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The Effect of Removing Early Retirement on Mortality

CRISTINA BELLES

SERGI JIMÉNEZ

HAN YE

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The Effect of Removing Early Retirement on Mortality*

Cristina Bellés-Obrero†
Universitat de Barcelona, IEB and IZA

Sergi Jiménez-Martín‡
Universitat Pompeu Fabra, FEDEA
and Barcelona School of Economics

Han Ye §
University of Mannheim, IZA and ZEW

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Abstract

This paper sheds new light on the mortality effect of delaying retirement by investigating the impacts of the 1967 Spanish pension reform. This reform exogenously changed the early retirement age, depending on the date individuals started contributing to the Social Security system. Those contributing before 1 January 1967 maintained the right to voluntarily retire early (at age 60), while individuals who started contributing after that date could not voluntarily claim a pension until the age of 65. Using the Spanish administrative Social Security data, we find that the reform delayed the individuals' labor market exit by around half a year and increased the probability that individuals take up disability pensions, partial pensions, and no pensions. We show evidence that remaining employed longer increases the hazard of dying between the ages of 60 and 69 for almost all individuals. Heterogeneous analysis indicates that the increase in mortality is stronger for those employed in low-skilled, physically and psychosocially demanding jobs. Moreover, we show that allowing for flexible retirement schemes, such as partial retirement, mitigates the detrimental effect of delaying retirement on mortality.

JEL Codes: I10, I12, J14, J26
Keywords: Delaying retirement, Mortality, Heterogeneity, Flexible retirement

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†Universitat de Barcelona, Department of Economics, Spain *Email:* cristina.belles@ub.edu
‡Universitat Pompeu Fabra, Department of Economics, Spain. *Email:* sergi.jimenez@upf.edu
§University of Mannheim, Department of Economics, Germany. *Email:* han.ye@uni-mannheim.de

1 Introduction

Many countries have reformed their public pension systems to cope with their aging populations and to maintain financial solvency. One of the main policy tools used is to restrict access to early retirement schemes by increasing the minimum pension eligibility age. While there has been extensive literature studying the labor supply responses to such pension reforms,[1] there are relatively few studies about the impact of delaying retirement on mortality. Moreover, the existing empirical evidence mostly draws lessons from policy experiments that allow for earlier retirement (Coe and Lindeboom, 2008; Hernaes et al., 2013; Hallberg et al., 2015; Bloemen et al., 2017; Kuhn et al., 2020). Because the effects on mortality from preponing and postponing the retirement age are not necessarily symmetric, these estimates might not generalize to today's policy world, where most policymakers aim to incentivize prolonged working lives. Therefore, it is policy-relevant to understand the impact of delaying retirement on mortality, particularly the effect of closing the early retirement options on mortality.

This paper provides novel empirical evidence on this important issue by investigating a Spanish pension reform. This 1967 reform exogenously changed the early retirement age depending on the date individuals started contributing to the Social Security system. Individuals who contributed to the pension system before 1 January 1967 could voluntarily claim a pension as early as 60 years of age. On the other hand, individuals who started contributing after 1967 could only voluntarily claim a pension at age 65.[2]

This reform has several advantages in answering our research question. First, the discontinuity change in retirement age, based on the year the individuals started contributing to the Social Security system, allows us to credibly identify causal effects. Second, in contrast to most of the previous literature, this reform creates a substantial increase (approximately four years) in the early retirement age and leads to a considerable delay in the exit time of the labor market. Third, the reform affects a more general population compared to existing studies (see, e.g., Hallberg et al. (2015); Bloemen et al. (2017); Hagen (2018), all of which study specific subsets of the population, such as military personnel and civil servants). This feature allows us to capture the mortality responses in the general population and examine the heterogeneous responses of subgroups. Lastly, the treatment was determined at the early stage of a worker's career, which provides a long-term horizon for the expected retirement age to impact mortality, if there are some anticipatory responses.

We use a novel version of the Spanish administrative Social Security panel data covering 10% of

[1] For example, see Coile and Gruber (2007), García-Pérez et al. (2013), Atalay and Barrett (2015), Manoli and Weber (2016), Blundell et al. (2016) and Geyer and Welteke (2021) for recent evidence on the direct effects of raising retirement ages.

[2] Individuals of certain cohorts can retire at age 61 through involuntary early retirement under certain conditions. See Section 2 for more details on the institutional setting.

the cohort of individuals born between 1938 and 1949 who are registered with the Social Security system at any point in time until 2020. We compare individuals who started contributing one year before 1 January 1967 with those who started one year after that date. Using within-cohort first-difference regression and controlling for a broad list of fixed effects, we find that the reform delays the age at last employment by around half a year.[3] Those who contributed in 1967 are also less likely to claim a regular pension and more likely to claim partial and disability pensions. This indicates that individuals have utilized other ways to leave the labor market earlier when the early retirement schemes are not available anymore. We also show that they have a higher probability of not claiming any pension, driven mainly by premature mortality. More specifically, individuals who started contributing after 1 January 1967 are 1.7 percentage points more likely to die before claiming any pension. To test the causality of our estimates, we use placebo cut-off dates and find no significant impacts on these placebo dates both before and after 1967.

To show the impact of delaying labor market exit on mortality, we instrument the age at last employment using the year individuals started contributing to the Social Security system. We examine the impact of age at last employment on the hazard of dying between different age brackets. We find that delaying labor market exit by one year increases the hazard of dying between the ages of 60 to 69 by 4.4 percentage points (equivalent to a relative increase of 44%). When we look more closely, we find that the mortality responses are the strongest between ages 60 and 64 when individuals no longer have access to regular pensions. This result indicates that the negative effect of delaying retirement on mortality is driven mainly by the immediate effect of losing access to early retirement schemes. Furthermore, we shed some light on the possible mechanisms behind the detrimental effect of delaying retirement on mortality. In particular, we focus on the heterogeneous effects of delaying the labor market exit by the individuals' labor market conditions prior to retirement. As the parameters of most jobs are multi-dimensional, we examine four dimensions of individuals' labor environments: the physical burden, psychosocial burden, self-value at work, and occupational skill level.

First, using registered workplace accidents at the industry level as a proxy for physical burden, we show that the increase in mortality is stronger for those who have worked in sectors with a very high number of workplace accidents. This finding is consistent with previous literature establishing that physically demanding occupations lead to adverse health effects. We also find that the mortality effect is stronger for individuals in high psychosocial burden jobs (with a high level of mental and social stress). We measure the psychosocial exposure in a job following the Job Exposure Matrices constructed by Kroll (2011). Delaying labor market exit by one year increases the hazard of dying between the ages of 60 and 69 by 6 percentage points for individuals in high psycho-socially

[3] We show our results are robust using several robustness tests, including regression-based tests of the differences in covariates, and using within-age start contributing fixed effects analysis. For more details, see Section 7.

demanding jobs, while this number is 2.9 percentage points for those in low psychosocially burdensome jobs. Furthermore, we measure an individual's sense of achievement and recognition at their last job using the Occupational Information Network data (O*NET). We show that only individuals who work in low self-value industries are more likely to die when facing a one-year delay in the labor market exit. This result indicates that individuals who 'feel recognized' and have a sense of achievement in their work do not experience a negative mortality effect due to a delay in the labor market exit. Lastly, similar to previous literature, we find that delaying labor market exit by one year increases the hazard of dying by 5.5 percentage points for blue-collar workers, while this number is 2.8 percentage points for other workers. The heterogeneous results suggest that advocating for different ages to exit employment, depending on the working conditions of each individual's occupation, can mitigate the detrimental impacts of delaying retirement.

Our findings imply that losing access to early retirement can decrease life expectancy. One proposal to incentivize individuals to stay longer in the labor force without having such a negative impact on their health is to allow them to gradually reduce their working time towards the end of their careers. In Spain, some workers can access partial retirement by working part-time while claiming a partial pension. One of the eligible conditions is to have contributed to the Social Security system for at least 33 years. Comparing individuals with and without access to partial retirement, we find that individuals who have no access to partial pension experience higher mortality rates when the retirement age is delayed. This finding highlights the importance of providing the opportunity for gradual retirement, which can smooth the adverse effects of delaying retirement.

Apart from contributing to studies on the impact of pension reforms on retirement decisions (e.g., Mastrobuoni (2009); García-Gómez et al. (2012); Manoli and Weber (2016); Geyer and Welteke (2021)), our paper relates to and completes papers studying the mortality effects of retirement. The existing well-identified empirical literature finds mixed results and explores three types of policy experiments: allowing earlier retirement (Coe and Lindeboom, 2008; Hernaes et al., 2013; Hallberg et al., 2015; Bloemen et al., 2017; Kuhn et al., 2020), promoting later retirement (Zulkarnain and Rutledge, 2018; Hagen, 2018; Bozio et al., 2021) and switching to retirement at the statutory retirement age (Fitzpatrick and Moore, 2018).

The studies of earlier retirement overall find no significant or positive impacts on mortality. For example, Hernaes et al. (2013) find that accessing a pension two to five years earlier has no effect on the probability of dying by the ages of 67, 70, 74, and 77 for the entire population of Norway. Looking at some particular population groups, Hallberg et al. (2015) and Bloemen et al. (2017) find a positive impact of earlier retirement. Hallberg et al. (2015) show that five-year early access to a retirement pension reduces the mortality of male army officers in Sweden. Bloemen et al. (2017) find that male civil servants in the Netherlands who are entitled to claim a pension around eight years earlier have a lower mortality rate. The only paper that finds (earlier) access to a pension

increases mortality is Kuhn et al. (2020). Using Austrian register data, they estimate the (very) short-term impact of three-year early access to pension on mortality. Kuhn et al. (2020) find that early retirement increases male deaths before the age of 67.

Evidence on the impacts of later retirement is more scarce. Our paper directly contributes to this literature and is the first paper that provides a precisely estimated impact of later retirement induced by a delay in the statutory early retirement age. To the best of our knowledge, only three papers study the effect of delayed retirement. While Hagen (2018) studies the mortality effect of a two-year increase in the statutory retirement age, they find an imprecisely measured no effect on mortality by the age of 69.[4] The other two papers are Bozio et al. (2021) and Saporta-Eksten et al. (2021). While they both show precisely estimated impacts of later retirement on mortality, they explore pension reforms that change early retirement financial incentives rather than only removing the early retirement option, as in our setting. Bozio et al. (2021) find that delaying retirement in France has a zero effect on the probability of dying between the ages of 61 and 79. Saporta-Eksten et al. (2021) explore an exogenous decrease in the implicit working tax in Israel and show the impact of work on longevity. They find that later retirement increases mortality between the ages of 75 and 85 but that it has no impact on mortality between the ages of 65 and 74. Our paper differs from Bozio et al. (2021) and Saporta-Eksten et al. (2021), as we expect the response to pension reforms that incentivize retirement via financial incentives is different from reforms that shut down early retirement schemes.

Our paper is the first one to provide empirical evidence that removing early retirement access increases mortality. When we look at the literature on the health impacts of delayed retirement, it is not surprising to find a negative impact of delayed retirement. Many studies on the health impacts of retirement find adverse health effects (e.g., Grip et al. (2012); Shai (2018); Salvati (2020) and see, Pilipiec et al. (2021) for a recent survey.) through increased social isolation and depression (Atalay and Barrett, 2014; Eibich, 2015). Studies also find a positive impact of retirement on health outcomes due to the adoption of a healthier lifestyle (Insler, 2014; Celidoni and Rebba, 2017; Gorry et al., 2018). Therefore, it is reasonable to expect that later retirement might increase mortality rates.

Our findings have important policy implications. First, we show a large heterogeneity in the effect of delayed retirement on mortality, depending on the characteristics of jobs that the individuals held before retirement. Going beyond distinguishing between blue- and white-collar jobs, we show that other job dimensions (such as physical, psycho-social, and self-value) also matter. This finding implies that policies that remove access to early retirement for the general population can

[4] Hagen (2018) studies the mortality effect of a two-year increase in the statutory retirement age of local government female workers in Sweden and finds that the reform had no impact on mortality and/or health care utilization. See Section 8.1 for a more detailed comparison with the existing literature.

exacerbate the socioeconomic disparities in life expectancy.

Second, we show the option of a gradual transition to retirement matters with regard to the impacts of retirement on mortality. Allowing older workers to gradually reduce their working time at the end of their careers can mitigate the adverse effects on mortality. Such mitigating effects can be made possible by promoting gradual retirement options. The results also speak to the recent public discussions on flexible retirement. This insight is also relevant for public policy and budgetary considerations, particularly when policymakers in many countries face long-term solvency challenges in both the pension and public healthcare systems.

This article proceeds as follows: Section 2 presents a brief description of the institutional setting in Spain and the 1967 pension reform. Section 3 describes the data, and Section 4 the empirical strategy. Section 5 and 6 present results on the labor supply responses, plus the instrumental variable estimates of the impact of age at last employment on mortality. We also discuss the heterogeneity and potential mechanisms that may explain the impact on mortality. Section 7 presents all the robustness checks and placebo of our main results. We provide a discussion of the findings in Section 8. Section 9 concludes.

2 Institutional Setting

The key elements of the existing Spanish pension system were established in 1967 and the relevant rules for our sample we set in the 1985 reform. The current old-pension system for the elderly in Spain is a pay-as-you-go system, with an average replacement rate of around 80% (one of the highest in the European Union). The statutory retirement age is 65 years of age, and individuals need a minimum of 15 years of contributions to gain access to the pension. Full benefits are given to individuals with more than 35 contribution years, and the penalty for insufficient years of contributions is 2 percent per year. The pension benefits are calculated based on the average contributions during the 15 years preceding a claim. See Appendix B for more details on the different reforms that the Spanish pension system has experienced since 1967.

The pension of all individuals born in the same year is regulated by the same pension law. However, individuals who contributed before 1 January 1967,[5] even by one day, had an indefinite right to early retirement at the age of 60. These workers have this right because they began contributing before the current old-age pension system was established in 1967. The 1967 law (published on 30 December 1966) that created the new Social Security system maintained this benefit from the old Spanish pension system for only these workers. These individuals could freely retire early from

[5]The January 1967 deadline was set at a later date for workers in specific sectors, such as construction, mining, fishing, and the railway. For workers in these sectors (which constitutes a very small sample), we compare individuals that started contributing 12 months before and after that later date instead of 1967.

age 60, though with some financial penalties. The penalty for early retirement is 8 percent (or up to 6 percent as a function of the years contributed after the 2001 reform) per year of early claim. Around 13% of the individuals who started contributing in 1966 claimed a regular pension at the age of 60.

On the other hand, individuals who contributed after 1 January 1967 faced a statutory retirement age of 65. They can only retire early under the involuntary early retirement scheme, set in the 2001 law, which allows individuals to retire as early as age 61 (again with some financial penalties, between 6 and 8 percent, depending on the years of contribution, per year of advancement) under certain conditions. These individuals need to have been unemployed (involuntarily) for at least six months and have contributed to the Social Security system for at least 30 years. Due to these stringent requirements, a very small proportion of workers have taken up this involuntary early retirement option.

Because the law was published on 30 December 1966, there is little room left to manipulate the date of the first social security contribution. This feature, therefore, allows us to compare individuals who started contributing before and after 1 January 1967. As we can see in Figure 1, individuals who contributed before 1967 (independently of their birth year) could voluntarily retire early at the age of 60. For those who contributed after 1967, the only other way to receive early retirement was to claim involuntary early retirement at the age of 61; otherwise, the earliest an individual can voluntarily claim a pension is at the age of 65. Therefore, we expect individuals who started contributing after 1967 to increase their retirement age considerably.

