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Ruhr Economic Papers

Published by

RWI – Leibniz-Institut für Wirtschaftsforschung
Hohenzollernstr. 1-3, 45128 Essen, Germany

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstr. 150, 44801 Bochum, Germany

Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Ruhr Economic Papers #800

Responsible Editor: Jochen Kluve

ISSN 1864-4872 (online) – ISBN 978-3-86788-928-5

Ruhr Economic Papers #800

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Bibliografische Informationen der Deutschen Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at **http://dnb.dnb.de**

RWI is funded by the Federal Government and the federal state of North Rhine-Westphalia.

http://dx.doi.org/10.4419/86788928
ISSN 1864-4872 (online)
ISBN 978-3-86788-928-5

Matthias Giesecke[1]

The Retirement Mortality Puzzle: Evidence from a Regression Discontinuity Design

Abstract

I estimate the effect of retirement on mortality, exploiting two discontinuities at age-based eligibility thresholds for pension claiming in Germany. The analysis is based on unique social security records that document the age at death for the universe of participants in the German public pension system. Using variation from bunching of retirements at age-based eligibility thresholds, I demonstrate that retirement can have both mortality-decreasing and mortality-increasing effects, depending on the group of retirees who comply to eligibility at each threshold. To reconcile heterogeneous effects with likewise mixed results from the literature I provide evidence that the retirement-mortality nexus is driven by the activity change at retirement.

JEL Classification: H55, I12, J14, J26

Keywords: Retirement; mortality; age-based eligibility thresholds; regression discontinuity design

May 2019

1 Matthias Giesecke, RWI and IZA. – *I am grateful to Thomas Bauer, David Card, Laura Janisch, Michael Ransom, Hendrik Schmitz, Reinhold Schnabel and Matthias Westphal for helpful suggestions and thank the participants of several seminars and conferences for valuable comments. I also thank the team of the data research center of the German federal pension insurance (FDZ-RV), in particular Ute Kirst-Budzak, for supporting the on-site data processing.* – *All correspondence to: Matthias Giesecke, RWI, Hohenzollernstr. 1/3, 45128 Essen, Germany, e-mail: matthias.giesecke@rwi-essen.de*

1 Introduction

The event of retirement usually coincides to an abrupt change of individual living conditions. Retiring from active employment is associated with a reduction of work-related stress and the joy of leisure but can also coincide to reduced activity, social isolation, and cognitive decline. Empirical evidence on the effects of retirement on subsequent health and mortality outcomes is thus mixed and still controversial. Understanding the countervailing mechanisms that determine the impact of retirement on mortality is policy-relevant not only because retirement may impact the costs of health care provision but also because post-retirement survival years are a key determinant of redistribution. Both of these aspects are sometimes overlooked in discussions about raising the retirement age.

In this paper I provide new evidence on the effects of retirement on mortality. I exploit two discontinuities at age-based eligibility thresholds for pension claiming[1] in Germany, adopting a regression discontinuity design (RD) to examine whether there is a causal link from retirement to mortality. The key contribution is to rationalize that immediate mortality effects of retirement can be heterogeneous depending on the retirees who become eligible to claim a pension at the corresponding age threshold. I substantiate this by using information on lifetime earnings and the type of pension claimed that allow to assess the activity change at retirement.

The identification strategy builds on recent studies that use variation of outcomes at age-specific thresholds. Research designs of this kind are based on discontinuities that arise due to abrupt changes either in age-related eligibility for social insurance programs (Card et al., 2008, 2009; Battistin et al., 2009; Anderson et al., 2012, 2014; Fitzpatrick and Moore, 2018) or the minimum legal drinking age (Carpenter and Dobkin, 2009, 2015, 2017). I make use of a peculiarity in the German social security system where older workers become eligible for different types of old age pensions abruptly at age 63 and 65, which leads to considerable bunching of retirements at these thresholds. The identifying assumption is that no relevant determinants of the outcome mortality, other than retirement, change discontinuously at the two specified thresholds such that mortality would

[1]Retirement is defined as claiming a pension for the first time, according to the measurement of retirements in the pension insurance data that will be used throughout.

evolve smoothly if nobody retired. The analysis is based on unique administrative data that document incidences of death for the universe of participants in the German public pension system between 1994 to 2013. These records document the date of birth, the retirement age (pension claiming age) and the age at death (closure of pension accounts) virtually without measurement error. The large number of observations allows for high densities around the age cutoffs, thus supporting the precision of the RD estimates.

As key finding I estimate a 1.1% – 3.1% *reduction* in male mortality immediately after retiring at the age of 63. The mortality-reducing effect is driven by men in the lower half of the lifetime earnings distribution and vanishes when earnings are high. Institutionally induced eligibility for specific pensions and pre-retirement employment information reveal that, at the age of 63, men predominantly retire from routine manual jobs in dependent employment or from unemployment. Retiring from manual routine jobs may coincide to a relief from workplace hazards or work-related stress while retiring from unemployment goes along with reduced stigma[2], both potentially inducing health-improving and mortality-reducing effects.

In contrast, I document a considerable mortality *increase* just after retiring at the age of 65 both for men (2.0% – 2.9%) and women (2.6% – 2.7%). Mortality-increasing effects are remarkably higher in the upper half of the lifetime earnings distribution and thus driven by individuals who retire from employment biographies that are characterized by high earnings. Within this group, retirement coincides to the loss of job prestige and social networks and these changes, most notably social isolation[3], imply that adverse health effects dominate the retirement process. In summary, the heterogeneous mortality effects of retirement can be rationalized by selection at eligibility thresholds, operating through the activity change that individuals experience when retiring. I conclude that retiring from bad jobs with low earnings or hazardous work conditions tends to be health-improving while retiring from good jobs with high earnings and more prestigious occupations is dominated by adverse health effects.

This paper makes three major contributions to the literature. First, my research

[2]This is consistent with previous findings of increasing life satisfaction when retiring from unemployment (Hetschko et al., 2014).

[3]Social isolation has been shown to be a fairly strong predictor of mortality (Pantell et al., 2013).

design allows to identify credible causal estimates of the effects of retirement on mortality as an objective and precisely measured health outcome. The analysis is based on data that cover the universe of participants in the German public pension system, which is one of the largest of its kind worldwide. Deepening the understanding on how retirement impacts mortality is important because raising the retirement age as a response to population aging is a topical policy issue in many industrialized countries.

Second, I reconcile heterogeneous mortality effects of retirement with mixed evidence from previous studies. Parts of this literature link retirement to rising mortality[4] (Kuhn et al., 2010; Fitzpatrick and Moore, 2018) while others find that the effect of retirement on mortality does not statistically differ from zero (Hernaes et al., 2013) or document mortality-reducing effects of retirement (Hallberg et al., 2015; Bloemen et al., 2017). Many of these studies are built on one specific policy change, like an early retirement offer, and thus measure policy- or group-specific mortality effects. The present paper extends this strand of the literature by comparing mortality effects at different eligibility thresholds, each referring to different subgroups within the population of retirees. I demonstrate that heterogeneous effects, negative and positive, are possible because they are identified for the corresponding groups that comply to eligibility at each threshold and differ substantially in their pre-retirement activity. Compliers are those who retire because they become eligible and would not have retired if they had not reached eligibility.[5] The novel insight is that the retirement-mortality nexus largely depends on what people do previous to retirement and whether the activity change is beneficial for their health.

Third, I document a robust positive relation between the mortality effects of retirement and lifetime earnings. Mortality increases are more pronounced at the upper margin of the lifetime earnings distribution while mortality reductions are stronger at the bottom. This does not contradict well-established evidence on the inverse relationship between

[4]There is also a large literature on the effects of retirement on mental health and cognition. These studies predominantly document adverse health effects of retirement, termed as cognitive decline (for example Rohwedder and Willis, 2010; Bonsang et al., 2012; Mazzonna and Peracchi, 2012; Celidoni et al., 2017). As an exception from the detrimental effects, the study by Celidoni et al. (2017) shows that early retirement pathways can improve cognition.

[5]The terminology used is in line with the evaluation literature (for an overview see Angrist and Pischke, 2009). According to this terminology, the mortality effects identified at each threshold are local average treatment effects (LATEs) with a causal interpretation for the compliers.

income and mortality[6], but rather extends previous findings of higher mortality rates in higher income groups that are possible if income and mortality covary with activity (Snyder and Evans, 2006).[7] The results presented here support and extend this view by using lifetime earnings to approximate how income was generated before retirement and how this relates to mortality. Assessing heterogeneity by lifetime earnings thus reveals valuable information about how the activity change at retirement determines subsequent mortality outcomes.

