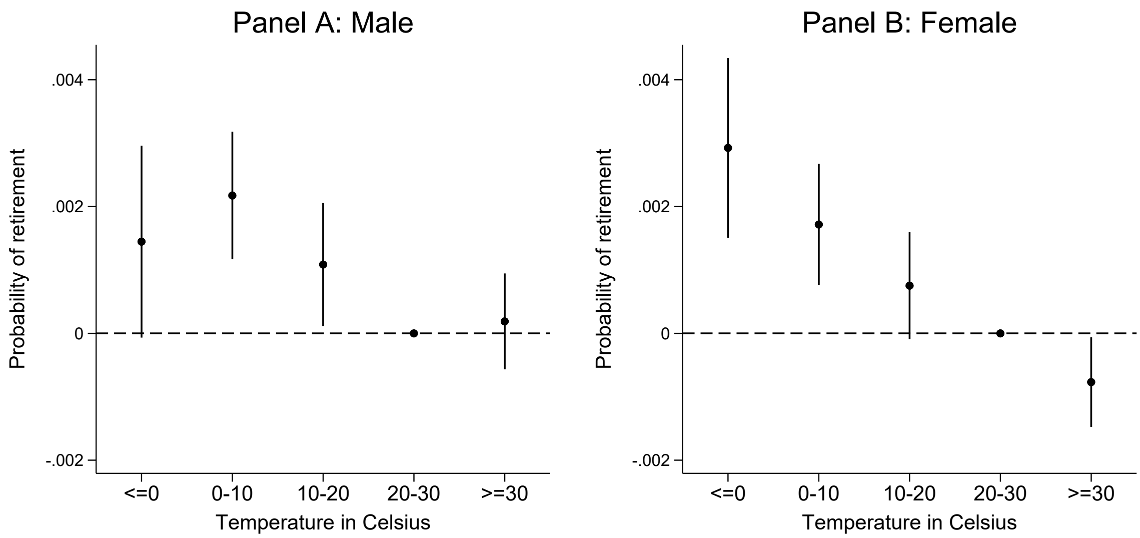
Figure A.6: Detailed independent variables



The figure displays the estimates of a specification similar to the baseline one but that uses as explanatory variables of interest a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 5°C ranges in their county of residence during the six months preceding the interview date. We present their estimates and 95% confidence intervals. Panels A and B use as the dependent variable the probability of retirement and the number of working hours per week, respectively.