In addition to the regular retirement pathway, there are two alternative pathways: permanent disability and partial retirement pensions. Permanent disability benefits have been used extensively in Spain as an early retirement mechanism (Boldrin et al., 1999; García-Gómez et al., 2012). Additionally, in 2002, partial retirement options became available, allowing the combination of income from work with old-age pension benefits. The partial retirement option enables individuals aged 60 years and older, with at least 33 years of contribution and six years of tenure in the same company, to claim 85% pension while working 15% of the time (up to 75% of benefits after the 2011 reform). The partial retirement option requires the firm's agreement because the worker must be replaced with a new employee. In this paper, we investigate the impact of the reform on the age of the individual when claiming disability, partial and regular retirement pensions, and the probabilities of choosing these alternative exit routes from the labor market.

3 Data

This paper uses novel administrative data of an extended sample from the Continuous Sample of Working Histories (*Muestra Continua de Vidas Laborales* (MCVL)) provided by the Spanish

Social Security system. The dataset contains a 10% random sample of individuals born between 1938 and 1949 who have registered with the Social Security (such as contributive workers and pensioners) at any point in their lives up to 2020.

Therefore, we use a non-publicly available version of the MCVL provided by the Spanish Social Security system, which allows us to observe contributive workers and pensioners prior to 2005 (the starting time of the publicly available version). This data advantage makes it possible to explore a representative sample of workers affiliated with the Spanish Social Security at any point in their working lives and examine their mortality responses. See Appendix C.1 for more details about the novelty of our dataset and how to obtain it.

The MCVL includes time-invariant information, such as gender, birth month, and birth year. It also contains detailed labor market biographies from the date individuals started contributing to the Social Security system until their death.[6] Moreover, we observe their employment and unemployment spells, occupations, industry, and monthly contributions. The pension records from the MCVL contain accurate information on an individual's age at the time of claiming a pension, pension benefits, the type of pension they receive at each point in time, and the total number of contributive years before retirement. When individuals exit from the dataset due to death, we observe the exact date of their death, which helps us measure mortality accurately.

3.1 Sample

Our main sample covers Spanish individuals born between 1938 and 1949 who started contributing to the Social Security system 12 months before and after 1 January 1967. We further restrict our sample to individuals attached to the labor market by including those that still contribute at the age of 50, that have not claimed a disability pension before 50, and with at least eight years of contribution. We also drop individuals that claim a SOVI pension. A SOVI pension is a residual pension from the old system for individuals that, at the age of 65, are not entitled to a pension from the current Social Security System but can prove that they contributed at least 1,800 days to the previous system. These individuals could not claim early retirement even though they started contributing before 1967. We drop 20% of observations with these restrictions.

In Table A1, we verify that our sample is not selected. First, we check if the reform has impacted the probability of not being in the main sample, and we find no significant differences. Moreover, we also show no significant mortality differences among individuals not included in the main sample. In Table A22, we perform some robustness checks modifying the definition of individuals

[6]Note that the date that individuals started contributing to the Social Security system coincides with the date at which they started their first formal job. It is important to emphasize that, for some individuals, this date does not correspond to the date they started working (for example, for those who switch from the informal sector to the formal sector).

not attached to the labor market. We can observe that including individuals that got a disability before age 50, have less than eight years of activity during her/his working life, or receive a SOVI pension does not impact our results. The final sample contains 25,764 individuals, of whom 27% are female. See Appendix C.2 for more details.

3.2 Treatment Status

To identify the treatment status, we need information about the exact date individuals started contributing. One caveat of the dataset is that the exact date of the first contribution is poorly recorded for some individuals, especially those who started contributing around 1967, as the administrative dataset started to be constructed at the end of the 60s. The top graph in Figure A1 shows the distribution of years the individuals in our sample started contributing, as recorded in the original dataset. We can observe that there is bunching in the years 1966 and 1967. Figure A2 shows that the monthly distribution in the starting year is normal in the years before 1965 and after 1967, indicating that the bunching problem is limited to the years 1965 and 1967. The majority of individuals that started contributing in 1965 are recorded as having started in January. Individuals that started contributing in 1966 are overrepresented towards the end of the year, while those that started in 1967 toward the start of the year. This distributional bunching indicates that some individuals recorded in 1965, 1966, and 1967 probably started contributing to the Social Security system before these dates. In fact, in Figure A3a), we can observe that some of the individuals that originally were recorded as having started contributing in 1967 claim a regular pension at age 60, which is impossible. This limitation is the reason we cannot use a Regression Discontinuity Design.

Fortunately, we can partially correct this measure as we have excellent information on the number of years contributed and the exact date individuals claim a regular pension. To correct the reported date of the first contribution, we subtract the total number of years contributed from the year they claim a regular pension. If the corrected year of starting contributions is before the reported date of the first contribution, we make this correction. This correction is only possible for individuals who have claimed a regular pension, as only for them the total number of years contributed is reported. We perform this correction for the years 1965, 1966, and 1967. However, for our main sample, which only includes individuals that started contributing in 1966 or 1967, the correction of 1965 will not matter. After this correction, we see in Figure A1 that the bunching has been greatly reduced. Figure A3b) also shows that, after the correction, fewer individuals started contributing in 1967 and retired early at 60. This means that the number of mistakes in the first year of contribution in 1966 and 1967 has been dramatically reduced with our correction. See Appendix C.3 for more discussion about the correction of this variable.

Finally, in Table A21, we perform several robustness checks for our main results. We use the reported date without any correction or removing the months where the majority of bunching is happening in our main sample (month 12 of 1966 and month 1 of 1967) and show that the results are similar.

4 Empirical Strategy

Estimating the causal effect of the retirement age on mortality is difficult because many unobserved factors can influence both retirement age and mortality. To deal with the endogeneity in retirement behavior, we exploit an exogenous variation in retirement age provided by the 1967 Spanish pension reform. We first provide causal estimates of the reform on retirement outcomes using a within-cohort OLS regression with a list of fixed effects and controls. We then use an instrumental variable (IV) approach to estimate the causal impact of age at last employment on mortality.

4.1 Within-cohort OLS Strategy

First, we estimate the following equation, where $Treated_{it}$ is a dummy that takes the value of one for individuals who started contributing to the Social Security system in 1967 and zero for those that started contributing in 1966. The treated group can claim regular pensions voluntarily at age 65 (involuntarily at 61), while the control group can claim them as early as 60 years of age.

$$R_{icmt} = \beta_0 + \beta_1 \delta_c + \beta_2 \mu_m + \beta_3 Treated_{it} + \gamma X_{icmt} + U_{icmt} \quad (1)$$

R_{icmt} represents the outcome variable of individual *i* born in year *c* and month *m* who started contributing in year *t* (1966 or 1967). The outcome variables include the age at last employment, the probability, and the age at which individuals claim the different pensions and pension benefits. δ_c is the year of birth, and μ_m is the month of birth fixed effects. β_3 measures the average treatment effect of the reform on the different outcomes.

X_{imct} includes a list of fixed effects, such as the highest level of occupation and industry sector between the ages of 30 and 40, and a list of other predetermined covariates, including individuals' mean monthly contribution to the Social Security system, the fraction of days active and employed, and the fraction of time self-employed between the ages of 30 and 40. We cluster the standard errors at the birth year level and report the wild-bootstrap p-values in brackets in all tables.

The estimates from Equation 1 provide us with the reform's reduced-form effects, plus the first-stage estimates for the IV regression.

4.2 Instrumental Variable Strategy

The causal effect of age at last employment on mortality is estimated by the following equation, where age at last employment (R_{icmt}) is replaced by the predicted value ($\widehat{R_{icmt}}$) from Equation 1:

$$M_{icmt} = \alpha_0 + \alpha_1 \delta_c + \alpha_2 \mu_m + \alpha_3 \widehat{R_{icmt}} + \gamma X_{icmt} + U_{icmt} \quad (2)$$

M_{icmt} represents the probability of dying of individual *i* born in year *c* and month *m* that started contributing in the year *t*. We also include the same list of controls used in Equation 1 (δ_c, μ_m, and X_{icmt}). Additionally, we control for the individuals' proxy of their mean pension benefit.[7] The coefficient α_3 captures the local average treatment effect of age at last employment on mortality among individuals who delayed their retirement because they were not able to claim a regular pension at age 60 (compliers). In Section 6, we discuss who the compliers are in our estimation.

Assumptions

The critical assumption for the treatment status to be a valid instrument for access to early retirement is that the year individuals started contributing to the Social Security system is independent of unobserved characteristics that affect the age at last employment and mortality. The following steps support the validity of our instrument.

First, we restrict our sample to those who started contributing in 1966 and 1967. The treated and control group individuals had similar labor market conditions when they began working: they were born in the same year and started working only one year apart. Second, we include their highest occupation, industry, birth year, and month of birth fixed effects, which allows us to estimate variations within occupation, industry, and birth year.

Furthermore, we check whether the characteristics of the treated and control groups are similar when they are between 30 and 40 years old.[8] Table A2 shows the impact of the treatment on a list of predetermined variables, including the fraction of time spent in employment, activity, and self-employment between the ages of 30 and 40; the probability of working in a blue-collar occupation and industry sectors; and average monthly contributions between the ages of 30 and 40. The estimates are obtained from estimating Equation 1. Except for the fraction of time spent

[7] We do not have information on pension benefits for individuals who have never claimed a pension of any kind. Therefore, for all individuals in our sample, we construct a proxy of the mean pension benefit using monthly contributions and years of contribution (or years of employment and unemployment) using the Social Security formula to calculate pension benefits. The correlation between this proxy and the actual mean pension benefit is 0.93 for individuals who claim a regular pension, indicating that it is a good proxy. Moreover, in Table A9, we show the effect of the reform on this proxy.

[8] Ideally, we would like to check whether the characteristics of individuals in the treatment and control groups differ at the beginning of their careers (before the age of 30). However, the data quality was not particularly good when our individuals were that young, so the labor market characteristics during the first years of their careers might have been wrongly recorded for some individuals. We, therefore, look at their characteristics between the ages of 30 and 40.

in self-employment, there are no significant impacts.[9] This suggests that there is no manipulation of the treatment status and that our control and treatment groups are very similar.

To further establish the causality of the first stage estimates, we perform placebo tests using other years to define treatment status and a robustness test using age at first contribution fixed effect instead of birth month fixed effects. These tests rule out the possibility that other confounding factors drive our reduced-form estimates. For more details, see Section 5.

To fulfill the exclusion restriction, we need to ensure that the treatment status only affects mortality through its impact on age at last employment. The only possible alternative channels through which the year individuals started contributing can affect mortality are changes in labor market outcomes close to retirement and changes in pension benefits. We always control for the proxy of the mean of the pension base to wash out any possible income effect. In Table A11, we also show that controlling for the labor market decisions before retirement (between 45 and 55 years of age) does not affect our IV estimates.

Finally, the monotonicity assumption requires that contributing to the Social Security system in 1967 instead of 1966 would not lead to earlier retirement. The monotonicity assumption is also satisfied in our context because the treated individuals do not have the option to retire as early as 60 years of age.

5 The Reform Effect on Retirement Outcomes

5.1 Descriptive Evidence

Table A3 provides summary statistics for the main outcomes used in our analysis. There are three different pensions that individuals can claim. Table A3 shows that 47% of individuals claim a regular pension (old-age pension), while 33% claim a disability pension, and 4% of individuals choose a partial pension. Some individuals in our sample never claim any pension due to reasons such as a period of prolonged inactivity ($\sim 6\%$), dying before a claim can be made ($\sim 8\%$), and still being active in the labor market in 2020 ($\sim 0.3\%$). Figure A4 compares the share of different types of pensions by treatment status. Compared with those who started contributing in 1966 (control, light green bars), individuals who started contributing in 1967 (treated, darker green bars) have a lower likelihood of claiming a regular pension and are more likely to claim a disability pension, a partial pension, or claim no pension.

On average, individuals leave the labor market at 59.56 years old and claim regular pensions at 63.57 years of age. Figure 2 shows the age distribution at last employment for individuals who

[9] In Table A19, we show that the effect of the reform on our main outcomes is robust to excluding from our sample individuals in one of the self-employed pension regimes.

started contributing in 1966 and 1967. As expected, we see a distinct difference. Figure 2 shows that around 8% of individuals who started contributing in 1966 (control group, solid red line) leave the labor market at the age of 60, while this percentage is almost zero for those individuals that started contributing in 1967 (treated group, green dashed line). More than 22% of the treated individuals exit the labor market at the age of 65, while this number is only 17% for the control group. We see the same pattern regarding the age of claiming a regular pension. Figure 3a) shows that 28% of individuals who started contributing in 1966 (control group, solid red line) claim a regular pension at the age of 60, and 32% of them claim at the age of 65. We also see some claims at the ages of 61 to 64. However, for those individuals who started contributing in 1967 (treated group, green dashed line), almost no one claims a regular pension at any age other than 65 years, whilst almost 70% claim a regular pension at 65 years of age. These figures provide visual evidence that the reform is binding and that individuals affected by it delayed their retirement.

In our sample, individuals, on average, claim a disability pension at the age of 57.16 and a partial pension at 61 years of age. Figure 3b) and Figure 3c) show the distribution of these ages by treatment status. We observe that individuals who started contributing in 1967 (green dashed line) claim more disability insurance between the ages of 60 and 65 than those who started contributing in 1966. Moreover, individuals who started contributing in 1967 (green dashed line) claimed partial pensions at slightly earlier ages.

Finally, regarding the mortality measure, conditional on being alive at the age of 50, 32% of our sample died between the ages of 50 and 86. The hazard rate of dying between the ages of 50 and 59 years and the hazard rate of dying between the ages of 80 and 86 are low, at 7% and 2%, respectively. The highest mortality occurs between 60 and 79 years of age. The hazard of dying between the ages of 60 and 69 is 11%, and the hazard of dying between the ages of 70 and 79 is 16%.

5.2 Regression Results

Table 1 examines the impact of the reform on the different types of pensions that individuals have claimed. We find that individuals who started contributing to the Social Security in 1967 are less likely to claim a regular pension by 10.4 percentage points ($\sim$ 19%), yet their probability of claiming disability insurance increases by 5.9 percentage points ($\sim$ 19%). In Table A4, we further show that the reform equally impacted the probability of claiming a severe or absolute disability and a partial or professional disability pension (by a 3.2 and 2.7 percentage point increase, respectively).[10] They are also 1.9 percentage points ($\sim$ 54 %) more likely to claim a partial pension.

[10]There are four types of disability pensions. First, *partial disability* pensions are for individuals who have seen their functional capacity reduced by at least 33 percent. These individuals can continue working, even in the same jobs they had before applying for the pension. Second, *professional disability* is assigned to those workers who cannot resume

These results indicate that individuals did not fully comply with the rise in statutory retirement age and have utilized other ways to leave the labor market before claiming a regular pension, by either claiming disability insurance or a partial pension.

We also observe that individuals contributing to the pension system in 1967 are 2.6 percentage points ($\sim$ 18%) more likely to leave the labor market without any pension. In Table A5, we further explore three reasons why individuals might not claim any pension: first, they were still working in 2020; second, they became inactive; third, they died before claiming any pension. Table A5 indicates that the reform has only a minimal impact (an increase of 0.2 percentage points) on the probability of continuing to work up until 2020 and has no impact at all on the probability of becoming inactive. Interestingly, individuals who started contributing in 1967 have a 1.7 percentage point ($\sim$ 24%) higher probability of dying before claiming any pension. This finding implies that premature death is the main driver for not claiming any pension. We further explore this effect in Section 6.