The remainder of this paper is structured as follows. Section 2 reviews institutional details of the German public pension system and illustrates the identifying variation from age-based eligibility thresholds. Section 3 describes the data, defines retirement and mortality, and outlines the sample selection criteria. Section 4 describes the research design and estimation details. Section 5 presents results and corresponding explanations as well as robustness checks. Section 6 concludes.

2 Institutional Details

Public pensions in Germany are organized as a pay-as-you-go system. Monthly contributions from insured employees are directly discharged to benefit recipients. Old age pensions are available upon eligibility after reaching the corresponding age-based eligibility thresholds (table 1). This institutional design creates considerable jumps in the retirement rate at age 60, 63 and 65 that are depicted in figure 1.

The vast majority of pensions are claimed as soon as individuals become eligible. This is evident from the institutionally driven bunching points in figure 1.[8] These patterns

[6]Chetty et al. (2016) find that higher income is associated with greater longevity through the entire income distribution. Sullivan and von Wachter (2009a) show that averaging longitudinal earnings measures over several years, instead of a single year, reveals a particularly strong negative association between earnings and mortality. Further evidence suggests a strong negative relationship between individual income and remaining life expectancy after the age of 65 (Kalwij et al., 2013) and a persistent negative relation between parental income and mortality later in life (Palme and Sandgren, 2008).

[7]Snyder and Evans (2006) show that persons who were affected by benefit cuts (the U.S. "Social Security Notch") also increased their post-retirement work effort to compensate the income loss, arguing that increasing activity reduces mortality. They also point out that an important co-factor in the income-mortality relationship is social isolation that can arguably be prevented through work activity.

[8]Age-specific eligibility thresholds were enacted in 1972 (see Börsch-Supan, 2000, for details) and hold for the observed cohorts throughout the observation period. Several recent reforms have shifted some of

induce three considerable discontinuities of which I use the ones at age 63 and 65 to identify the effect of retirement on post-retirement mortality. Although the cutoff at age 60 involves a considerable jump in the retirement rate, I exclude this threshold from the analysis because the sampling of deaths below age 60 is not suitable for comparisons above this age.[9]

Retirement patterns of men and women differ to some extent. Only men exhibit a jump in the retirement rate at age 63 (figure 1) because they reach the retirement age for long-term insured persons and this group predominantly consists of men who meet the requirement of at least 35 contribution years. While women also have access to this pension type, most of them are not eligible due to insufficient accumulation of contribution years from active employment. At age 65, however, the observed jump in the retirement rate of women is huge (40 percentage points) and much larger compared to men despite the fact that male retirement also jumps considerably by 15 percentage points. Although both men and women reach the normal retirement age at 65, which implies that their claiming behavior is dominated by regular old age pensions, there is some heterogeneity between the two sexes at this age cutoff. While men predominantly retire from active employment, women rather claim pensions because are eligible due to child raising periods that they accumulated earlier in life.

3 Data and Definitions

3.1 Pension Insurance Records

The empirical analysis is based on high-quality administrative data provided by the German federal pension insurance that are accessible on-site at the data research center of

the age-based eligibility thresholds. For example, the early retirement age for the unemployed was raised from age 60 to 63 (cohorts 1946 - 1948) and currently the normal retirement age is shifted from age 65 to 67 (cohorts 1947 - 1964) but none of these changes affects the birth cohorts 1934 - 1936 that are under study here.

[9] At age 60, old age pensions become available for the first time. Retirements before age 60 are possible, but only when claiming a reduced earnings capacity pensions that is restricted to reduced earnings capacity status from a medical indication. Looking below age 60 would challenge the discontinuity design because I do not observe mortality outcomes for the reduced earnings capacity pension.

the German federal pension insurance (FDZ-RV). The principal data source consists of two parts. First, I use pension shortfall records (*Rentenwegfall*) that document the closure of individual pension insurance accounts once the person dies. The pension shortfall records cover the universe of deaths among retirees in the German public pension system for the years 1994 - 2013.[10] Second, I use additional information on deaths from actively insured persons (*Aktiv Versicherte*) who are not yet retired. The additional data source is necessary to obtain the universe of deaths in the boundaries of the pension system because the pension shortfall records only document cases of death for those who actually receive a pension.[11] Pension records on actively insured persons include any individual who contributes to the public pension system either actively (through employment) or passively (through periods of illness, unemployment or other reasons[12]), also indicating when the insurance account is closed due to death.

Merging death records of actively insured persons to the pension shortfall records finally yields the universe of deaths from all individuals that actively participate in the public pension system.[13] Capturing deaths for all individuals before and after retirement is important because I examine mortality patterns around eligibility thresholds such that the research design requires observing mortality from below and from above the age cutoff. This allows to investigate whether mortality patterns change whenever the retirement probability jumps around eligibility thresholds.

Four aspects are worthwhile to note why using pension insurance records is particularly

[10]See Kreyenfeld and Scholz (2010) for an overview on mortality data in Germany. Previous studies on mortality have either used extracted samples (Kühntopf and Tivig, 2012) or the entire population (Bauer et al., 2019) of the pension shortfall records.

[11]Death incidences are not recorded for individuals who do not receive a pension, even if they have an insurance account and accumulated pension claims. Individuals who are not retired and do not receive pension benefits also do not appear in the pension shortfall records if they die.

[12]Other reasons for passive contributions are periods of education or child-raising, but these are irrelevant for the age group above 60.

[13]There is a minority of inactive persons for whom mortality is unobserved before they claim a pension. These "latently insured" individuals have accumulated pension claims at some time in the past but are neither actively insured (e.g. employed or unemployed) nor retired. Once these persons claim a pension, their deaths are captured in the pension shortfall records such that these deaths are only countable after retirement. This is not a drawback because I can account for the potential imbalance before and after retirement by weighting mortality counts by the inverse of the cumulative retirement rate at each monthly age (depicted in figure 1). This filters out any change in mortality due to disproportional changes in retirement from unobserved latently insured individuals.

advantageous to examine the retirement-mortality nexus. First, they cover the universe of individual pension insurance accounts and thus a large number of observations that permit precise estimates. Second, these records are generated within the administrative process and document the exact date of death, virtually without measurement error.[14] Third, they cover the predominant part of deceased individuals in Germany because the participants in the German public pension system reflect more than 80% of the German population.[15] Fourth, the pension insurance records not only include the exact date of death but also document the retirement age, the type of pension claimed and a measure of lifetime earnings. Especially the pension type and lifetime earnings are informative about the activity change at retirement, allowing to uncover heterogeneity in the mortality effect of retirement.

3.2 Survey Data

To explain the observed mortality patterns in more detail, I use survey data from the German Socio-Economic Panel (SOEP) as a secondary data source. In contrast to the pension insurance records, the SOEP is not feasible to examine the mortality patterns due to measurement error regarding incidences of death and a small number of observations. It does, however, provide the retirement age and a rich set of socio-economic variables that are informative on what people do before they retire. Hence, I use the SOEP to calculate pre-retirement summary statistics that illustrate the activity change for retirements around the specified thresholds at the age of 63 and 65.

[14]Measurement error can occur if the death of a person is not reported promptly to the official authorities but this is a minor issue in Germany.

[15]Relating the number of deaths from the pension records to the total number of deaths reported in the official mortality statistics for Germany (Federal Statistical Office, 2016) indicates a coverage rate of about 82%, including 96% among men and 75% among women. The primary analysis sample (only cohorts 1934 - 1936) covers 80% of deaths among men and 74% of deaths among women within the observation period. A data sheet relating mortality counts from pension records to official mortality tables is available from the author upon request. Further details on sampling properties and representativeness are also available in appendix B.

3.3 Definition of Mortality

Mortality is defined as the date of closure of an insurance account if the individual deceases. The pension insurance accounts document this information on the monthly level and they also document the date of birth for these persons. This allows to calculate the exact age at death for each individual.

3.4 Definition of Retirement

Retirement is defined as claiming pension benefits for the first time. The age at first claiming is documented precisely without reporting errors because the pension insurance needs this information to calculate claims. Figure 1 shows the distribution of retirements, comprising reduced earnings capacity pensions before age 60 and old age pensions thereafter. Old age pensions become available in the month after a person celebrates her 60th, 63rd or 65th birthday. Bunching of retirements thus occurs exactly one month after people reach eligibility and claim the corresponding type of pension.