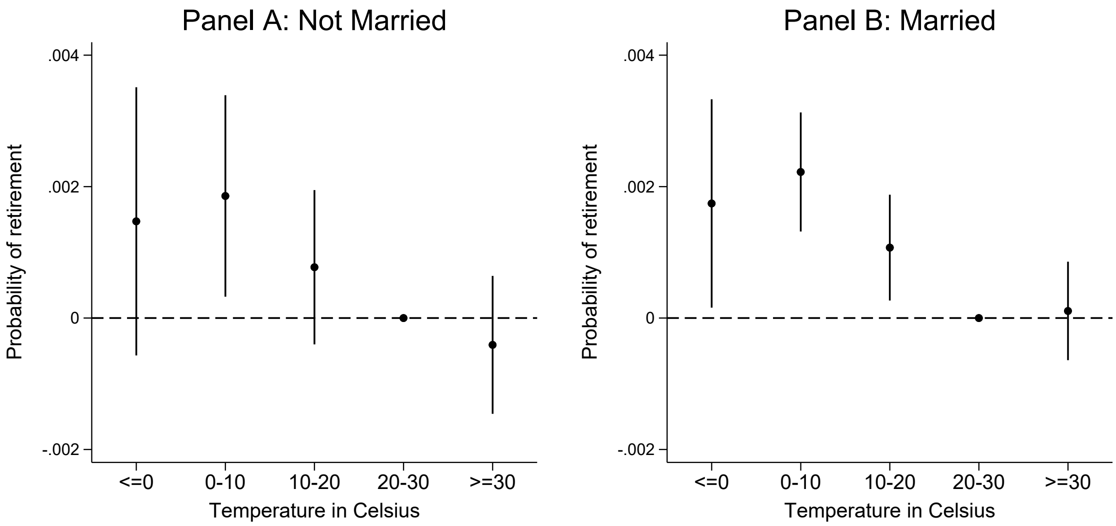
A.3 Heterogeneity analysis

Figure A.7: Heterogeneity by Gender



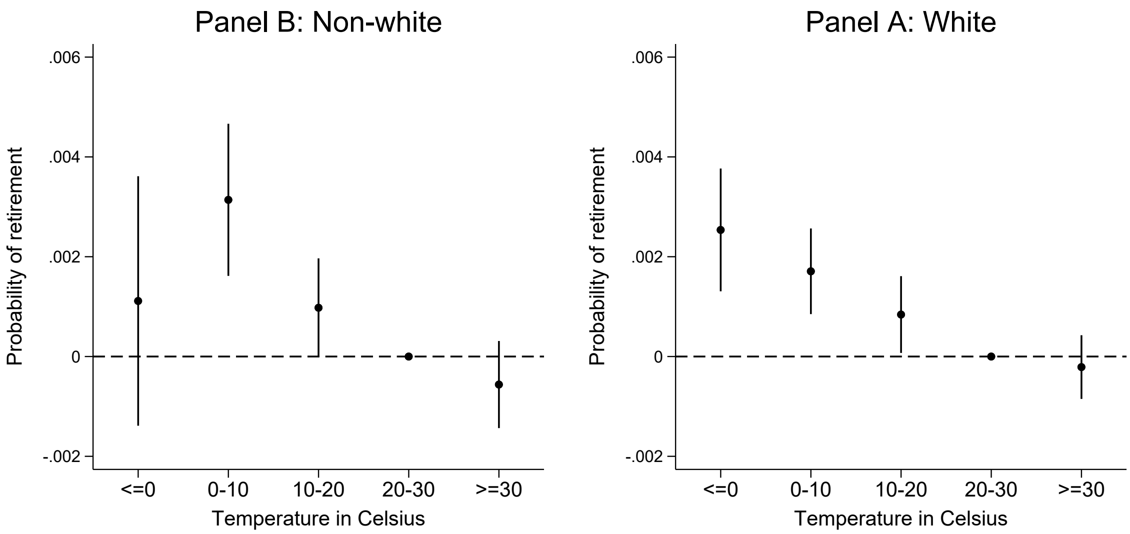
Panels A and B of the figure display the estimates of our baseline specification and their 95% confidence intervals for the samples of men and women, respectively. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The dependent variable is the probability of retiring.

Figure A.8: Heterogeneity by Marital Status



Panels A and B of the figure display the estimates of our baseline specification and their 95% confidence intervals for the samples of not married and married individuals, respectively. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The dependent variable is the probability of retiring.