Table 2 examines the impact of the reform on the ages at which individuals leave the labor market and claim different types of pensions. The 1967 reform resulted in the treated individuals delaying their labor market exit by almost half a year and delaying claiming their first pension (regardless of the type) by 0.26 years (four months). Table A6 shows the reform's effect on the probability of exiting the labor market in different age brackets. The reform decreases the probability of leaving the labor market between the ages of 55 and 63. As expected, the reform has the most impact on reducing the probability of exiting the labor market at the age of 60, with a decrease of 4.1 percentage points or 37%. Individuals who started contributing in 1967 also have a higher probability of exiting the labor market after the age of 64. Once again, the reform has the most notable effect on increasing the probability of exiting the labor market at the age of 65, with an increase of 6.8 percentage points or 41%.

We find that early retirement is reduced by one year and three months for individuals who claim a regular pension.[11] The ages at claiming a disability pension and a partial pension are also affected. Individuals who contributed after 1967 delay claiming disability by around four months but anticipate claiming a partial pension by around two months. Table A8 shows that the reform significantly increased the probability of claiming a disability pension between the ages of 60 and 65 only. This result suggests that individuals affected by the reform use disability pensions as an early retirement scheme between the ages of 60 and 65, ages at which these individuals would

their work activity but could carry out a different occupation. Third, *absolute pensions* are thought for individuals who cannot carry out any type of work due to physical or mental deterioration. Finally, *severe disability* occurs when the worker needs the support of another person to carry out their daily subsistence tasks.

[11] We observe in Table A7 that the reform decreased by 10 percentage points ($\sim$ 67 %) the probability of claiming a regular pension at age 60 and between 2 and 3 percentage points ($\sim$ 48 % to 76%) the probability of claiming it between the ages of 61 and 64. On the other hand, the reform increased the probability of claiming a regular pension at age 65 by 9.2 percentage points ($\sim$ 50 %) and 3.6 percentage points after the age of 65 ($\sim$ 32 %).

have been able to retire with a regular pension if they had contributed in 1966. Moreover, it also indicates that the reform does not capture differential ex-ante health conditions of individuals. If this were the case, the reform should have significantly increased disability pensions before the age of 60.

In Table 3, we examine the reform impact on the pension benefit amount. We expect the pension benefits to be affected because the reform incentivizes individuals to work longer (as shown in Table 2), which increases the pension base and decreases the penalty for early retirement. Moreover, as more individuals claim disability insurance due to the reform, we expect the overall pension benefits to be lower as disability pension benefits are typically less generous. We find that the total pension benefit of individuals who started contributing in 1967 increased by 42€ ($\sim$ 3%). The increase in the pension benefit is driven by an increment in the base pension (without any financial adjustments) of 18€ ($\sim$ 1.5%) and an increase in the pension adjustment (due to later claiming) of 5 percentage points ($\sim$ 6%). It is important to note that the positive effect on pension benefits that we observe for the sample where individuals claimed any pension is driven mainly by those individuals who claimed a regular pension, as Table A9 shows. In particular, individuals who claimed a regular pension and started contributing in 1967 received, on average, a monthly pension benefit that was 73 73€ higher. This increase is driven by a rise of 25€ in the pension base and a 9.2 percentage point increase in the pension adjustments. Furthermore, we observe that the mean monthly pension benefit decreases by 24€ for individuals who claimed a disability pension, while the reform does not significantly affect partial pension benefit.

6 Right to Retire Early and Mortality

6.1 The Effect of Age at Last Employment on Mortality

In this section, we examine the impact of retiring later in life on mortality using the instrumental variable method. Table 4 reports the effects of age at last employment on mortality at different age brackets (conditional on having survived until that age). Panel 1 reports the simple OLS estimation where we regress age at last employment over mortality. For all our estimations, delaying retirement is negatively and significantly correlated with mortality. This correlation likely captures the fact that less healthy workers tend to retire early. Panel 2 shows the reduced form effect of the reform on mortality. We find that individuals who contributed in 1967 have a 3 percentage point ($\sim$ 10%) higher probability of dying between the ages of 50 and 86. When we examine the reform's impact on mortality at different age brackets, we observe that the increase in mortality is concentrated between the ages of 60 and 69. In particular, individuals who contributed in 1967 die between those ages (that is, ages 60 and 69) with a 2.1 percentage points higher probability

($\sim$ 22%). We also find a minor increase in mortality after 80 (0.4 percentage points). Figure 5 shows that all the placebo estimates for overall mortality after the age of 50 and between the ages of 60 and 69 are insignificant and close to zero. This confirms that our reduced-form estimates result from the exogenous increase in early retirement age due to the reform rather than from other confounding factors.

The IV estimates in Panel 3 of Table 4 indicate that delaying the age at last employment by one year increases the probability of dying between the ages of 50 and 86 by 7.8 percentage points ($\sim$ 26%), 4.4 percentage points ($\sim$ 44%) between the ages of 60 and 69, and 0.6 percentage points ($\sim$ 26%) after 80. In Table 5, we also report the effect of age at last employment on mortality in five-year age brackets. We observe that the mortality responses are the strongest between ages when public pensions are not accessible (between the ages of 60 and 64). Delaying leaving the labor market by one year increases mortality in that age bracket by 3.9 percentage points ($\sim$ 70%). This result indicates that the negative effect of delaying retirement on mortality is driven mainly by the short-term effect of losing access to early retirement schemes.

In Column 6 of Table 4, we also examine the effect of delaying retirement on age at death (in years). This measure will capture both the extensive margin (the effect of delaying retirement on premature death) and the intensive margin (the length of life). We censor the age of death at 71 years old for those individuals still alive at that age (as the younger cohort, born in 1949, are 71 years old at the end of our database in 2020). We find that delaying the age at last employment by one year reduces individuals' age at death by 0.79 years.

It is important to note that the F-statistic of the first stage regression for all our IV estimates in Table 4 and 5 are above the rule-of-thumb threshold of 10. Our instrument (the year individuals started contributing) is relevant and correlated with the endogenous variable we are instrumenting (age at last employment).

When we compare the OLS results with the IV estimates, we can see that the IV strategy does a good job controlling for the negative bias present in the correlation between age of last employment and mortality. Moreover, compared with the reduced-form estimates, the IV results are more than double. This is consistent with the almost half a year increase in age at last employment (as estimated in Table 2). In addition, the IV estimates control for other effects of the reform that could potentially impact mortality through different channels. In particular, in the IV strategy, we control for the positive effect of the reform on pension income. As we do not have information about the potential pension benefits for those individuals who never claimed any pension, we control for a proxy of the monthly pension base. We constructed this proxy using the individual's history of monthly contributions and the formula used by the Social Security system to calculate the pension base.[12]

[12]The correlation between this proxy and the actual mean pension base is 0.9 for the whole sample and 0.93 for

Another potential channel through which the reform could be affecting mortality is the labor market outcomes of individuals before retirement (between the ages of 45 and 55).[13] Table A11 shows the IV estimates of the effect of age at last employment on mortality between the ages of 60 and 69 with different control variables. We observe that adding the labor market outcomes of individuals before retirement as controls in the IV estimation does not change the size of estimates to any great extent. Thus, our baseline IV estimations will only control for the proxy of the pension base.

Finally, it is important to understand who the potential compliers are. We can proxy the characteristics of the compliers by looking at the individuals that, before the reform, retired at the age of 60. However, this group would also include always-takers (individuals that, even after the reform, would still leave the labor market at the age of 60). Therefore, in our specification, we can compare individuals that, when they had the chance, claimed a regular pension early at the age of 60 with the rest of the individuals that started contributing in 1966. Table A12 compares these two groups.[14] Not surprisingly, individuals that retire at 60 have less attachment to the labor market at the end of their working career (between the ages of 45 and 55) and have a lower probability of employment in a white-collar occupation. However, our results do not seem to suggest that, before the reform, those claiming retirement earlier worked in occupations and sectors with a higher health burden.

6.2 Mechanisms

This section attempts to shed light on some of the potential mechanisms explaining why losing access to early retirement increases mortality. We focus on two types of heterogeneities: labor market conditions before retirement and the possibility of flexible retirement.

6.2.1 Labor Market Conditions Prior to Retirement

Delaying retirement can have very different effects on an individual's life expectancy, depending on the working conditions experienced by the individuals during their last years of employment

individuals who claim a regular pension, indicating that it is a good proxy. Moreover, in Table 3, we show that the reform impacted this proxy similarly to the actual pension base.

[13] Table A10 shows that the reform had an impact on the labor market outcomes of individuals between the ages of 45 and 55. We observe that individuals that started contributing in 1967 spent 2.01 percent more time employed during these years, and they are 0.6 percent more likely to be active in the labor market. We also find that the individuals affected by the reform have a 1.6 percentage point higher probability of having a blue-collar occupation. They also have a 1.9 percentage point lower probability of working in the trade or transportation sector, 2.7 percentage points of working in the public, health, or education sectors, and 0.8 percentage points of working in the services, hotel, and housekeeping sectors.

[14] For this comparison, we only consider individuals who were not affected by the reform (who started contributing to the Social Security in 1966). The difference between the two groups of individuals is estimated by running a regression on a dummy variable, indicating if the individual claimed a regular pension before age 61, controlling for gender, month, and year of birth fixed effects.

(Mazzonna and Peracchi, 2017).[15] In this paper, we acknowledge that the burden of a job may be multi-dimensional. Therefore, we examine four characteristics of the individuals' labor environment before retirement: physical burden, psychosocial burden, self-value at work, and the skill level of their last occupation before retirement. The correlation between the first three measures (physical burden, psychosocial burden, and self-value at work) is not very high, indicating that they capture different characteristics of the individuals' labor environment. Specifically, the correlation between physical and psychosocial burden is 0.14, -0.25 between physical burden and self-value at work, and -0.37 between psychosocial burden and self-value at work.

Table 6 reports the heterogeneity results for the probability of dying between the ages of 60 and 69 (conditional on surviving to age 60)[16] based on all four measures. In the first panel, we report the effect of the reform on the age at last employment for each subgroup, which serves as the first stage of the IV estimation. In the second and third panels, we report the effect of delaying retirement on mortality between the ages of 60 and 69. First, we report the reduced-form effect of the reform and then the IV estimates, which capture the effect of delaying by one year the exit of the labor market on mortality. We also report p-values testing the hypothesis that the coefficients by subgroups are equal in the last row.

Physical and Psychosocial Burden

Retirement enables individuals to enjoy more leisure time and eliminates work-related stress and exposure to job-specific accidents, potentially positively impacting individuals' mental and physical health and well-being. Thus, retirement may be particularly beneficial for those who work in strenuous occupations, either physically or mentally. Indeed, labor unions have used this argument heavily in their opposition to increases in the statutory retirement age. Therefore, we first classify individuals' last industry depending on their physical and psychosocial burden in order to analyze if the adverse effects of delaying retirement on mortality differ by these characteristics.

Previous literature has already established that physically demanding occupations lead to adverse health effects (see Case et al. (2005) and Ravesteijn et al. (2013) for a summary). To measure

[15] One of the reasons we expect to see heterogeneity in mortality by labor market conditions is because harsher working conditions are more likely to trigger mortality due to specific causes, which are predominant during the ages of 60 to 69. For instance, the medical literature has long established that circulatory system diseases can often be correlated to work-related stress (Kivimäki et al., 2002). In fact, both Bloemen et al. (2017) and Hallberg et al. (2015) report that retirement reduces the risk of heart-related mortality. For the cohort considered in our sample, circulatory diseases are the second cause of mortality (after tumors) between the ages of 60 and 69. Moreover, the third cause of mortality for our cohort of individuals is due to respiratory diseases. Important risks for respiratory conditions include smoking and lack of physical activity (Godtfredsen et al., 2008; Lee et al., 1999). Both factors can be affected by working status and, ultimately, retirement (Falba et al., 2005; Black et al., 2015; Evenson et al., 2002; Barnett et al., 2014). Fitzpatrick and Moore (2018) find that mortality due to two lung-related conditions (COPD and lung cancer) statistically increases immediately after retirement at the age of 62.

[16] As the reform has no impact on the probability of dying before age 60, the sample used in this regression is not selected.

physical burden at work, we use the Spanish Register of Workplace Accidents between 2003 and 2019, which has information on the total number of workplace accidents that individuals in our sample (cohorts born between 1938 and 1949) experienced in different industry sectors. Figure A5 shows the distribution of industry sectors depending on their incidence of workplace accidents. We link individuals' last industry to this aggregate industry-level data and divide our sample by the median of the workplace incidence. After this division, the manufacturing, energy, water, sanitation, and construction sectors are considered to have a high incidence of workplace accidents, and the rest are included in the low-incidence group.

Columns 1 and 2 of Table 6 show that the increase in mortality is stronger for those individuals who worked in sectors with a higher incidence of workplace accidents before retirement. Delaying the age at last employment by one year increases the probability of dying between the ages of 60 and 69 by 8.3 percentage points ($\sim 77\%$) in sectors with a high incidence of workplace accidents. At the same time, the effect is only 1.3 percentage points (and not significant) in sectors with a low incidence of workplace accidents. The p-value of the difference between these two groups is 0.026, indicating the difference is statistically significant. This heterogeneity confirms that individuals in more physically demanding jobs will benefit the most from having access to early retirement.

Next, we examine the heterogeneous effect of delaying retirement on mortality by the mental and social stress that individuals have experienced before retirement. Unfortunately, we do not have a good measure of occupations or industries by this measure for the Spanish context. Thus, we measure psycho-social exposure by adopting occupational indexes based on the Job Exposure Matrices constructed by Kroll (2011) using a large-scale representative survey of working conditions of approximately 20,000 employees in Germany. In particular, we use their measure of 'psycho-social burden', which is based on mental stress, social stress, and temporal loads. Figure A6 shows a distribution of industry sectors by this psychosocial exposure index. We link individuals' last industry with this aggregate occupation-level data[17] and divide our sample by the median of this index.

Columns 3 and 4 of Table 6 report that a delay of one year increases the probability of dying by 6 percentage points ($\sim 57\%$) for individuals with occupations in industries with a high psychosocial burden. In contrast, the increase is smaller (2.9 percentage points) for those with occupations in industries with fewer psychosocial burdens. The p-value of the difference between these two groups is 0.135. We further divide our sample into three groups (see Table A13) and find that the

[17]The psychosocial burden occupational index elaborated by Kroll (2011) is linked to individuals' last industry following these steps. First, we group all the industries defined in CNAE09 into 21 different groups. Using the Labor Force Survey of 2011, we observe which occupations (defined by CNO11) are most often performed in each of the 21 industry groups and with what frequency. Finally, we link the psychosocial index with each industry depending on which occupations are usually performed within each industry, using the frequencies as weights to calculate the mean psychosocial burden in each sector.

impact of delaying retirement is significantly different between the highest and lowest groups. In particular, we find no effect on mortality for individuals working in sectors with a very low psychosocial burden, while mortality increases by 6.5 percentage points for those in sectors with a very high psychosocial burden. These results imply that losing the right to retire early can lead to the death of individuals who were not only in physically demanding jobs but also had high exposure to psychosocial burdens in their workplace.

Self-value at Work

Previous literature has pointed out that retirement can negatively impact individuals' well-being, as they often lose the social network of their co-workers and may feel less valuable to society (Szinovacz et al., 1992). Therefore, we want to test this hypothesis by looking at the heterogeneous effect of delaying retirement on mortality based on how and whether individuals felt useful in their job before retirement.