3.5 Definition of Lifetime Earnings

The pension shortfall records also include accumulated pension claims for each individual. I use this information to construct a measure of pre-retirement lifetime earnings, allowing to investigate mortality patterns around the eligibility thresholds in more detail.[16] Based on this earnings measure, I estimate the mortality effect of retirement separately for the lower and the upper half of the lifetime earnings distribution.

The data (both pension shortfall and actively insured) include the individual sum of so-called earnings points (EP), documenting pension claims that predominantly consist of plain labor earnings. One EP from labor earnings of individual i in year t is defined as $EP_{it} = \frac{y_{it}}{\overline{y}_t}$, where y_{it} are labor earnings of individual i in year t and $\overline{y}_t$ are average labor

[16] A distinctive feature of the data is that they permit to separate *pre-retirement* lifetime earnings and *post-retirement* mortality at least for those who decease after they retire. Based on completed earnings biographies that are fixed by the date of pension claiming, the problem of reverse causality between income and health is arguably a minor one because earnings shocks after retirement can be ruled out (for similar arguments, see Sullivan and von Wachter, 2009a). This setting makes earnings a plausible predictor of mortality.

earnings of all contributors of the public pension system in that year. One EP thus reflects the relative earnings position of each individual in a given year.[17] The data include the sum of annual earnings points that are given for each person as $EP_i = \sum_{t=1}^{T} EP_{it}$, where T is the last year of gainful employment usually before the individual retires.

Although EP_i are not perfect in measuring earnings because they also include creditable periods from education, unemployment or child-raising[18] and are top-coded[19], they provide a fairly accurate measure of lifetime earnings. Since EP_i totals individual relative labor earnings across years, it is net of price changes and can be used as a direct earnings measure. Assigning a real Euro currency value is possible but not necessary because I only stratify the mortality effects of retirement by different regions of the lifetime earnings distribution.

3.6 Restrictions and Analysis Sample

The analysis sample for the RD framework is restricted to the birth cohorts 1934 to 1936 (table 2). First, the sample is restricted from below such that every individual reaches age 60 at the beginning of the observation period in 1994, which is the case for all birth cohorts as of 1934. The second cohort choice ensures that individuals are homogeneous regarding their eligibility thresholds, facing similar retirement rules as summarized in table 1 (for details regarding the 1972 legislation, see section 2). This implies that individuals in the sample must be born no later than 1936 because several reforms effectively changed

[17] An employee receives one EP if she earns exactly the average of annual earnings, or two EP if she earns twice the average of annual earnings in a given year.

[18] The EP measure is limited to the extent that it also contains information other than plain labor earnings. It includes all labor market related information as needed by the German federal pension insurance to calculate monthly pension benefits. This information comprises the entire labor market history (pre-retirement lifetime earnings, creditable periods of unemployment), education (creditable periods of vocational training or higher education), family background (creditable periods of child raising) and health-related aspects (creditable periods of illness).

[19] Labor earnings are subject to top coding due to a contribution ceiling in the German pension insurance. The contribution ceiling is adjusted to price changes every year. By the end of the observation period in 2013, for example, the contribution ceiling was fixed at 69,600 Euros in absolute terms. In the same year, average earnings amounted to 33,659 Euros and thus the contribution ceiling was equivalent to 69,600/33,659 = 2.1 EP. At the contribution ceiling, labor earnings are censored from above which means that we only observe earnings up to this threshold.

the retirement age thereafter.[20] Using the birth cohorts 1934 to 1936 still allows for a large number of observations and low standard errors. The three cohorts include more than 2500 deaths per age-month, ensuring a high density around the age-based eligibility thresholds and thus precise RD estimates.

The subsequent mortality analysis distinguishes between men and women, first of all, because women strongly outlive men. Furthermore, men and women exhibit differential retirement patterns (figure 1) due to differences in labor force participation that largely determine eligibility status and due to legislative differences (e.g. womens' pensions, table 1).

All relevant variables are summarized in table 2, contrasting the population[21] to the analysis sample. In total, the analysis sample consists of 502,049 men and 278,818 women. Both age at death and the retirement age are lower in the analysis sample due to the restrictive cohort choice that implies that these cohorts are not extinct by the end of the observation period. For the observation period from 1994 to 2013, the age at death in the analysis sample is measured from age 58 to 77 (1936) and 60 to 79 (1934). This restriction is also responsible for the lower number of female observations because a higher share of women is still alive when moving towards age 80. Lifetime earnings of men (43 EP) almost double the earnings of women (23 EP) due to the much lower female labor force participation. The retirement age conditional on claiming an old age pension (retirement age >= 60) is higher among women (62.3) than among men (61.7) because a much larger fraction of women claims a pension only at age 65.

[20] Major changes were introduced to the German public pension system as of cohort 1937. Several reforms either changed the retirement age directly by corresponding age policies or indirectly through financial incentives. For example, introduction of benefit reductions (cohort 1937 onwards) induced a considerable upward shift in the retirement age (see Hanel, 2010; Giesecke, 2018) and would thus confound the RD around the age-based eligibility thresholds.

[21] The population includes the universe of deaths that are documented for actively insured persons and pension recipients in the observation period from 1994 to 2013. In total, its distribution spans over birth cohorts from 1885 to 1993 and is depicted in figure 6 in appendix A.

4 Empirical Strategy

4.1 Research Design

To estimate the causal effect of retirement on mortality, I adopt a fuzzy RD around the two eligibility thresholds at age 63 and 65 separately. Let R be the retirement status such that R = 1 if retired and R = 0 otherwise. Let A denote age as the assignment variable that determines eligibility status according to the rule $\mathbb{1}(A \geq e)$ where $e \in \{63, 65\}$ denotes eligibility age. Let Y denote observed mortality counts in the typical potential outcome framework, where $Y = RY^1 + (1 - R)Y^0$, so that the two potential outcomes in this setting are Y^0 (death count if not retired) and Y^1 (death count if retired). The causal effect of retirement is then defined as the difference between the two potential outcomes $\alpha = Y^1 - Y^0$. The key assumption here is that the mean value of Y^0 conditional on A is a continuous function at $A = 63$ and $A = 65$. This means that mortality would remain smooth if nobody retired at the threshold for pension eligibility.

The variation from bunching of retirements at eligibility thresholds identifies the local average treatment effect (LATE). The LATE is identified locally for those who comply to eligibility at the corresponding threshold. Compliers are those who claim a pension because they become eligible at the threshold but would not have claimed a pension if they were not eligible. Since the group of compliers differs across eligibility thresholds, the research design yields estimates that allow to rationalize effect heterogeneity. The LATE of retirement on mortality is given by

$$\alpha = \frac{E[Y|A = e^+] - E[Y|A = e^-]}{E[R|A = e^+] - E[R|A = e^-]} \tag{1}$$

stating that the mortality effect of retirement is the difference in the conditional expectation of mortality marginally above (e^+) and below (e^-) the respective eligibility threshold, weighted by the probability of retirement above and below the threshold.

Reaching eligibility does not necessarily mean that a person instantaneously retires and claims a pension. At the eligibility threshold, however, the probability of retiring exhibits a discontinuous jump due to the fact that a substantial share of individuals becomes eligible for claiming a pension that was not available below the respective age cutoff, implying a fuzzy RD.[22]

Taking the retirement-mortality relationship to the data, let y_a denote the observed mortality count at age a. I estimate the equation

$$log(y_a) = \beta_0 + \beta_1 \mathbb{1}(a \geq e) + \beta_2 a + \beta_3 f(a) + \varepsilon_a \quad (2)$$

where the dependent variable $log(y_a)$ is the natural log of mortality counts at age a (y_a). The coefficient of primary interest, β_1, measures the percentage difference of mortality in the local environment of each cutoff (e = 63 or e = 65). In this equation, β_1 identifies the LATE (denoted as α, above) and thus reflects the mortality effect of retirement.

To account for a potential functional relationship between the outcome mortality and the assignment variable age to the left and to the right of each cutoff, the model captures a linear age-mortality relationship a, captured by the coefficient β_2 and higher order polynomials (quadratic, cubic, or quartic) of age $f(a)$, captured by the coefficient β_3. Graphical evidence suggests that the relationship between mortality counts and age is predominantly linear but exhibits a slight U-shape as age increases (figure 2). Baseline estimates are obtained from local polynomial RD separately by gender and separately by the two age cutoffs.

The RD framework focuses on changes in mortality in close neighborhood of the age cutoff. It measures mortality counts along the lines of age as running variable while exogenous variation is implied by the jumps of the cumulative retirement rate at each threshold (figure 1). In the baseline, I use a bandwidth of 12 months to the left and the right of each age cutoff, similar to Fitzpatrick and Moore (2018) who estimate mortality effects of retirement based on the eligibility threshold for U.S. Social Security at age 62.