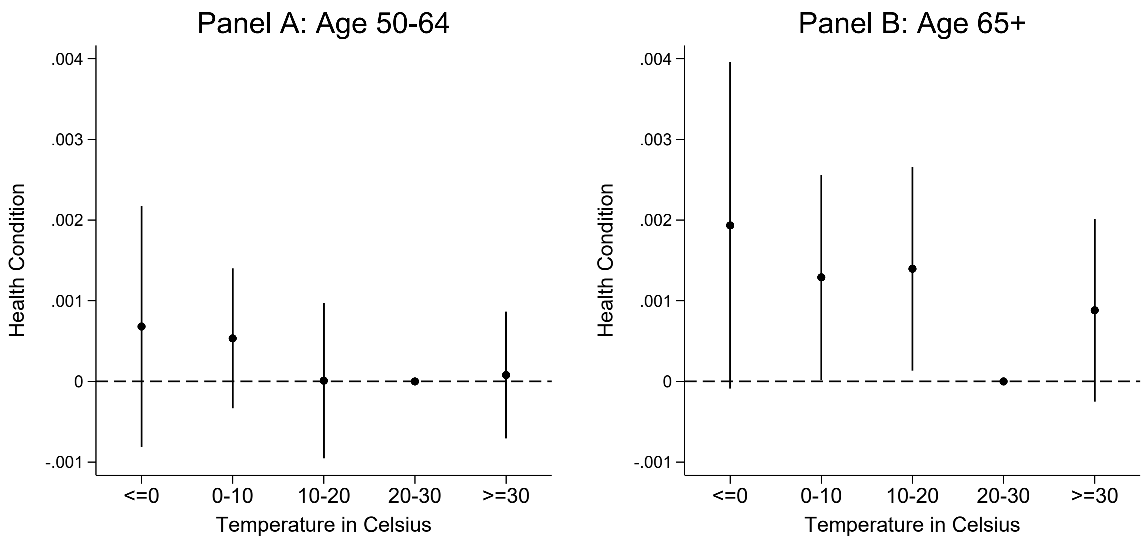
Figure A.9: Heterogeneity by Ethnicity



Panels A and B of the figure display the estimates of our baseline specification and their 95% confidence intervals for the samples of non-white and white individuals, respectively. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The dependent variable is the probability of retiring.

A.4 Health – heterogeneity by age

Figure A.10: Heterogeneity by Age

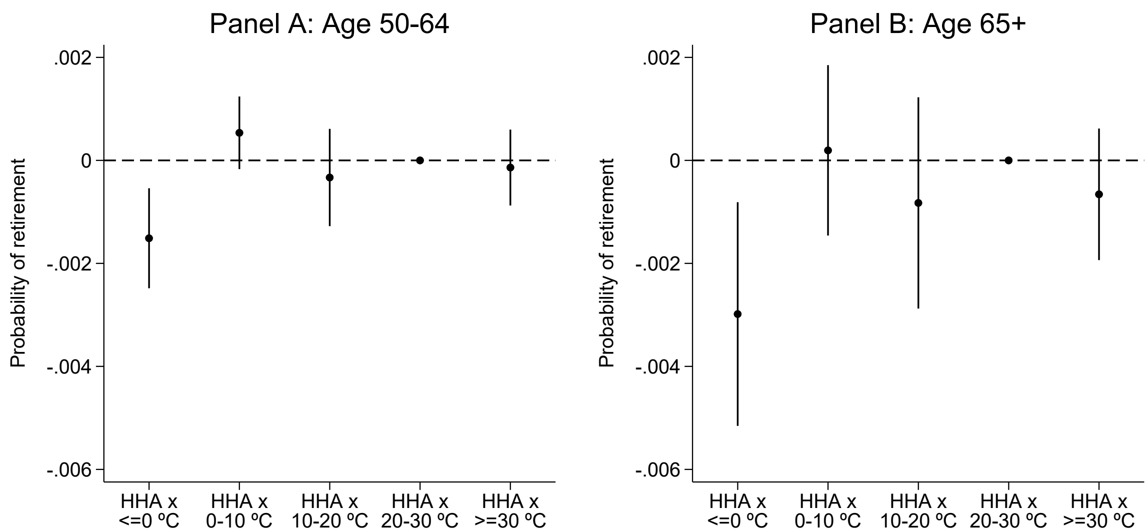


Panels A and B of the figure display the estimates of our baseline specification and their 95% confidence intervals for the samples of individuals aged 50–64 and 65 or more years old, respectively. Our explanatory variables of interest are a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. The dependent variable is the probability of having suffered from a health problem.

A.5 Healthcare availability

A.5.1 Heterogeneity by age

Figure A.11: Heterogeneity by Age



The figure displays the estimates and 95% confidence intervals of the interactions between a dummy of value one if the individual lives in an area with a high density of hospitals and a set of continuous measures representing the proportion of days in which individuals have been exposed to maximum temperatures within 10°C ranges in their county of residence during the six months preceding the interview date. Panels A and B use the samples of individuals aged 50–64 years old and 65 or more years old, respectively. The dependent variable is the probability of retiring.