As we do not have a good proxy of usefulness at work in the Spanish context, we utilize the Occupational Information Network (O*NET) collected by the US Department of Labor. We use the work value classification to measure self-value at the workplace, which includes two elements: a sense of achievement and recognition within the workplace. Figure A7 shows the distribution of industry sectors by this self-value index. In our sample, we link individuals' last industry with this aggregate occupational-level data,[18] and divide the sample by the index's median.

In columns 5 and 6 of Table 6, we find strong evidence that the mortality effects between the ages of 60 and 69 are driven by individuals working in low self-value industries. Delaying the labor market exit by one year increases the probability of dying between the ages of 60 and 69 by 6.5 percentage points ($\sim 61\%$) for individuals working in these sectors, while the impact is small and insignificant for individuals working in sectors with high self-value. The impacts on these two subgroups are statistically different. Therefore, this result indicates that individuals who feel a sense of achievement and recognition within their workplace do not experience a negative mortality effect due to a delay in their exit from the labor market.

Skill Level

Finally, previous literature has relied heavily on heterogeneity differentiating between blue- and white-collar jobs, typically based on each occupation's assumed skill level (Coe et al., 2012). Following this previous literature, we also look at the differential effect of age at last employment on mortality for individuals working in white- and blue-collar occupations in columns 7 and 8 of Table 6. Contrary to Mazzonna and Peracchi (2017), we find this heterogeneity very similar to that

[18] We link the occupational index of self-value with individuals' last industry following the same steps as for the psychosocial burden index.

based on the physical burden. Delaying retirement by one year increases the probability of dying between the ages of 60 and 69 by 5.5 percentage points ($\sim$ 57%) for individuals with a blue-collar job, while it is 2.8 percentage points for the rest. Even though this difference in results is not statistically different, it indicates that, in this context, skills capture differences in physical burden across occupations.

6.2.2 Possibility of Gradual Retirement

Reducing the possibility of early retirement, as examined here, appears to be a good strategy to cope with an aging population, as it prolongs the working careers of older workers. However, we have shown that this type of policy leads to serious adverse effects on individuals' life expectancy. A potential solution to incentivize workers to stay longer in the labor force without negatively impacting their health is to allow these workers to gradually reduce their working time at the end of their careers.

We analyze whether having the option to claim a partial pension can mitigate the negative impact of delaying the age at which individuals leave the labor market on mortality. As we observe that the reform affected the probability of individuals claiming a partial pension, we cannot simply directly look at the mortality effect of those individuals who chose this retirement scheme. Therefore, we take advantage of the fact that only individuals with at least 33 years of contribution have access to this scheme.[19]

As already explained in Section 2, in 2002, the Spanish pension system introduced the possibility of individuals partially retiring after the age of 60, allowing them to combine income from work with old-age pension benefits. They were allowed to claim up to 85% of their pension while reducing employment time from 85% to 15% of the original contract. However, this option, which is also subject to the agreement of the firm, was only available for workers with at least 33 years of contribution and six years of tenure in the same company. Figure A8 demonstrates that the probability of claiming partial pension increases exponentially after reaching 33 years of contribution and is almost zero before. The first row of Table 7 also confirms that those with more than 33 years of contribution respond to the reform by having a higher likelihood of claiming a partial pension. In particular, treated individuals that contributed more than 33 years have a 4.6 higher probability of claiming a partial pension, while those with less than 33 years of contribution only have 0.3 percentage points higher probability compared with the control group.

Table 7 shows that an increase of one year in the age at last employment increases mortality

[19] We only have the number of years contributed for those that claim a regular pension or a partial pension. For those individuals that do not claim any pension or claim a disability pension, we calculate the number of years that have been active (total number of years since they started contributing to the Social Security system until they claim a disability pension, die, or the end of our data).

between the ages of 60 and 69 by 6.8 percentage points ($\sim$ 62%) for individuals with less than 33 years of contributions, who could not access to partial retirement. On the other hand, the effect is much smaller (2 percentage points or 23%) for individuals with more than 33 years of contributions who could potentially access the partial retirement scheme. We also observe that the differential impact of the reform on both subgroups is statistically different.

Because having more years of contribution could be correlated with knowledge of the partial pension program and other unobserved characteristics, we also test the robustness of this finding by using a smaller sample of individuals. We take two samples, individuals with contribution years between 23 and 43 years and individuals with contribution years between 28 and 38 years. We compare those with less than 33 and more than 33 years of contribution in these two samples. Table A15 displays the results. The p-values testing the hypothesis that the coefficients by subgroups are equal are reported. We again find that delaying retirement has almost four times less impact on the mortality outcomes of those who have contributed for more than 33 years. The estimates are significantly different for the whole sample or when we restrict to individuals that contributed between 23 to 43 years. The difference is smaller and not significantly different when we restrict our sample to individuals that contributed between 28 and 38 years. This is expected and consistent with the probability of claiming a partial pension only increasing gradually after reaching 33 years of contribution, as illustrated in Figure A8.

This result indicates that introducing the possibility of partially reducing the working time for older workers at the end of their careers can help mitigate the adverse effects on health of delaying retirement.

7 Robustness and Placebo Tests

In this section, we perform several robustness checks on the labor market reduced form effects of the reform, as well as both the IV and reduced form estimates of the mortality responses. Moreover, we test the causality of our estimates by using placebo cut-off dates from both before and after 1967.

7.1 Within-Age at First Contribution Fixed Effects Model

The baseline analysis compares individuals born in the same year (along with their highest occupation level and industry sector fixed effects) who started contributing to the system one year apart (1966 vs. 1967). One potential confounding factor of this specification is the age at which individuals started contributing. These individuals were born in the same year but started contributing in 1966 and 1967 and were at different ages when they started contributing. One reason for starting

at different ages could be differences in educational attainment. Unfortunately, we do not have information on the education level of individuals in our database. Therefore, to test that the reform is not capturing differences in educational attainment, we use age at first contribution fixed effect instead of birth year fixed effects in Table A16. This robustness check estimates the impact of losing access to early retirement for individuals who start working at the same age but were born one year apart. These estimates should be similar to the main estimates unless the different starting age is a confounding factor. Compared with the baseline results in Tables 1 and 2, the magnitudes of the estimates in Table A16 are very similar.

Table A20 also shows that our mortality estimates are not sensitive to using age at first contribution fixed effects instead of month and year of birth fixed effects (Column 2). This robustness check indicates that the impact of losing access to early retirement on mortality is similar if we consider individuals who start working at the same age but were born one year apart.

7.2 No Controls

In our baseline estimation, we control for a list of fixed effects, such as the highest level of occupation and industry sector between the ages of 30 and 40, and a list of other predetermined covariates, including individuals' mean monthly contribution to the Social Security system, the fraction of days active and employed, and the fraction of time self-employed between the ages of 30 and 40. Ideally, we would like to control for the characteristics of the individuals at the beginning of their careers. However, the data quality was not particularly good when our individuals were that young, so the labor market characteristics during the first years of their careers might have been wrongly recorded for some individuals. We, therefore, control for their characteristics between the ages of 30 and 40.

In order to make sure that these controls are not endogenous, in Table A2, we check if the treatment had any significant impact on these variables and, except for the fraction of time spent in self-employment, we confirm that these variables are not affected by the treatment. We also performed another robustness check of our main results, not controlling for any of these controls. Table A17 shows that the magnitude of the reduced form labor market estimates is quite similar to the baseline results in Tables 1 and 2. Column 3 of Table A20 also estimates the mortality effect without controlling for any labor market variable when the individuals were between 30 and 40 years old, and the estimates are quite similar to the baseline estimates. These robustness checks suggest that these covariates are not likely to be endogenous.

7.3 Cohorts Born between 1941 and 1949

In the baseline sample, we consider individuals born between 1939 and 1949. A law in 2002 introduced the possibility of retiring early via the involuntary pathway. As a result, cohorts born from 1938 to 1940 can claim a pension at the ages of 64, 63, and 62, respectively, while cohorts born after 1941 can claim at the age of 61 (see Figure 1).

Therefore, we performed a robustness check, dropping the cohorts that were only partially affected by the law of 2002. Table A18 and column 4 of Table A20 report the main labor market and mortality results for the cohorts born between 1941 and 1949. If we compare them with the baseline results, we can see that the magnitude of the estimates is quite similar. These results demonstrate that our reduced form effects are not driven by the older cohort of individuals with later access to involuntary early retirement.

7.4 Dropping Self-Employed Individuals

Table A2 shows the impact of the treatment on a list of labor market variables when the individuals were between 30 and 40 years old. Except for the fraction of time spent in self-employment, we do not find significant impacts, suggesting that there is no manipulation of the treatment status. A potential reason for finding significant effects on individuals' fraction of time spent in self-employment is that self-employed individuals might have more flexibility in deciding when they want to start contributing to the Social Security system. In this robustness check, we want to ensure that our main baseline results are not driven by these individuals.

Therefore, we perform a robustness check dropping those individuals who received a pension under the self-employed regime (see Table A19 and column 5 of Table A20). If we compare them with the baseline results, we can see that the magnitude of the estimates is quite similar, indicating that our baseline reduced form effects are not driven by those individuals who were self-employed.

7.5 Correction for the Starting Year

Table A21 shows the mortality effects using different corrections for the years individuals started contributing reported in the affiliation data. We can observe that the effect is very similar to the baseline estimation if we remove from the sample those months with the highest bunching (month 12 of 1966 and month 1 of 1967). When we do not perform any correction, the mortality effects are still significant but reduced. As suggested by Figure A1, without the correction, some treated individuals might be in the control group, biasing our estimates downward. Finally, Table A22 shows that our estimates are not sensitive to modifying the definition of individuals not attached to the labor market.

7.6 Placebos

A concern for causality is that our results could be potentially biased by unobserved characteristics that affect both the date of starting contributions and labor supply decisions. To test this possibility, we perform several placebo tests where we assign placebo treatment status to the individuals using other dates at first contribution. Figures 4 and 5 plot the estimated coefficients of the different placebo tests, comparing individuals who started making contributions in the years indicated on the y-axis (from 1959 to 1976). The placebo estimates are labeled in black, while our baseline estimates are in red. We can observe that almost all placebo estimates are insignificant or close to zero. This suggests that the estimated changes in our baseline analysis result from the exogenous increase in early retirement age rather than from other confounding factors.

We do not perform the placebo test on years that are too close to the actual treatment years, including 1964 vs. 1965, 1965 vs. 1966, and 1967 vs. 1968. As explained in Appendix C.3, we adjusted the years 1965, 1966, and 1967 of the first contribution by using the total number of years contributed and the first date that individuals claim a pension. Therefore, if we were to use placebos for 1964 vs. 1965, 1965 vs. 1966, or 1967 vs. 1968, we would be comparing a corrected year of the first contribution with a year that has not been corrected.

Alternatively, we report our main results in Table A23, where we expand our sample to include those who began contributing in 1965 and 1968. In Table A24, we consider the same augmented sample but exclude individuals who began contributing in 1966 and 1967. These robustness exercises demonstrate that our labor market reduced-form results are stronger when we compare individuals who are potentially more different.

8 Discussion

8.1 Comparison with Existing Studies

We find that individuals who contributed in 1967 (a delay of five years in statutory retirement age) have a 2-percentage point higher probability of dying between the ages of 60 and 69 (21% increase). The IV estimates indicate that delaying the age at last employment by one year increases the probability of dying between the ages of 60 and 69 by 4.4 percentage points (44%). This may seem quite a large effect; however, our estimates are comparable in magnitude with studies showing that early retirement reduces mortality (Hallberg et al., 2015; Bloemen et al., 2017).

Hallberg et al. (2015) find that offering a five-year reduction of the statutory retirement age from the age of 65 to 60 reduces the probability of dying by the age of 70 by 26 percent. Using the same measure of mortality, we find that a five-year increase in the statutory retirement age from the age of 60 to 65 increases the probability of dying before age 70 by 3 percentage points, which

is equivalent to a 17 percent increase. Additionally, Hallberg et al. (2015) show that the mortality effects are driven by those who are more exposed to workplace hazards; that is, those with low pre-retirement incomes and those without a college education. Their finding is consistent with our heterogeneous results. Bloemen et al. (2017) also find estimates of a similar magnitude. They find that retirement induced by a temporary decrease in the retirement eligibility age (from the age of 65 to 61 or 62) for male Dutch civil servants decreased the probability of dying within five years by 47 percent (2.6 percentage points).[20] Although our prior is that the effect of delaying retirement is not necessarily symmetric with the impact of early retirement, our estimates suggest that the effect on mortality has a similar magnitude when the nature of the reform and affected age ranges are comparable.

Our paper is the first to find that retirement reduces mortality by exploring quasi-experiments that shut down early retirement options. Existing papers find no effect of delaying retirement on mortality. Bozio et al. (2021) and Saporta-Eksten et al. (2021) are the only two papers we know of that have the statistical power to conclusively estimate the mortality impacts, and they find precisely zero effects of delaying retirement.[21] One common feature of these two papers is that they explore reforms that increase the financial incentives to delay retirement while keeping the statutory retirement age unchanged. Bozio et al. (2021) find a precisely zero impact of delaying retirement on the probability of dying between the ages of 61 and 79 for private-sector workers in France. Saporta-Eksten et al. (2021) find no effect of delaying retirement on mortality between the ages of 65 and 74 by exploring a reform that reduced the implied tax of working for married males in Israel.[22] One possible reason that we find an adverse impact of delayed retirement (while their study finds no effect) is that the groups of compliers differ. Those who retire later as a response to a pension reform incentivizing later retirement via financial incentives differ from those who retire later because the early retirement possibility is not available. Therefore, it is reasonable to expect a more harmful impact on mortality when the early retirement option is removed than when early retirement is financially less attractive. Moreover, we find that workers entitled to gradual retirement suffer less from the reform (see Table 7). This finding indicates that delaying retirement is less harmful when pension reform provides a flexible choice rather than a paternalistic policy that prohibits workers from retiring earlier.

[20] Although Hallberg et al. (2015) study male military officers in Sweden and Bloemen et al. (2017) focus on Dutch male civil servants, both papers point out that the working environment of these subgroups of males is not more demanding than that for the general population.

[21] Hagen (2018) explores a reform that increases the statutory retirement age from the age of 63 to 65 for Swedish public sector workers born since 1938. They find an imprecisely measured no effect on mortality by the age of 69. Their IV estimates show that a one-year increase in retirement age results in a 0.34% increase in morality by the age of 69 (insignificant).

[22] It is important to note that Saporta-Eksten et al. (2021) show a decline in the probability of survival of the affected men between the ages of 75 and 85 due to later retirement. Overall, they find that one additional year of employment decreases longevity by 9 to 12 months. Our result is in line with this finding.

Lastly, we compare our paper with studies on the impact of pension income on mortality (e.g., Jensen and Richter (2004); Snyder and Evans (2006); Malavasi and Ye (2023)). In particular, Snyder and Evans (2006) examine a variation in social security wealth for the U.S. "notch" cohort and show that reductions in pension benefits led to lower mortality, which they attribute to beneficial effects of employment. In contrast, our paper shows that the reform, which removes early retirement access, leads to higher mortality, despite inducing higher pension benefits (as shown in Table 3). Our IV analysis, which controls for pension income, suggests that the adverse mortality impact is mainly due to delayed employment. While both Snyder and Evans (2006) and our paper show that the employment impact dominates, Snyder and Evans (2006) suggest that working longer is beneficial, whereas we find working longer is detrimental. One possible explanation for this difference is that our compliers are more likely to be blue-collar workers (Table A12). Additionally, in our setting, people entitled to earlier retirement do not necessarily experience the pain of being displaced, which can lead to an increase in mortality (Sullivan and Von Wachter, 2009). Finally, Snyder and Evans (2006) points out that the "notch" cohort is working longer, mostly through an increase in part-time employment while still receiving pension benefits. As a result, their results are more comparable to our findings for people who are eligible for the partial retirement scheme. These institutional details may explain why we find that later retirement leads to higher mortality.