[22]For a related setting, see Battistin et al. (2009) who examine consumption outcomes at eligibility thresholds for retirement in Italy.

Additionally, I implement several specifications with varying bandwidths using optimal bandwidth choices and bias correction as proposed by Imbens and Kalyanaraman (2012); Calonico et al. (2014a,b).

5 Mortality Effects of Retirement

5.1 Graphical Evidence

I start by presenting graphical evidence on the retirement-mortality relationship. Figure 2 depicts mortality counts, indicating a slight U-shape across age. Within the plotted age interval 60 - 75, the number of deaths increases over age and is higher in absolute terms among men (panel a) as compared to women (panel b) who tend to die at higher ages. Taking a particular look at the age-based eligibility thresholds at 63 and 65, figure 3 presents similar mortality counts zoomed to the relevant age interval.[23] The figure shows that mortality patterns change in close neighborhood of the age cutoffs, with a reduction of mortality among men at age 63 and a respective increase for men and women at age 65. I now test these patterns by adopting an RD design.

5.2 Baseline Estimates

Table 3 reports baseline RD estimates based on local polynomial estimation including linear and quadratic polynomials of age. The estimates exploit exogenous variation from jumps in the cumulative retirement rate at each threshold (see figure 1) to identify the mortality effects immediately after retirement. This serves as a benchmark for the subsequent presentation of more particular estimates that reveal heterogeneity by lifetime earnings and pension type.

[23] The figure excludes two outliers in male mortality counts marginally below the age of 65 that are dropped from the analysis. Figure 7 in appendix A shows the full mortality count for men without dropping observations just below the age of 65. An explanation for the low mortality counts is that some men withdraw from their active insurance status when facing the upcoming retirement but do not yet receive a pension. This may induce a gap of one or two months where cases of death are not adequately documented, neither in the actively insured data nor in the pension shortfall records. Estimates including these outliers (available from the author upon request) have the same direction but are less conservative and larger in magnitude compared to the estimates presented here.

At the age of 63, I estimate a 1.1% – 3.1% reduction in male mortality immediately after retirement. In contrast, I estimate a significant increase in mortality for both men and women just after retirement at the age of 65, ranging between 2.0% – 2.9% among men and 2.6% – 2.7% among women. The magnitude of the estimates differ slightly by the order of the age polynomial but are, at each eligibility threshold, consistent in terms of direction and precision.

5.3 Effect Heterogeneity by Lifetime Earnings

Estimates obtained from samples that are stratified by the lifetime earnings distribution[24] indicate that the baseline results strongly depend on the region of the lifetime earnings distribution (table 4). Mortality-reducing effects, measured at the age of 63, are driven by men in the bottom 50% of the lifetime earnings distribution. When lifetime earnings are low, male mortality reduces by 1.6% just after retiring and hence the mortality-reducing effect is 40% larger when compared to the baseline estimate obtained from the full lifetime earnings distribution. Estimates obtained for the upper half of lifetime earnings (top 50%) do not significantly differ from zero.

Mortality-increasing effects, measured at the age of 65, are remarkably higher in the top half of the lifetime earnings distribution and thus dominate for men and women who retire from high-pay jobs. Although these estimates significantly differ from zero both at the bottom and the top, they are dramatically larger at the top. Among men, the mortality increase of 2.6% at the top is 70% larger in contrast to the increase at the bottom (1.5%). Among women, the mortality increase at the top (4.6%) even triples the one at the bottom (1.4%). The particularly large difference among women may be explained by larger heterogeneity in terms of working biographies with only few women retiring from regular jobs while the majority retires from inactivity.

Analyzing the mortality effects of retirement by lifetime earnings is insightful because it reveals information on the activity change at retirement. Retiring from an employment history with low lifetime earnings is not only associated with formerly low-paid jobs but

[24] For details on how lifetime earnings are measured, see section 3.5.

could also reflect former part-time or marginal employment. Given that mortality effects of retirement are low (at age 65) or even dominated by health-improving effects (at age 63) when earnings are low hence suggests that retiring from less prestigious jobs is health improving. Many low-pay jobs are also associated with physically demanding occupations or simply involve higher workplace hazards, such as in cleaning, construction or transport. Retiring from these jobs arguably reduces work-related stress and the exposure to hazardous environments.

In contrast, retiring from an employment history with high earnings is associated with working in high-pay and full-time jobs. Retirements from these good jobs are dominated by mortality-increasing effects and one plausible explanation for this is the loss of job prestige and job-related networks that potentially induce social isolation. This is consistent with evidence showing that social isolation is a strong predictor of mortality (Pantell et al., 2013) and that social isolation as a mortality risk could be prevented if work activity was higher (see Snyder and Evans, 2006, for a discussion).

5.4 Effect Heterogeneity by Pension Type

To reveal further information on the individuals' activity change at retirement, I present RD estimates that are obtained from regressions on pension type-specific sub-samples. These estimates are limited to the extent that specific pensions are only available at specific thresholds. Since everyone reaches the normal retirement age at 65 (100% claim regular old age pensions, see figure 4), I focus on heterogeneity in the mortality effects of retirement among men at the age of 63.[25]

The estimates in table 5 suggest that the reduction in male mortality after age 63 is predominantly driven by men who retire from unemployment and from long employment careers. This is consistent with the shares in figure 4, indicating that male retirement at the age of 63 is dominated by claiming pensions for the unemployed (more than 20%) and

[25] Consistent with the baseline estimates, table 5 reports no significant mortality effects of retirement among women for different pension types at the age of 63. Although figure 4 indicates that more than 40% claim womens' pensions and that more than 30% claim pensions for the long-term insured, these shares are based on only very few women who actually retire. Given that there is no considerable jump in retirements it is plausible that female mortality remains unchanged at the age of 63.

for long-term insured (more than 50%).

Retiring from unemployment is associated with a 1.2% mortality reduction. Reduced mortality among men who retire from unemployment is in line with previous evidence that suggests improvements such as increasing life satisfaction when people retire from unemployment (Hetschko et al., 2014), which is explained by changing identity. The mortality-reducing effect that I document is consistent with these findings in a sense that the reduced stigma attached to unemployment also impacts mortality as a more objective outcome.

Retiring from long employment biographies is also associated with a significant mortality reduction of 0.9% just after retirement. The group of older workers who claims pensions for the long-term insured consists predominantly of manual workers such as craftsmen and technicians who had stable and long working histories, simply because they need a minimum of 35 contribution years to become eligible. These workers typically went through apprenticeships without higher education and started their working careers rather early (below age 20). It is possible that these persons value leisure gains more strongly than others because, overall, their main motive for working is generating income and less self-fulfillment and prestige. A more direct explanation for reduced mortality among these workers is a lower exposure to workplace hazards at least for manual jobs that are physically demanding or dangerous. This interpretation is consistent with the finding of reduced mortality when retiring from low-earnings biographies. It is also consistent with various characteristics that are evident for men who retire at the age of 63 that I present in the next section.

5.5 Further Evidence on the Activity Change

Investigating the pre-retirement activity of retirees yields plausible explanations for heterogeneity in the retirement-mortality nexus. Based on representative survey data for Germany (SOEP), I present some key characteristics on retirees in the year before they retire.

5.5.1 Men

Previous to retirements at 63 (table 7), male labor force participation is high (71% employed, 21% unemployed). Employed men are predominantly full-time workers (82%) in dependent employment (78%) of which 42% are in manual jobs and 47% perform routine task activities. This combination of characteristics is very common among male craftsmen with long-lasting and stable working biographies. It is thus unsurprising that these men claim old age pensions for the long-term insured when this type of pension becomes available at age 63. The negative mortality effect with falling mortality rates immediately after retirement that is measurable at this age is probably driven by reduced workplace hazards (retiring from manual jobs) and a relief from work-related stress (retiring from routine jobs). Male retirement from "bad jobs" at age 63 can thus be associated to a relief from job duties.

Previous to retirements at 65 (table 8), men are similarly characterized by high labor force participation rates previous to retirement (70% employed, 15% unemployed), although the share of full-time workers among the employed is slightly lower (76%). These retirees are high-paid workers just before retirement (labor earnings above 30,000 EUR) and are represented by a particularly high share of civil servants (20%). The positive mortality effect of retirement with increasing mortality rates immediately after retirement thus implies that retiring from "good" jobs is associated with a loss of job prestige and social networks that may coincide to abrupt inactivity, social isolation, and cognitive decline.