8.2 Policy Discussion

The heterogeneous mortality impacts of delayed retirement suggest important distributional consequences of raising the statutory retirement age. In particular, the socio-economic disparities in lifespans are large and have increased in recent decades (OECD, 2016).[23] One possible contributing factor might be the heterogeneous mortality responses to pension reforms, which could exacerbate the disparity. Moreover, individuals who survive longer receive more years of pension. The resulting gaps in life expectancy will affect the actuarial fairness and progressivity of public pension systems (Sanchez-Romero et al., 2020). Specifically, individuals from lower socio-economic groups (typically those who are more exposed to workplace hazards) spend fewer years in retirement than the rest of the population due to the pension reform.

[23] We acknowledge that life expectancy also differs largely by gender. In Spain, in 2021, men live on average until age 80.2, while women live on average until age 85.8 (Spanish National Institute of Statistics). In Table A14, we examine if the reform had differential effects across gender. We show that a year of delaying retirement increases mortality more for men than women. In particular, a one-year delay in the age at which men exit the labor market increases by 8.2 percentage points ($\sim$ 69%) the probability of dying between the ages of 60 and 69. The same delay for women increases mortality by 1.8 percentage points ($\sim$ 46%). Factors influencing gender differences in mortality include biological factors (genetics and hormones) and behavioral and environmental factors. One behavioral factor that explains part of the mortality gender gap is that women and men select different occupations. Therefore, the differential effect of delaying retirement on mortality by gender may be partly driven by men and women selecting occupations and sectors with different degrees of health burden (DeLeire and Levy, 2001).

A reduction in the duration of claiming a pension is composed of two factors: delayed claiming a pension and earlier death. While the welfare impact of delayed labor market exit can be positive, earlier death is harmful. Table 6 shows that individuals with strenuous employment (both physically and psychosocially), low-self-value, and who work in blue-collar jobs experience a greater increase in mortality between the ages of 60 and 69 due to the reform. In comparison, the reform impact on the individual's age at last employment is relatively similar between the different subgroups. If anything, individuals with better jobs delay their exit from the workplace for a longer period. This comparison implies that the mortality impact plays an important role in explaining the shortened pension claiming duration for workers with worse working conditions. One possible policy recommendation would be to consider reforms that link retirement age to changes in life expectancy. It might be worthwhile to consider a target retirement age based on the years a person is expected to claim a pension rather than a uniform nationwide retirement age.

9 Conclusion

This paper studies the effect of delaying retirement on mortality. We exploit the 1967 Spanish reform that removed access to voluntary early retirement for individuals who had not contributed since that year. Individuals who started contributing to the pension system before 1 January 1967 maintained the right to retire early at the age of 60. However, individuals who have not contributed by that date can only retire voluntarily at the statutory retirement age of 65 (although, under certain circumstances, some individuals can involuntarily retire early at the age of 61).

Focusing on cohorts born between 1938 and 1949, we use Spanish administrative Social Security data and compare individuals who started contributing 12 months before and after 1 January 1967. We first show the reform effect on labor supply outcomes using a within-cohort OLS regression controlling for gender and individuals' employment history between the ages of 30 and 40. We find that individuals who started contributing after 1967 delayed their labor market exit by almost half a year. The reform not only modified the age at last employment but also changed the age of claiming a pension and the types of pensions claimed. We find a decrease in the probability of claiming a regular pension by 19%, an increase in the probability of claiming a partial pension by 54%, and an increase in the probability of claiming disability insurance by 19%. This indicates that individuals did not fully comply with the rise in the statutory retirement age and utilized other ways to leave the labor market before claiming a regular pension. Moreover, the results suggest that treated individuals are more likely to claim no pension, driven mainly by premature death.

Furthermore, we estimate the effect of age at last employment on mortality using the instrumental variable method. We find that delaying labor market exit by one year increases the hazard of dying between the ages of 60 and 69 by 4.4 percentage points (44%). The mortality responses are the

strongest between the ages of 60 and 64 (67%) when public pensions are no longer accessible for individuals who started contributing after 1967. This suggests that the effect of delaying retirement on mortality is driven mainly by the immediate effect of losing access to early retirement schemes.

We explore several mechanisms to explain the detrimental effects of delaying retirement on health. First, we show that individuals' workplace conditions before retirement are an essential factor. Moreover, we show that allowing workers to gradually reduce their working time towards the end of their careers and making partial retirement an option can incentivize workers to stay longer in the labor force without negatively affecting their health.

The applicability and relevance of our findings extend further than the Spanish setting. Delaying statutory retirement and closing early retirement options is a pertinent policy agenda in many countries. However, the existing empirical evidence on the mortality effects of retirement rests almost exclusively on the estimates of policy experiments that have allowed for earlier retirement. Given that it is unclear if there is a symmetry impact of advancing or delaying retirement age, our findings on the mortality effect of delaying retirement are particularly relevant.

Additionally, the heterogeneous mortality impacts of delaying retirement raise discussions on the distributional consequences of raising the statutory retirement age. We find that individuals who have high physically and/or psychosocially burdensome jobs are those who suffer the most from a delay in retirement. Furthermore, the reform has a more substantial effect on individuals in jobs where they feel they have achieved less and received less recognition for their contributions. Combining the results on partial retirement, our findings suggest that it is crucial to provide options for gradual and flexible retirement while raising the age of statutory retirement.

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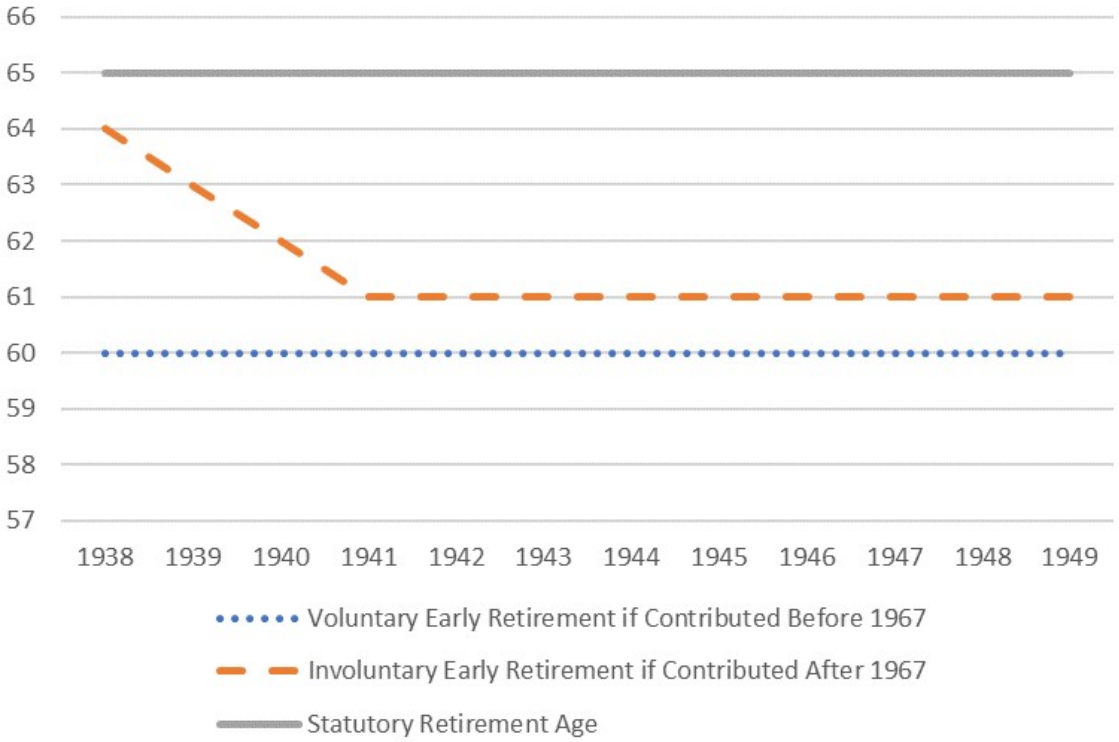
10 Figures and Tables

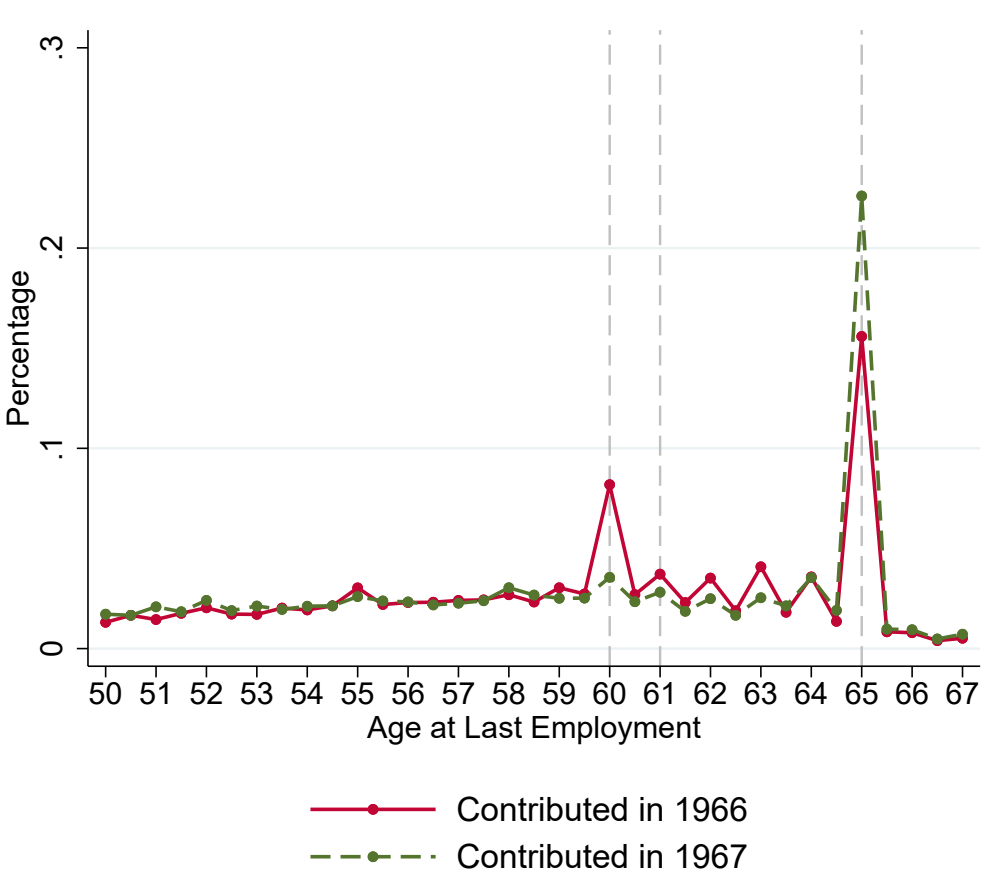
Figure 1: Retirement Age by First Year of Contribution and Cohort



Source: Authors' own construction according to the pension laws.

Notes: This figure plots the statutory retirement age and the earliest possible early retirement age for individuals that contributed before and after 1 January 1967 as a function of their birth year. The blue line shows that individuals who start contributing before 1 January 1967 can voluntarily retire after age 60, independently of their birth year. The orange line shows that those who start contributing after 1967 can only involuntary retire after 64 to 61, depending on their birth year. The grey line shows that the statutory retirement age remains at age 65 for all cohorts independently from the moment they started contributing.

Figure 2: Density of Age at Last Employment by Treatment Status



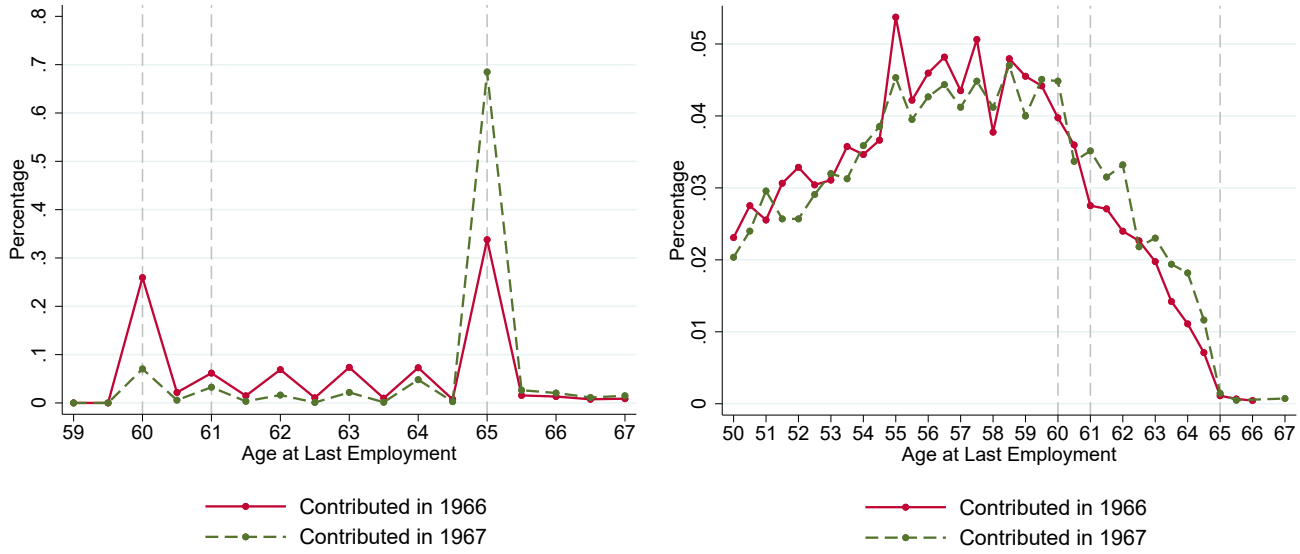
Source: MCVL, cohorts 1938-1949.

Notes: This figure plots the percentage of individuals by the age at which they finished their last employment. The solid red line shows the density for individuals who started contributing in 1966, while the green dashed line shows those who started contributing in 1967.

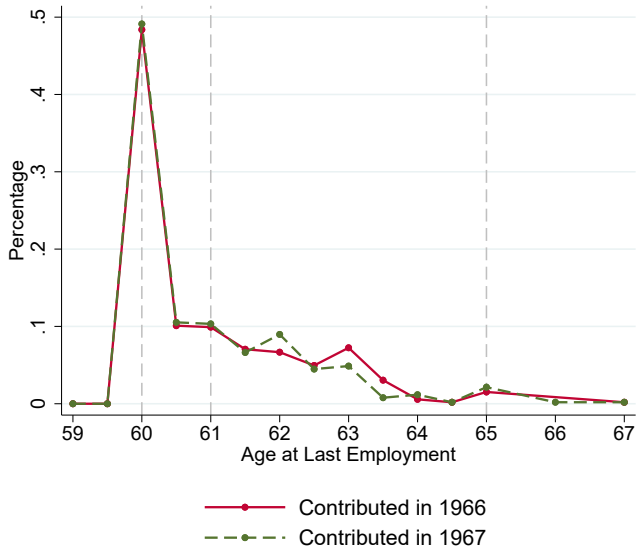
Figure 3: Density of Pension Ages by Treatment Status

(a) Age at Regular Pension

(b) Age at Disability Pension



(c) Age at Partial Pension

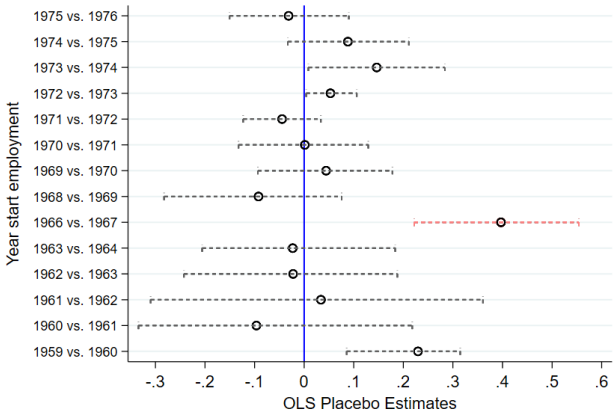


Source: MCVL, cohorts 1938-1949.