5.5.2 Women

Female labor force participation differs substantially in contrast to men. Only few women retire at the age of 63 (table 9), but those seem to have a closer labor market attachment (50% employed, 8% unemployed) and higher annual labor earnings (9,500 EUR) compared to women who retire at other ages. However, the negligible jump in the cumulative retirement rate (figure 1) suggests that there should not exist a measurable mortality effect of retirement. In fact, the results presented above do not suggest any female mortality effects for the cutoff at age 63.

In contrast, a huge share of women (almost 40%) retire at 65 (figure 1). These women have relatively low labor force participation rates before retirement (23% employed, 3% unemployed) as is evident from table 10, suggesting that a considerable share of women who retire at 65 are inactive regarding their labor force status and retire once they become eligible to claim pensions. This is possible for women who accumulated pension claims predominantly from periods of child raising earlier in life but have only little or no labor force attachment. One limitation in the pension records is that I cannot directly distinguish these women by their pre-retirement labor force attachment simply because all women claim regular old age pensions at the age of 65. However, the estimates stratified by lifetime earnings plausibly proxy the mortality effects for women with high labor force attachment (top 50%) and low labor force attachment (bottom 50%) because lifetime earnings directly reflect total contributions to the public pension system. In fact, the estimates in table 4 present estimates that are strongly consistent that women at the upper margin of the earnings distribution exhibit much stronger mortality effects of retirement than those in the lower half of the distribution. This finding is consistent with heterogeneity by labor force attachment where those with high earnings tend to retire directly from employment and thus the event of retirement implies a more abrupt change in living conditions compared to those women with low earnings who tend to retire from inactivity.

5.6 Robustness and Placebo Tests

Using the local non-parametric estimation procedure with robust bias-corrected confidence intervals and bandwidth selection (Calonico et al., 2014a,b) also yields results that are very similar to the parametric estimates. Table 6 shows that, as for the baseline, male mortality exhibits a slight reduction just after the age of 63 and a significant increase in both male and female mortality just after the age of 65. These estimates also indicate that once specifying a quadratic age-mortality relationship (local quadratic regressions), the estimates are larger in magnitude but are consistent in terms of direction and precision.

Figure 5 shows the results from regressions at various monthly age cutoffs between age 61 and 66, obtained from the baseline local linear RD specification with a bandwidth of 12 months. Choosing age cutoffs arbitrarily indicates that the mortality effects of retirement do not significantly differ from zero when deviating from age-based eligibility thresholds. The coefficient plots only report significantly negative mortality effects among men just after the age of 63 and significantly positive mortality effects among men and women just after the age of 65. Overall, the standard errors of the estimates in the female sample are somewhat larger which is due to fewer deaths in the observed age interval, reducing sample size. I conclude that the baseline RD estimates are highly robust against placebo tests of this kind.

6 Conclusions

This paper aims at resolving a puzzle that has emerged in the literature on the mortality effects of retirement. So far, the empirical results in the literature are mixed and document a whole range of mortality-increasing, mortality-reducing or zero effects. Many existing studies measure effects for specific subgroups that, for example, receive an early retirement offer or become eligible for social security benefits at one specific age cutoff. These quasi-experimental designs credibly identify local mortality effects of retirement and are highly internally valid. From a broader perspective, however, the reported estimates yield quite heterogeneous results that differ substantially in direction and magnitude. Unambiguous evidence on the impact of retirement on mortality is important because this objective and well-measured health outcome determines post-retirement survival years with implications for redistribution.

To reconcile heterogeneous mortality effects of retirement, I examine this relationship at different age-based eligibility thresholds in the German public pension system. I adopt a regression discontinuity design based on pension insurance records that cover mortality outcomes for the universe of participants. The groups who comply to eligibility, i.e. those who retire because they become eligible, differ remarkably across age cutoffs. This heterogeneity induces substantial differences in the mortality effects of retirement. Immediately after retirement at age 63, male mortality rates are falling. However, this effect stands in contrast to increasing mortality for both men and women just after the age of 65.

A plausible explanation for heterogeneous effects is the activity change at retirement. The abrupt change of living conditions around the retirement date is mainly driven by pre-retirement biographies and careers. I substantiate this by using information on lifetime earnings and the type of pension claimed, revealing insights on the groups that retire at specific thresholds. Mortality reductions are driven by men at the lower margin of the lifetime earnings distribution and are the largest among men who retire from unemployment. In contrast, the mortality-increasing effects are stronger when lifetime earnings are high and are measured for individuals who claim a regular old age pension at the normal retirement age. In conclusion, mortality-reducing effects dominate the retirement process whenever people retire from bad jobs with low earnings or hazardous workplace conditions. Mortality-reducing effects also dominate, if the event of retirement goes along with reduced stigma from unemployment. Mortality-increasing effects dominate when people retire from good jobs with high earnings, an activity change that can be associated with the loss of job prestige and social networks.

Two limitations should be considered when interpreting the results of this paper. First, the age-based eligibility thresholds that I use to identify the mortality effects of retirement are commonly known and thus anticipated. As a consequence, and similar to previous studies in related settings (e.g. Fitzpatrick and Moore, 2018), the mortality effects measured are net of long-run changes regarding anticipatory health behaviors. Second, I document immediate mortality effects of retirement. By construction, the RD framework is only able to identify mortality effects close to the eligibility thresholds. Measuring long-run effects would require extrapolation of the parameters identified in the local environment of the age cutoffs and this would involve strong assumptions about the age process in the retirement mortality relationship. However, studies that have examined other eminent events such as job displacement have shown quite a substantial persistence of corresponding mortality effects (Sullivan and von Wachter, 2009b) so that the contemporaneous mortality effects that I document here are also likely to persist many years after retirement.

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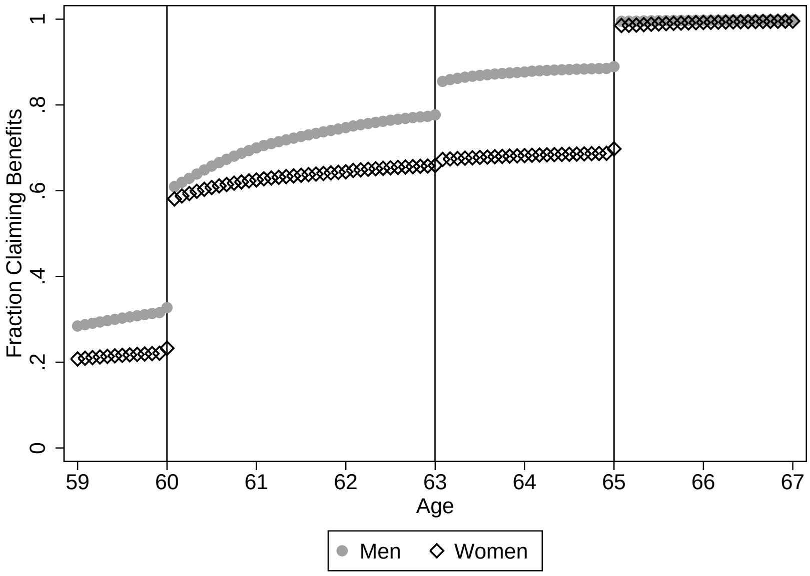
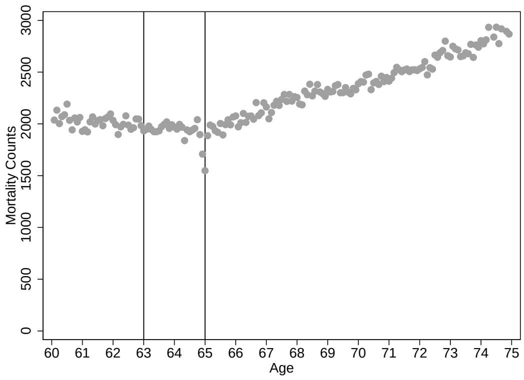
Figures

Figure 1: Cumulative Distribution of Retirement

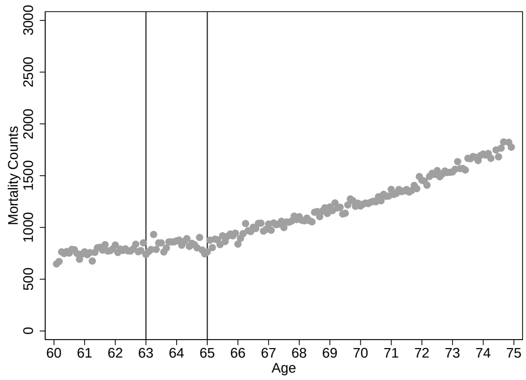


Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Retirement is defined as claiming a pension for the first time. The cumulative retirement rate is plotted for the birth cohorts 1934 - 1936.

Figure 2: Mortality Counts by Age



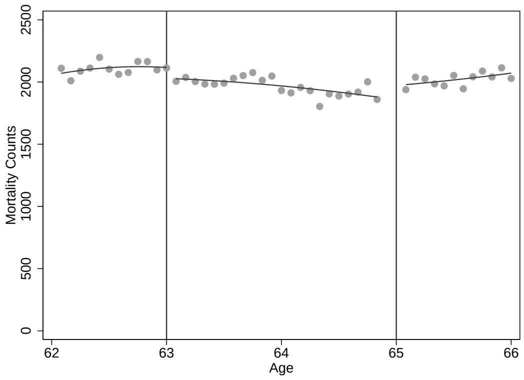
(a) Men



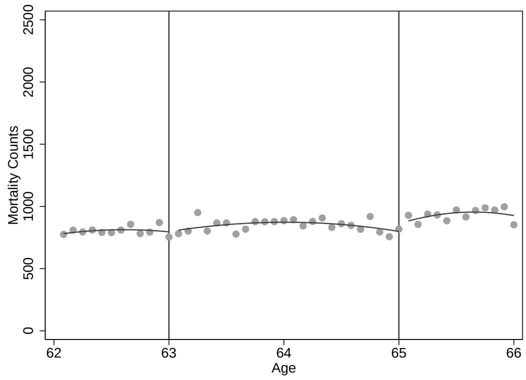
(b) Women

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Mortality counts are total number of deaths by age in months for the birth cohorts 1934 - 1936.

Figure 3: Mortality Counts by Age



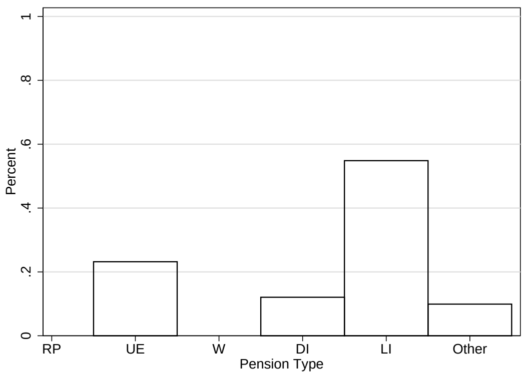
(a) Men



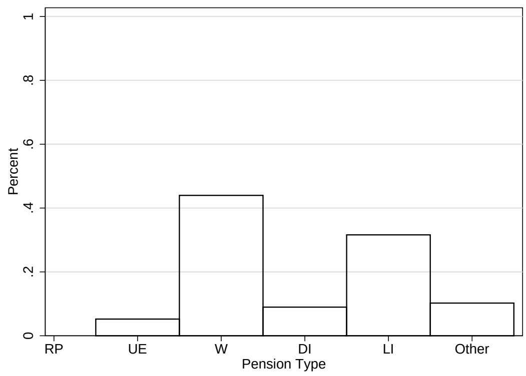
(b) Women

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Mortality counts are total number of deaths by age in months for the birth cohorts 1934 - 1936. The graph excludes two outliers in male mortality counts marginally below the cutoff 65.

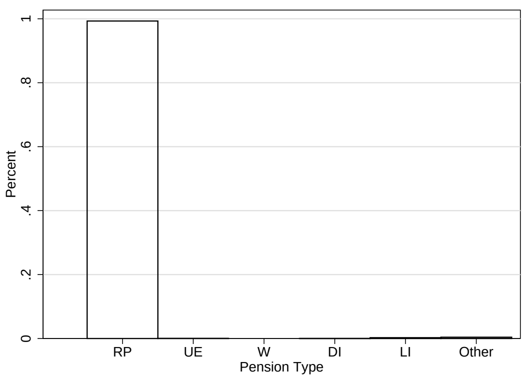
Figure 4: Retirement Age and Pension Type



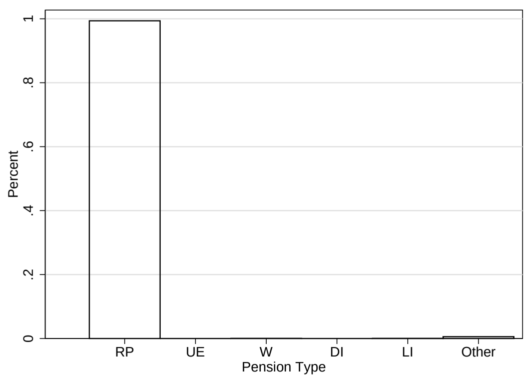
(a) Men: Retirement at 63



(b) Women: Retirement at 63



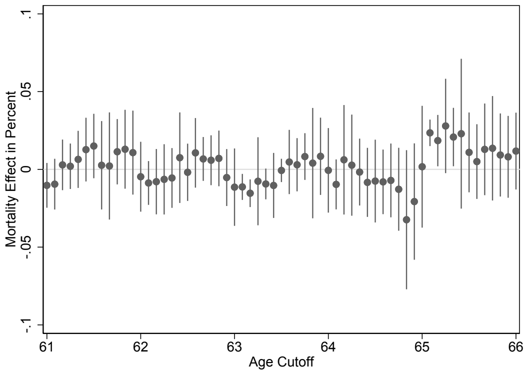
(c) Men: Retirement at 65



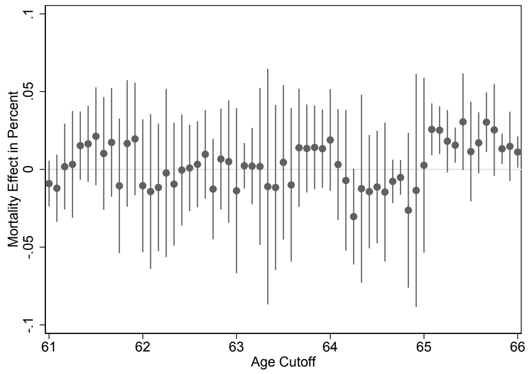
(d) Women: Retirement at 65

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Reported shares are conditional on claiming a pension at the specified age (shares add to 100%). Abbreviations are: Regular Pension (RP), Pension for the Unemployed (UE), Pension for Women (W), Pension for the Disabled (DI), Pension for the Long-term Insured (LI).

Figure 5: Placebo Regressions



(a) Men



(b) Women

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Reported values are point estimates and corresponding 95% confidence bands from baseline RD estimates. The age cutoff varies in monthly steps between age 61 and 66. The bandwidth choice is 12 months to the left and to the right of each cutoff.

Tables

Table 1: Age-Based Eligibility Thresholds for Old Age Pensions

Eligibility Type	Retirement Age	
	Early	Normal
Regular Old Age Pension	–	65
Unemployed	60	65
Women	60	65
Long-term Insured (35 years)	63	65
Disabled	60	63

Source: Own illustration based on social security legislation (SGB VI). *Note:* Reported eligibility ages refer to the social security legislation applying to birth cohorts 1934 - 1936. When reaching the retirement window of age 60 to 65 (between 1994 - 2001), eligibility thresholds remained unchanged for these cohorts.

Table 2: Descriptive Statistics

	Population	Analysis Sample (RD)
Birth Cohorts	1885 - 1993	1934 - 1936
	Men	
Age at Death	76.0	70.3
Retirement Age	59.9	59.2
Retirement Age | RA >= 60	62.9	61.7
Lifetime Earnings (EP)	43.9	43.0
Observations	5,742,290	502,049
	Women	
Age at Death	81.5	71.6
Retirement Age	60.4	60.1
Retirement Age | RA >= 60	63.5	62.3
Lifetime Earnings (EP)	19.6	23.0
Observations	6,185,080	278,818

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* The analysis sample is a nested sub-sample of the population. The population includes all cases of death that are documented for actively insured persons and pension recipients between 1994 and 2013. The analysis sample imposes a birth cohort restriction that ensures a homogeneous age-based eligibility threshold. The unconditional retirement age includes all retirements, while the conditional retirement age (RA) is restricted to ages 60 and older. Pre-retirement lifetime earnings are measured as earnings points (1 EP = one year of average earnings).