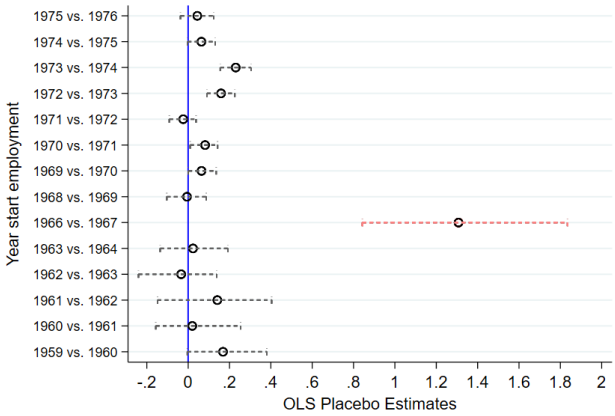
Notes: This figure plots the percentage of individuals by the age at claiming regular pension (Graph a), age at claiming disability pension (Graph b), and age at claiming partial pension (Graph c). The solid red lines show the density for individuals who started contributing in 1966, while the green dashed lines show those who started contributing in 1967.

Figure 4: Placebo Tests: Using Other Cutoffs

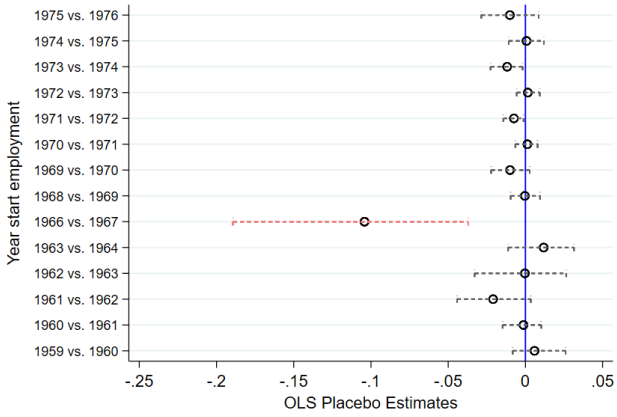
(a) Age at last employment



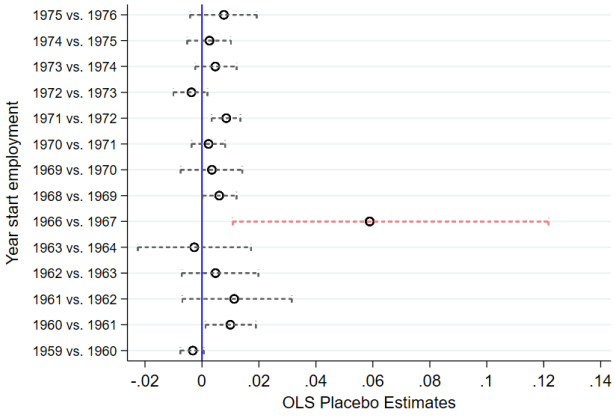
(b) Age at claiming regular pension



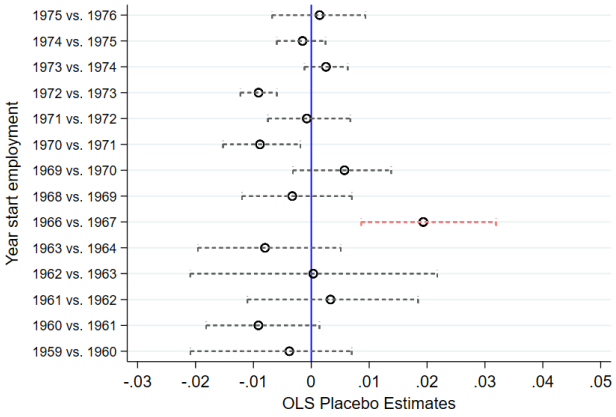
(c) Probability of claiming regular pension



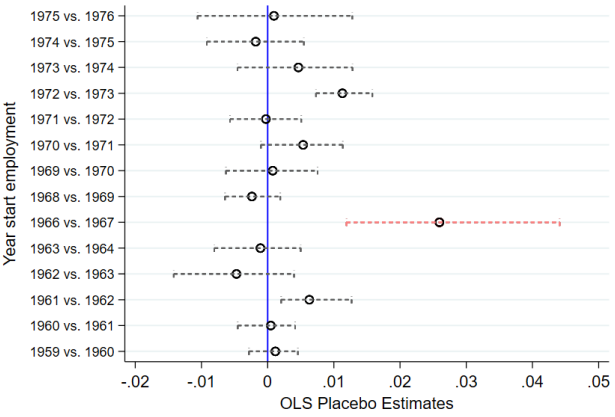
(d) Probability of claiming disability pension



(e) Probability of claiming partial pension



(f) Probability of not claiming any pension

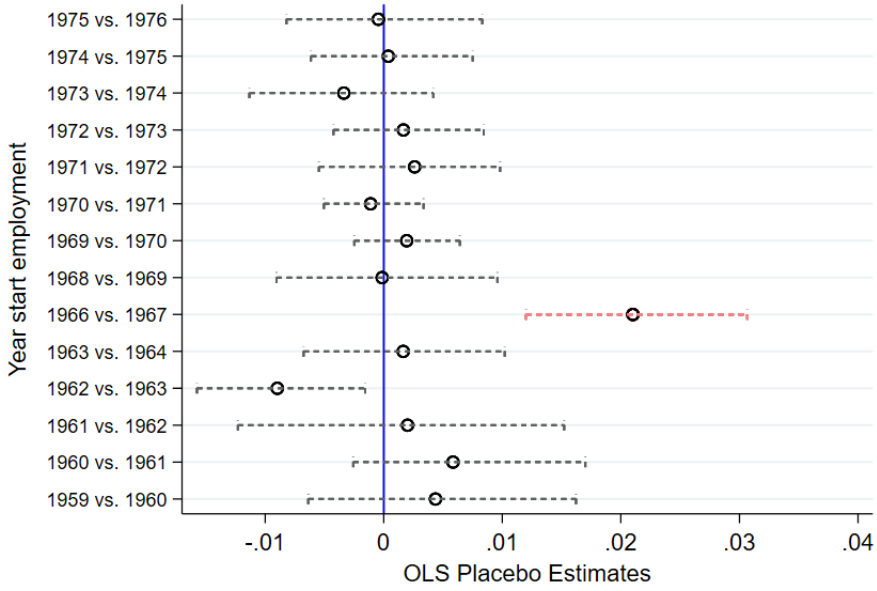


Source: MCVL, cohorts 1938-1949.

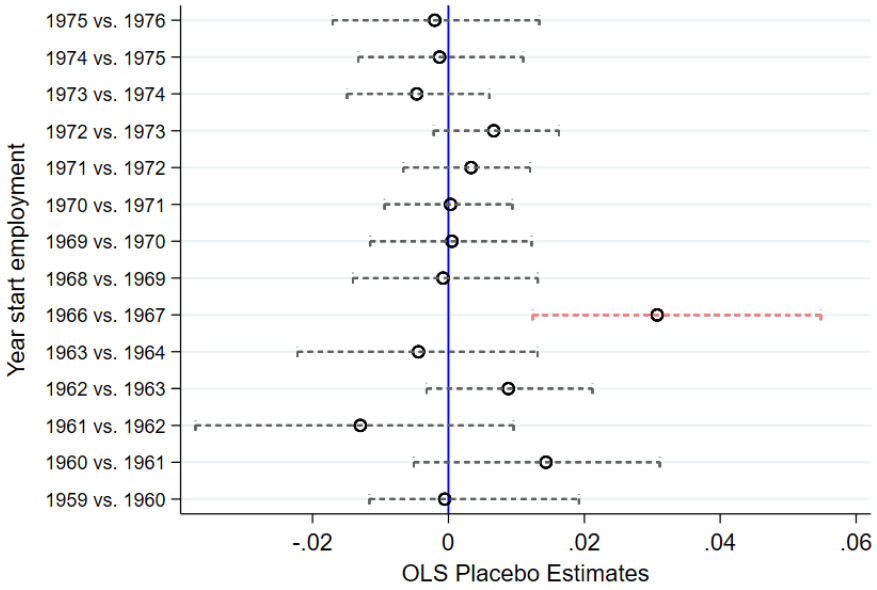
Notes: This figure shows the estimates and the 95 percent confidence intervals of a list of placebos, estimating regression 1 comparing individuals that starting contributing in the years of the y-axis. The red estimate corresponds to the estimation of the regression 1 on the real cutoff: 1966 vs.1967. The outcomes considered are displayed on top of each figure.

Figure 5: Placebo Tests for Mortality: Using Other Cutoffs

(a) Dying between 60 and 69 years old



(b) Dying between 50 and 86 years old



Source: MCVL, cohorts 1938-1949.

*Notes:*This figure shows the estimates and the 95 percent confidence intervals of a list of placebos, estimating regression 1 comparing individuals that starting contributing in the years of the y-axis. The red estimate corresponds to the estimation of the regression 1 on the real cutoff: 1966 vs.1967. The outcomes considered are displayed on top of each figure.

Table 1: Impact of the Reform on the Type of Pension

	First Pension Claimed			
	Regular pension	Partial Pension	Disability insurance	No Pension
Contributed in 1967	-0.104***	0.019***	0.059**	0.026***
	(0.032)	(0.005)	(0.024)	(0.007)
	[0.006]	[0.002]	[0.028]	[0.003]
Month-Year Birth FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764
R^2	0.140	0.067	0.091	0.054
Mean Dep. (Treated)	0.394	0.048	0.390	0.168
Mean Dep. (Control)	0.531	0.035	0.297	0.137

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labour market through regular pension (Column 1), partial pension (Column 2), disability pension (Column 3), and not claiming any pension (Column 4), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table 2: Impact of the Reform on the Age at Claiming Pension

	Age of the Individual at				
	Last Employment	First Pension	Regular Pension	Disability Pension	Partial Pension
Contributed in 1967	0.397***	0.263**	1.307***	0.288**	-0.158***
	(0.071)	(0.106)	(0.210)	(0.066)	(0.053)
	[0.003]	[0.046]	[0.001]	[0.023]	[0.006]
Month-Year Birth FE	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓
Observations	25,764	21,901	12,233	8,630	1,038
R^2	0.085	0.105	0.221	0.035	0.245
Mean Dep. (Treated)	59.830	61.020	64.636	57.350	61.097
Mean Dep. (Control)	59.386	60.875	63.032	56.986	61.131

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the age at last employment (Column 1), at claiming first pension (any type) (Column 2), regular pension (Column 3), disability pension (Column 4), and partial pension (Column 5), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table 3: Impact of the Reform on Pension Benefit

	Pension Benefit	Base Pension	Percent of Base Pension
Contributed in 1967	42.561***	18.016**	5.003***
	(11.409)	(7.042)	(1.013)
	[0.005]	[0.037]	[0.001]
Month-Year Birth FE	✓	✓	✓
Controls	✓	✓	✓
Contributed 1966-1967	✓	✓	✓
Observations	21,901	21,901	21,900
R^2	0.379	0.412	0.155
Mean Dep. (Treated)	1174.506	1200.635	86.132
Mean Dep. (Control)	1088.891	1148.447	78.866

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on monthly pension benefit (Column 1), pension base (Column 2), and pension adjustment factor (Column 3), obtained from the estimation of regression 1 for those individuals in our sample that claim any pension. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table 4: Impact of Age at Last Employment on Mortality

	Probability of Dying between the Ages					
	50-86	50-59	60-69	70-79	80-86	Age at Death Censored 71
OLS:						
Impact of Age at Last Employment	-0.013***	-0.012***	-0.004***	-0.003***	-0.000	0.210***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.016)
	[0.001]	[0.001]	[0.001]	[0.001]	[0.728]	[0.001]
Reduced Form:						
Contributed in 1967	0.031***	0.010	0.021***	0.002	0.004*	-0.311***
	(0.009)	(0.006)	(0.004)	(0.007)	(0.002)	(0.092)
	[0.002]	[0.101]	[0.001]	[0.770]	[0.056]	[0.001]
IV:						
Impact of Age at Last Employment	0.078**	0.026	0.044***	0.004	0.006**	-0.787**
	(0.032)	(0.016)	(0.010)	(0.012)	(0.003)	(0.289)
	[0.021]	[0.146]	[0.004]	[0.767]	[0.029]	[0.016]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓
Observations	25,764	25,764	23,848	20,877	17,398	25,764
Mean Dep. (Treated)	0.371	0.086	0.132	0.185	0.036	68.847
Mean Dep. (Control)	0.298	0.066	0.099	0.155	0.023	69.377
F-stat FS	36.818	36.818	67.340	64.819	70.044	36.818

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 50-86 (Column 1), 50-59 (Column 2), 60-69 (Column 3), 70-79 (Column 4), and 80-86 (Column 5). Column 6 reports the impact of age at last employment on age at death censored at 71 years old. The first panel reports the correlation of age at last employment on mortality (OLS), and the second panel shows the effect of the reform on mortality (reduced form effect using regression 1). The IV estimates, obtained from the estimation of regression 2, are reported in the third panel. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for a proxy of the pension base. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

Table 5: Impact of Age at Last Employment on Mortality at Five-year Intervals

	Probability of Dying between the Ages							
	50-86	50-54	55-59	60-64	65-69	70-74	75-79	80-86
OLS:								
Impact of Age at Last Employment	-0.013***	-0.007***	-0.006***	-0.002***	-0.002***	-0.002***	-0.002***	-0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]	[0.728]
Reduced Form:								
Contributed in 1967	0.031***	0.003	0.007	0.019***	0.007**	0.001	0.001	0.004*
	(0.009)	(0.002)	(0.005)	(0.004)	(0.002)	(0.006)	(0.005)	(0.002)
	[0.002]	[0.146]	[0.169]	[0.004]	[0.013]	[0.883]	[0.835]	[0.056]
IV:								
Impact of Age at Last Employment	0.078**	0.009	0.016	0.039***	0.013**	0.002	0.002	0.006**
	(0.032)	(0.006)	(0.011)	(0.009)	(0.006)	(0.010)	(0.008)	(0.003)
	[0.021]	[0.183]	[0.199]	[0.004]	[0.046]	[0.877]	[0.838]	[0.029]
Observations	25,764	25,764	25,084	23,848	22,245	20,877	19,050	17,398
Mean Dep. (Treated)	0.371	0.030	0.057	0.083	0.069	0.095	0.100	0.036
Mean Dep. (Control)	0.298	0.024	0.044	0.056	0.056	0.083	0.078	0.023
F-stat FS	36.818	36.818	46.028	67.340	61.569	64.819	66.596	70.044