Table 3: Fuzzy Regression Discontinuity Estimates (Baseline)

	(1)	(2)	(3)	(4)
	Men		Women	
	63	65	63	65
Local Linear	−.0112***	.0203***	.0023	.0257***
	(.0043)	(.0005)	(.0075)	(.0009)
Local Quadratic	−.0306***	.0288***	.0021	.0273***
	(.0063)	(.0008)	(.0114)	(.0014)
N	48,418	47,768	17,265	18,311

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Estimates based on local polynomial RD estimation with robust bias-corrected confidence intervals as proposed by Calonico et al. (2014a,b). The log mortality count is the dependent variable, age is the running variable. Bandwidth is 12 months to the left and to the right of the age cutoff. Age polynomials are interacted with the age cutoff dummy, allowing the age-mortality relationship to vary at each side of the cutoff. Standard errors (in parentheses) are clustered at the monthly age at death.

Table 4: Fuzzy Regression Discontinuity Estimates by Lifetime Earnings

Lifetime Earnings	(1)	(2)	(3)	(4)
	Men		Women	
	63	65	63	65
Top 50%	−.0065	.0260***	.0015	.0461***
	(.0057)	(.0007)	(.0013)	(.0011)
Bottom 50%	−.0158***	.0152***	.0032	.0143***
	(.0064)	(.0008)	(.0078)	(.0012)
All (Baseline)	−.0112***	.0203***	.0023	.0257***
	(.0043)	(.0005)	(.0075)	(.0009)
N	48,418	47,768	17,265	18,311

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Estimates based on local polynomial RD estimation with robust bias-corrected confidence intervals as proposed by Calonico et al. (2014a,b). Estimates stratified by the top and bottom 50% of the lifetime earnings distribution. The log mortality count is the dependent variable, age is the running variable. Bandwidth is 12 months to the left and to the right of the age cutoff. Age polynomials are interacted with the age cutoff dummy, allowing the age-mortality relationship to vary at each side of the cutoff. Standard errors (in parentheses) are clustered at the monthly age at death.

Table 5: Fuzzy Regression Discontinuity Estimates by Pension Type

	63 Cutoff	65 Cutoff	63 Cutoff	65 Cutoff
	Men		Women	
Unemployed	–.0124***	–	–	–
	(.0022)			
Disabled	–.0090**	–	–	–
	(.0039)			
Long-term Insured	–.0089***	–	.0010	–
	(.0019)		(.0027)	
Women	–	–	.0025	–
			(.0635)	
Regular Pension	–	.0203***	–	.0257**
		(.0005)		(.0009)
Baseline (Local Linear)	–.0112***	.0203***	.0023	.0257***
	(.0043)	(.0005)	(.0075)	(.0009)
N	48,418	47,768	17,265	18,311

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Estimates based on local polynomial RD estimation with robust bias-corrected confidence intervals as proposed by Calonico et al. (2014a,b). Estimates stratified by pension type (see table 1). The log mortality count is the dependent variable, age is the running variable. Bandwidth is 12 months to the left and to the right of the age cutoff. Age polynomials are interacted with the age cutoff dummy, allowing the age-mortality relationship to vary at each side of the cutoff. Standard errors (in parentheses) are clustered at the monthly age at death.

Table 6: Local Non-parametric Regression

	(1)	(2)	(3)	(4)
	Men		Women	
	63	65	63	65
Local Linear	−.0098***	.0181***	.0044	.0253**
	(.0028)	(.0053)	(.0056)	(.0102)
Data-driven Bandwidth	4 months	6 months	9 months	6 months
Local Quadratic	−.0157***	.0284**	.0057	.0261**
	(.0044)	(.0117)	(.0067)	(.0129)
Data-driven Bandwidth	8 months	10 months	8 months	4 months

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Estimates based on local polynomial RD estimation with robust bias-corrected confidence intervals and bandwidth selection procedure as proposed by Calonico et al. (2014a,b). The number of observations varies by bandwidth, depending on the number of deaths at each age. The log mortality count is the dependent variable, age is the running variable. Age polynomials are interacted with the age cutoff dummy, allowing the age-mortality relationship to vary at each side of the cutoff. Standard errors (in parentheses) are clustered at the monthly age at death.

Table 7: Socioeconomic Characteristics Previous to Retirement at 63: Men

Variable	(1) R63	(2) Other Ages	(3) (1) - (2)	(4) t-Statistic
Hours Worked	1363	1006	357	5.8
Employed (%)	0.71	0.62	0.09	3.0
Full−time (%)	0.82	0.61	0.21	5.6
Part−time (%)	0.18	0.39	−0.21	−5.6
Unemployed (%)	0.21	0.29	−0.08	−3.0
Manual Worker (%)	0.42	0.44	−0.02	−0.7
Routine Task (%)	0.47	0.45	0.02	0.3
Involuntary Job Exit (%)	0.32	0.34	−0.02	−0.2
Labor Earnings (EUR)	25801	19396	6405	4.1
Employment Status (conditional on employment, %)				
Employee	0.78	0.66	0.12	3.1
Self−Employed	0.12	0.20	−0.08	−2.7
Civil Servant	0.10	0.14	−0.04	−1.2
Marital Status (%)				
Married	0.85	0.82	0.03	1.6
Single	0.02	0.03	−0.01	−0.7
Widowed	0.03	0.04	−0.01	−1.4
Divorced	0.05	0.05	−0.00	−0.3
Separated	0.02	0.02	−0.00	−0.1
Region: West Germany (%)	0.78	0.75	0.03	1.2
Health Status				
Self−Rated Health (1−5)	2.78	2.85	−0.07	−1.2
Disabled (%)	0.19	0.25	−0.06	−2.4
N Doctor Visits	3.6	4.3	−0.7	−1.6
N Hospital Treatments	1.31	1.46	−0.15	−0.6
Observations	342	2003		

Source: Own calculations based on the SOEP v33.1, waves 1984-2016. *Note:* Reported values are sample averages in the year previous to retirement, separately for male retirements at the age 63 (R63) and other ages (60 - 70, excluding 63). The number of observations is restricted to observable retirements at each respective age and can, due to missing values, be lower for specific characteristics (N for each subgroup is available from the author). Euro currency values for earnings are normalized to the year 2000. Self-rated health is scaled from 1 (very good) to 5 (very poor).

Table 8: Socioeconomic Characteristics Previous to Retirement at 65: Men

Variable	(1) R65	(2) Other Ages	(3) (1) - (2)	(4) t-Statistic
Hours Worked	1344	1008	336	5.5
Employed (%)	0.70	0.63	0.07	2.5
Full−time (%)	0.76	0.62	0.14	4.0
Part−time (%)	0.24	0.38	−0.14	−4.0
Unemployed (%)	0.15	0.30	−0.15	−6.0
Manual Worker (%)	0.32	0.46	−0.14	−3.9
Routine Task (%)	0.33	0.49	−0.16	−4.4
Involuntary Job Exit (%)	0.35	0.34	0.01	0.1
Labor Earnings (EUR)	30473	18513	11960	7.8
Employment Status (conditional on employment, %)				
Employee	0.62	0.70	−0.08	−2.3
Self−Employed	0.18	0.18	0.00	0.03
Civil Servant	0.20	0.12	0.08	3.1
Marital Status (%)				
Married	0.83	0.82	0.01	0.1
Single	0.03	0.03	0.00	0.3
Widowed	0.03	0.04	−0.01	−0.9
Divorced	0.06	0.05	0.01	0.4
Separated	0.02	0.02	0.00	0.3
Region: West Germany (%)	0.79	0.75	0.04	1.7
Health Status				
Self−Rated Health (1−5)	2.8	2.9	−0.1	−0.9
Disabled (%)	0.16	0.26	−0.10	−3.6
N Doctor Visits	3.4	4.3	−0.9	−2.3
N Hospital Treatments	1.2	1.5	−0.3	−1.3
Observations	350	1995		

Source: Own calculations based on the SOEP v33.1, waves 1984-2016. *Note:* Reported values are sample averages in the year previous to retirement, separately for male retirements at the age 65 (R65) and other ages (60 - 70, excluding 65). The number of observations is restricted to observable retirements at each respective age and can, due to missing values, be lower for specific characteristics (N for each subgroup is available from the author). Euro currency values for earnings are normalized to the year 2000. Self-rated health is scaled from 1 (very good) to 5 (very poor).

Table 9: Socioeconomic Characteristics Previous to Retirement at 63: Women

Variable	(1) R63	(2) Other Ages	(3) (1) - (2)	(4) t-Statistic
Hours Worked	598	520	78	1.3
Employed (%)	0.50	0.42	0.08	2.1
Full−time (%)	0.35	0.33	0.02	0.4
Part−time (%)	0.65	0.67	−0.02	−0.4
Unemployed (%)	0.08	0.17	−0.09	−3.2
Manual Worker (%)	0.36	0.46	−0.10	−1.9
Routine Task (%)	0.27	0.45	−0.18	−3.4
Involuntary Job Exit (%)	0.50	0.33	0.17	1.0
Labor Earnings (EUR)	9460	6579	2881	3.1
Employment Status (conditional on employment, %)				
Employee	0.80	0.82	−0.02	−0.4
Self−Employed	0.12	0.14	−0.02	−0.5
Civil Servant	0.08	0.04	0.04	1.8
Marital Status (%)				
Married	0.65	0.73	−0.08	−2.4
Single	0.05	0.03	0.02	2.1
Widowed	0.12	0.11	0.01	0.4
Divorced	0.12	0.07	0.05	2.0
Separated	0.02	0.01	0.01	1.0
Region: West Germany (%)	0.83	0.80	0.03	0.9
Health Status				
Self−Rated Health (1−5)	2.8	2.9	−0.1	−1.5
Disabled (%)	0.20	0.15	0.05	1.7
N Doctor Visits	4.0	4.1	−0.1	−0.2
N Hospital Treatments	1.3	1.5	−0.2	−0.4
Observations	190	2004		

Source: Own calculations based on the SOEP v33.1, waves 1984-2016. *Note:* Reported values are sample averages in the year previous to retirement, separately for female retirements at the age 63 (R63) and other ages (60 - 70, excluding 63). The number of observations is restricted to observable retirements at each respective age and can, due to missing values, be lower for specific characteristics (N for each subgroup is available from the author). Euro currency values for earnings are normalized to the year 2000. Self-rated health is scaled from 1 (very good) to 5 (very poor).

Table 10: Socioeconomic Characteristics Previous to Retirement at 65: Women

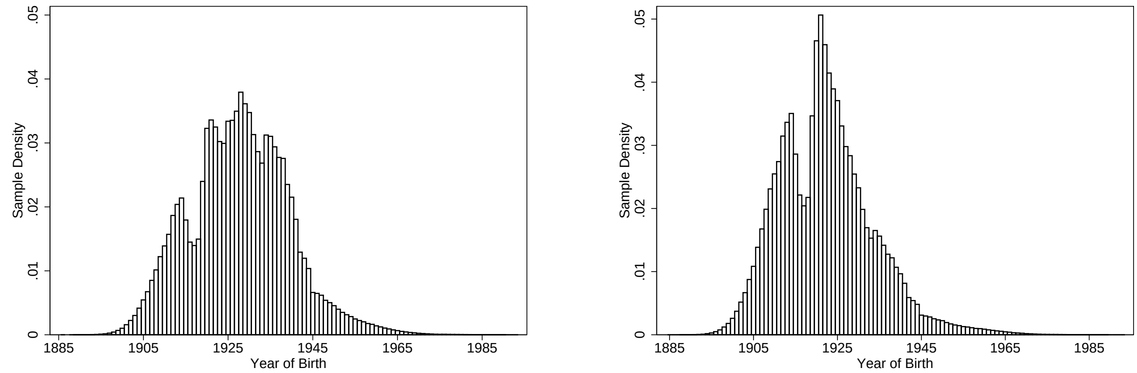
Variable	(1) R65	(2) Other Ages	(3) (1) - (2)	(4) t-Statistic
Hours Worked	248	591	−343	−8.0
Employed (%)	0.23	0.47	−0.24	−9.0
Full−time (%)	0.31	0.34	−0.03	−0.5
Part−time (%)	0.69	0.66	0.03	0.5
Unemployed (%)	0.03	0.20	−0.17	−8.1
Manual Worker (%)	0.45	0.45	0.00	−0.1
Routine Task (%)	0.37	0.44	−0.07	−1.1
Involuntary Job Exit (%)	0.20	0.37	−0.17	−0.8
Labor Earnings (EUR)	3566	7615	−4049	−6.1
Employment Status (conditional on employment, %)				
Employee	0.74	0.82	−0.08	−1.6
Self−Employed	0.19	0.14	0.05	1.2
Civil Servant	0.07	0.04	0.03	1.1
Marital Status (%)				
Married	0.86	0.70	0.16	6.9
Single	0.00	0.03	−0.03	−3.2
Widowed	0.05	0.13	−0.08	−4.4
Divorced	0.04	0.09	−0.05	−2.9
Separated	0.01	0.01	0.00	−0.2
Region: West Germany (%)	0.94	0.77	0.17	7.8
Health Status				
Self−Rated Health (1−5)	2.9	2.9	0.0	−0.6
Disabled (%)	0.13	0.16	−0.03	−1.4
N Doctor Visits	3.9	4.2	−0.3	−1.1
N Hospital Treatments	2.6	1.3	1.3	3.1
Observations	412	1782		

Source: Own calculations based on the SOEP v33.1, waves 1984-2016. *Note:* Reported values are sample averages in the year previous to retirement, separately for female retirements at the age 65 (R65) and other ages (60 - 70, excluding 65). The number of observations is restricted to observable retirements at each respective age and can, due to missing values, be lower for specific characteristics (N for each subgroup is available from the author). Euro currency values for earnings are normalized to the year 2000. Self-rated health is scaled from 1 (very good) to 5 (very poor).

Appendix (Supplemental Material for Online Publication)

A Additional Figures

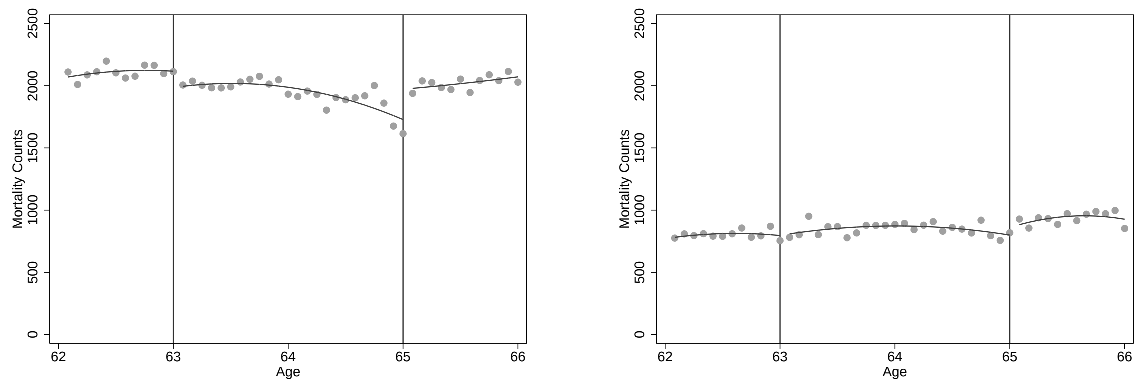
Figure 6: Birth Cohort Distribution by Sampled Deaths



(a) Men (b) Women

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* The figure depicts the birth cohort distribution as sampled by the incidences of death for the population.

Figure 7: Mortality Counts by Age (including outliers)



(a) Men (b) Women

Source: Own calculations based on FDZ-RV–RTBNRTWF93-14TDemoRWI and AKVS94-15. *Note:* Mortality counts are total number of deaths by age in months for the birth cohorts 1934 - 1936.

B Sampling Properties and Representativeness of Pension Insurance Records

The pension insurance records cover every person in Germany who has ever accumulated claims for public pensions and thus possesses an insurance account. The sample I use consists of two merged data sources. The core part are pension shortfall records that document the closure of insurance accounts due to death for individuals who retired and actually receive a pension. The second source consists of all actively insured persons who are not yet retired and do not receive a pension. This ensures that all individuals who have not retired yet, even though they are eligible for a pension, are sampled if they die. Adding this information to pension shortfall records provides the universe of deaths from all participants in the public pension system, covering a considerable share of the total German population.

In total, the data source covers 82% of the total number of death cases according to official mortality statistics (reported in Federal Statistical Office (2016)), covering 96% of male mortality and 75% of female mortality in Germany.[26] The high coverage rate of mortality in the German population is explained by the fact that only few individuals never actively register within the German public pension system. These cases comprise persons who never worked in dependent employment and also did not gain pension claims from other activities such as creditable periods of child raising. These individuals do not have a pension insurance account and thus do not appear in the pension records whenever they die.

[26]Male labor force participation is very high in the observed cohorts and thus the majority of men do have pension insurance accounts. Among women, labor force participation rates are considerably lower and thus their coverage rate regarding pension accounts is lower. However, even if women never worked they can still obtain pension claims from periods of child raising. Although there are alternative ways to obtain an insurance account, it is less probable to appear in the data which explains the difference in the coverage rate between men and women.