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 50-86 (Column 1), 50-54 (Column 2), 55-59 (Column 3),60-64 (Column 4), 65-69 (Column 5), 70-74 (Column 6), 75-79 (Column 7), and 80-86 (Column 8). The first panel reports the correlation of age at last employment on mortality (OLS), and the second panel shows the effect of the reform on mortality (reduced form effect using regression 1). The IV estimates, obtained from the estimation of regression 2, are reported in the third panel. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for the proxy of the pension base. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table 6: Impact on Mortality by Labour Market Conditions Before Retirement

	Last Industry						Last Occupation	
	Workplace Accidents		Psychosocial Exposure		Self-value		Blue-collar	
	High	Low	High	Low	High	Low	No	Yes
	Age at Last Employment							
First Stage:	0.414***	0.751***	0.456***	0.657***	0.922***	0.417***	0.593***	0.439***
Contributed in 1967	(0.094)	(0.129)	(0.105)	(0.126)	(0.206)	(0.092)	(0.073)	(0.095)
	[0.003]	[0.001]	[0.003]	[0.002]	[0.002]	[0.001]	[0.001]	[0.005]
	Probability of Dying between 60 and 69							
Reduced Form:	0.033***	0.010	0.027***	0.018**	0.011	0.027***	0.016**	0.024***
Contributed in 1967	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.005)
	[0.004]	[0.152]	[0.002]	[0.029]	[0.136]	[0.003]	[0.040]	[0.001]
IV:	0.083**	0.013	0.060***	0.029**	0.013	0.065***	0.028**	0.055***
Impact of Age at Last Employment	(0.029)	(0.008)	(0.017)	(0.012)	(0.009)	(0.019)	(0.012)	(0.017)
	[0.023]	[0.130]	[0.001]	[0.025]	[0.163]	[0.008]	[0.037]	[0.010]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓	✓
Observations	10,718	10,118	10,542	10,294	5,973	14,863	8,058	15,929
Mean Dep. (Treated)	0.153	0.119	0.148	0.126	0.113	0.147	0.129	0.133
Mean Dep. (Control)	0.108	0.097	0.105	0.100	0.095	0.106	0.103	0.096
F-stat FS	20.623	41.700	20.675	23.400	18.631	22.494	63.812	23.831
P-value Difference (IV Est.)	0.026		0.135		0.017		0.198	

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 60-and 69 by the labour market conditions experienced by the individual just before retirement. Individual's last industry is classified depending on their workplace accident incidence for our cohorts between 2003 and 2019 (Columns 1 and 2), by the psychosocial exposure (mental stress, social stress, and temporal load) following Kroll (2011) (Columns 3 and 4), and by their self-value index (sense of achievement and recognition) constructed using O*NET (Columns 5 and 6). We also differentiate if individuals' last occupation pertains to a white or a blue-collar occupation (Columns 7 and 8). The first panel reports the first stage of the IV estimation (the reform's effect on the age at last employment, using 1). The second panel shows the second stage; the effect on the probability of dying between 60 and 69 years old. First, we report the reduced form effect of the reform on mortality using regression 1. After that, we report the IV estimates obtained from the estimation of regression 2. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for a proxy of the pension base. At the bottom, we report the First Stage F-statistic and the p-value of the differences between groups in the IV estimation. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table 7: Impact on Mortality by Availability of Flexible Retirement

	More 33 Years of Contribution	Less 33 Years of Contribution
	Partial Retirement	
Contributed in 1967	0.046***	0.003*
	(0.011)	(0.002)
	[0.005]	[0.068]
	Age at Last Employment	
First Stage:	0.821***	0.322***
Contributed in 1967	(0.148)	(0.081)
	[0.004]	[0.009]
	Probability of Dying between 60 and 69	
Reduced Form:	0.017**	0.022***
Contributed in 1967	(0.007)	(0.004)
	[0.018]	[0.005]
IV:	0.020***	0.068**
Impact of Age at Last Employment	(0.008)	(0.022)
	[0.012]	[0.013]
Month-Year Birth FE	✓	✓
Controls	✓	✓
Contributed 1966-1967	✓	✓
Observations	11,679	12,169
Mean Dep. (Treated)	0.109	0.155
Mean Dep. (Control)	0.087	0.109
F-stat FS	30.492	15.546
P-value Difference (IV Est.)	0.047	

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 60-and 69 for individuals with less (Column 1) or more than 33 years of contribution (Column 2). Only individuals with more than 33 years of contribution when claiming a pension can access the partial retirement scheme. The first panel reports the reform's effect on the probability of claiming a partial pension, using 1). The second panel reports the first stage of the IV estimation (the reform's effect on the age at last employment, using 1). The third panel shows the second stage; the effect on the probability of dying between 60 and 69 years old. First, we report the reduced form effect of the reform on mortality using regression 1. After that, we report the IV estimates obtained from the estimation of regression 2. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for a proxy of the pension base. At the bottom, we report the First Stage F-statistic and the p-value of the differences between groups in the IV estimation. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Online Appendix

The Effect of Removing Early Retirement on Mortality

Cristina Bellés-Obrero
University of Mannheim, IZA

Sergi Jiménez-Martín
Universitat Pompeu Fabra, FEDEA

Han Ye
University of Mannheim, IZA, ZEW

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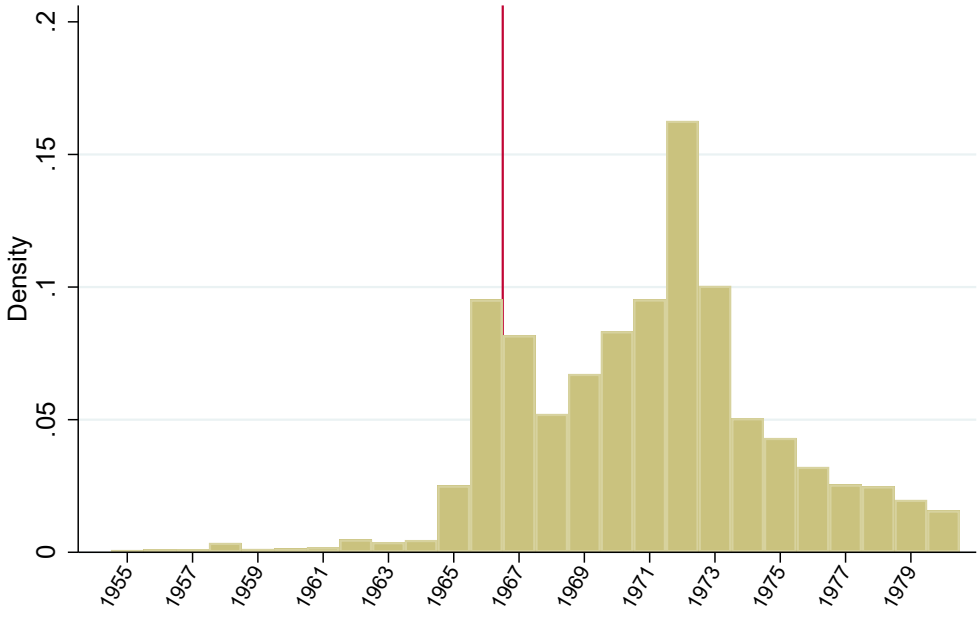
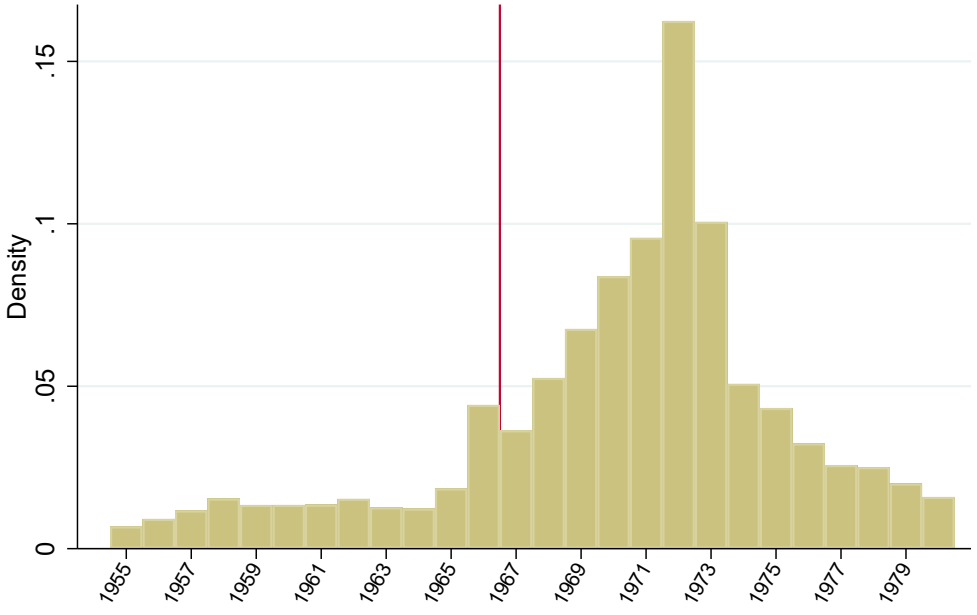
A Appendix Tables and Figures

Figure A1: Correction of Year Started Contributing



(a) Without Correction



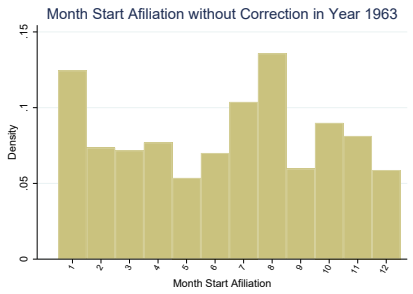
(b) With Correction

Source: MCVL, cohorts 1938-1949.

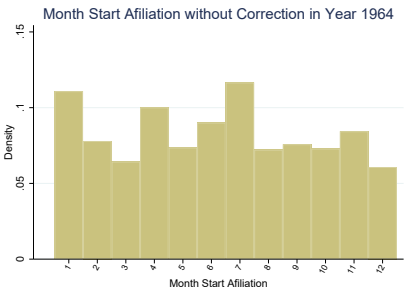
Notes: This figure plots the density of date started contributing without correction (Graph a) and with correction (Graph b). The correction uses the number of years of contribution and the date starting a regular or partial pension (years of contribution are not available for individuals that claim a disability pension) to correct for the date of starting contributing for those whose year of started contributing was between 1965 and 1967.

Figure A2: Distribution of month started contribution by year

(a) 1963

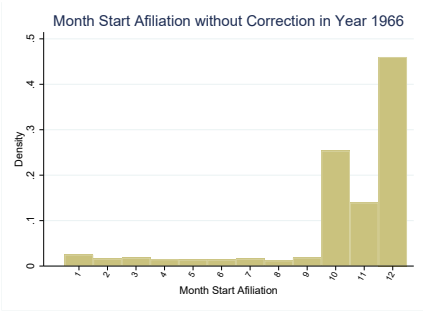


(b) 1964

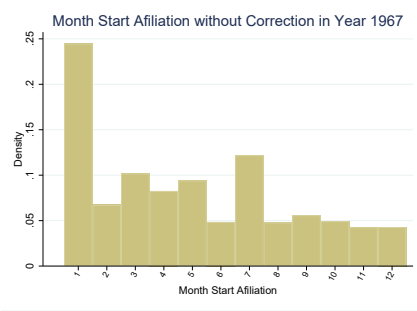


(c) 1965

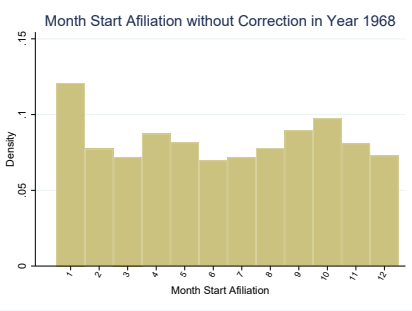
(d) 1966



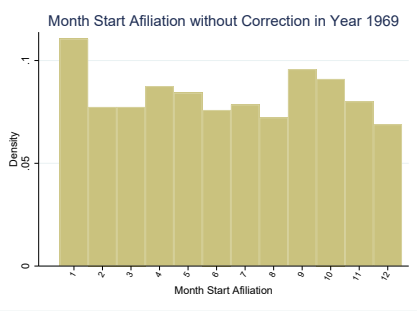
(e) 1967



(f) 1968



(g) 1969



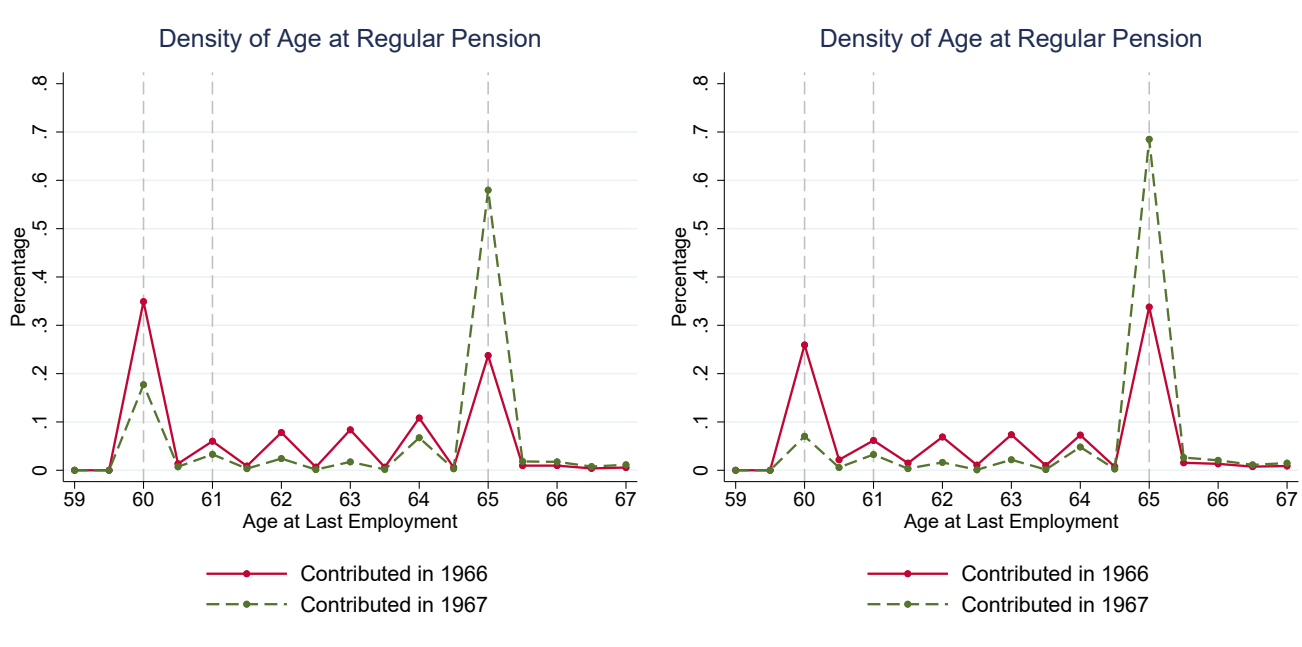
Source: MCVL, cohorts 1938-1949.

Notes: These figures plot the distribution of individuals by the month they started contributing to the Social Security system for years 1963 to 1969.

Figure A3: Density of Age at Regular Pension by Treatment Status with and without Correcting Age at First Contribution

(a) Age at Regular Pension, without Correction

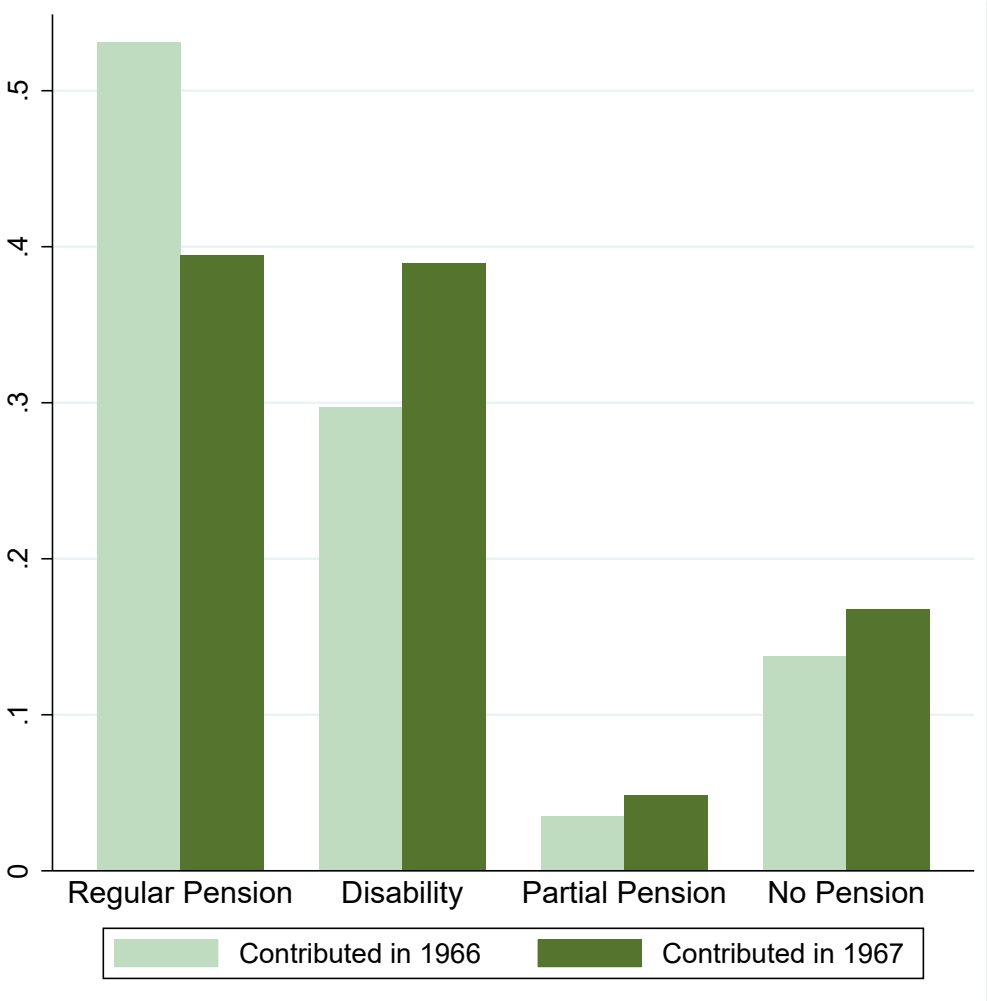
(b) Age at Regular Pension, with Correction



Source: MCVL, cohorts 1938-1949.

Notes: This figure plots the percentage of individuals by the age at claiming regular pension without correcting for age start contributing (graph a), and with correcting for age start contributing (graph b). The solid red lines show the density of individuals who started contributing in 1966, while the green dashed lines show those who started contributing in 1967.

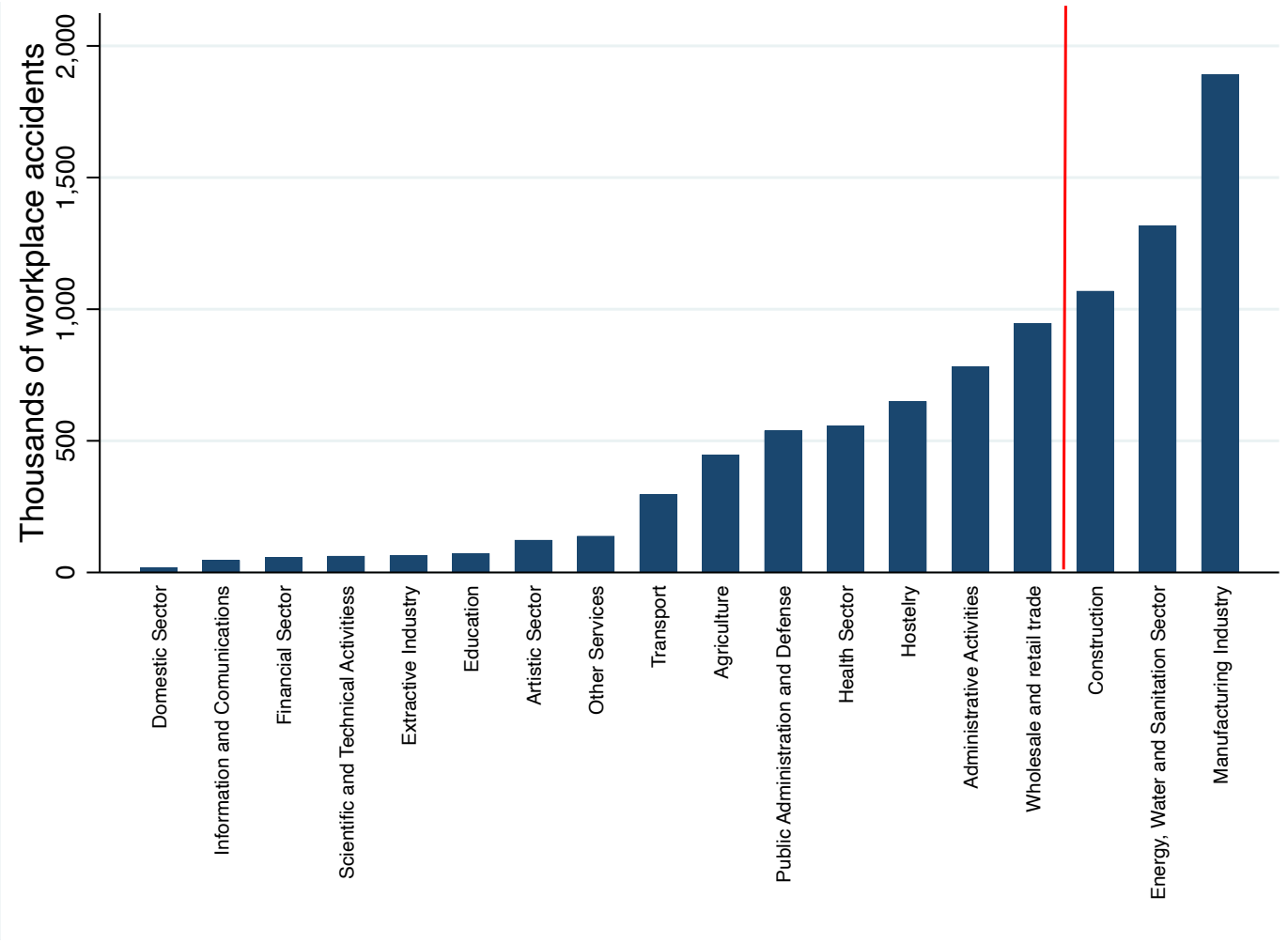
Figure A4: Types of Pension by Treatment Status



Source: MCVL, cohorts 1938-1949.

Notes: This figure plots the percentage of individuals by the different types of pension claimed (regular pension, disability insurance, partial pension, or no pension). The light green bars show the density for individuals that started contributing in 1966, while the dark green bars show the density for those who started contributing in 1967.

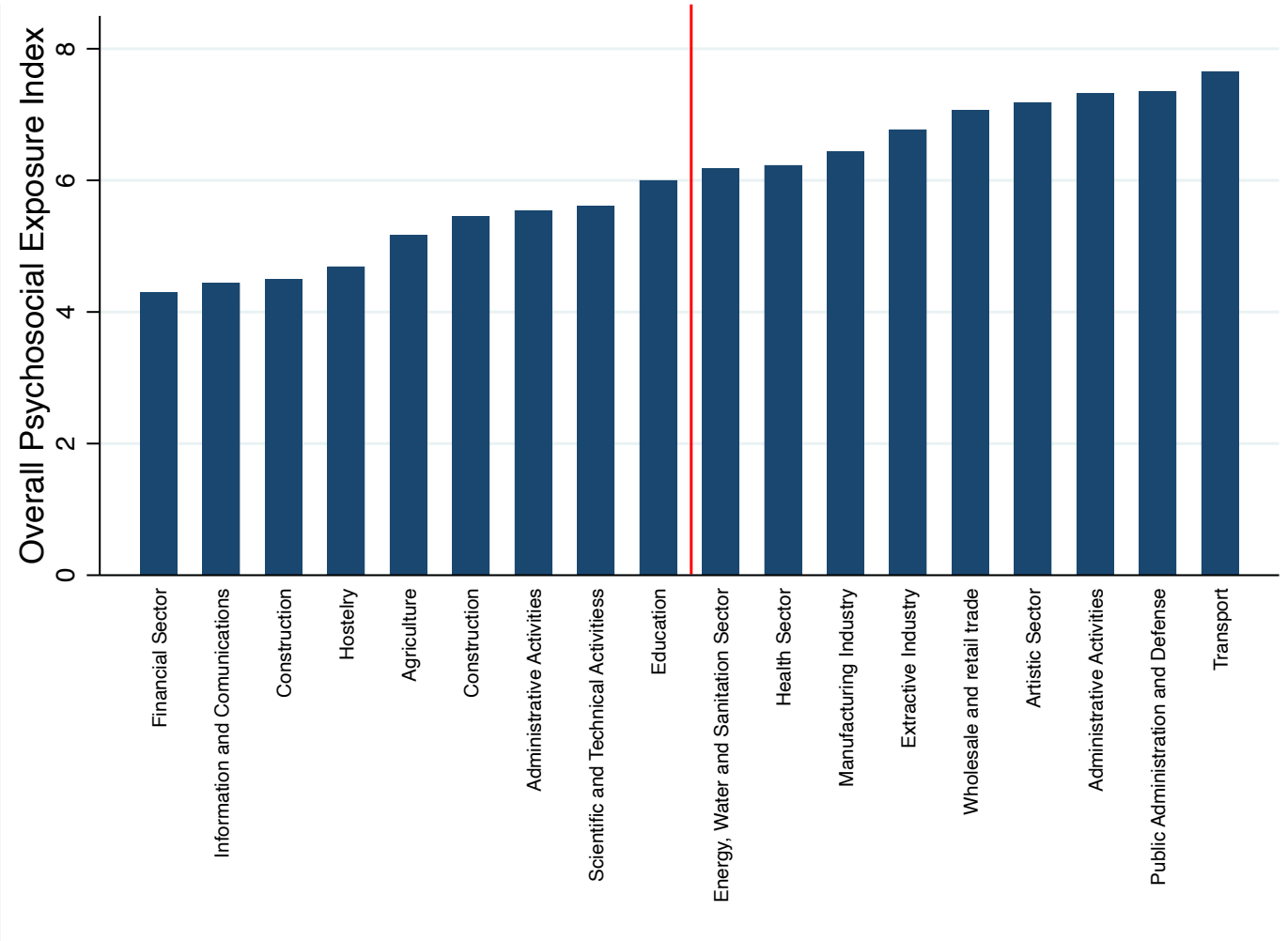
Figure A5: Classification of Industries by Incidence of Workplace Accidents



Source: Register of Workplace Accidents 2003-2019, cohorts 1938-1949.

Notes: This figure plots the total number of workplace accidents between 2003 and 2019 for workers born between 1938 and 1949 in the industry sector the workers were working at the moment of the accident.

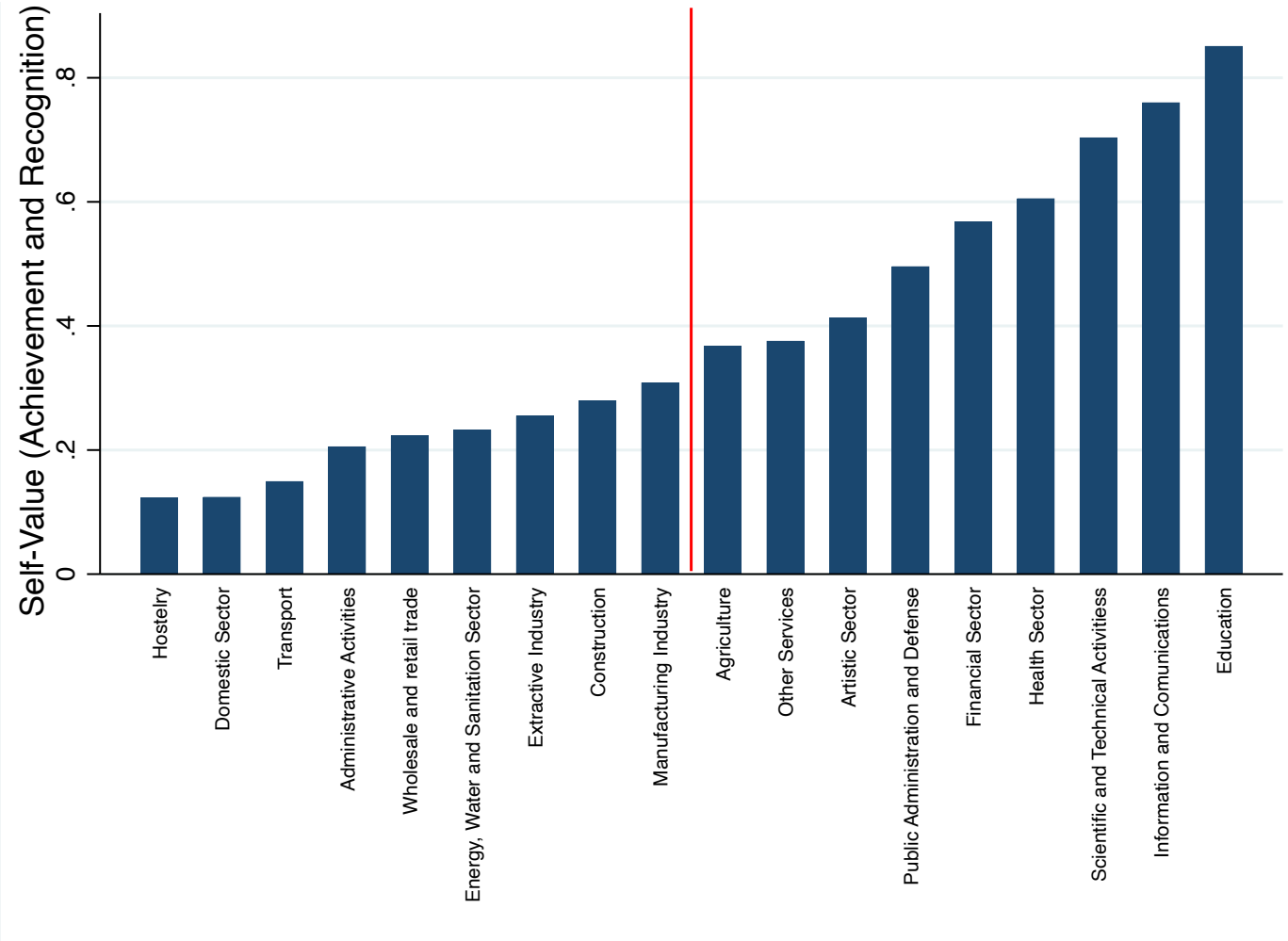
Figure A6: Classification of Industries by Psychosocial Exposure



Source: MCVL, cohorts 1938-1949.

Notes: This figure plots the different industry sectors classified by the degree of psychosocial pressure (mental, social stress, and temporal load) individuals working in these sectors are exposed to. We follow Kroll (2011) for the definition of psychosocial exposure.

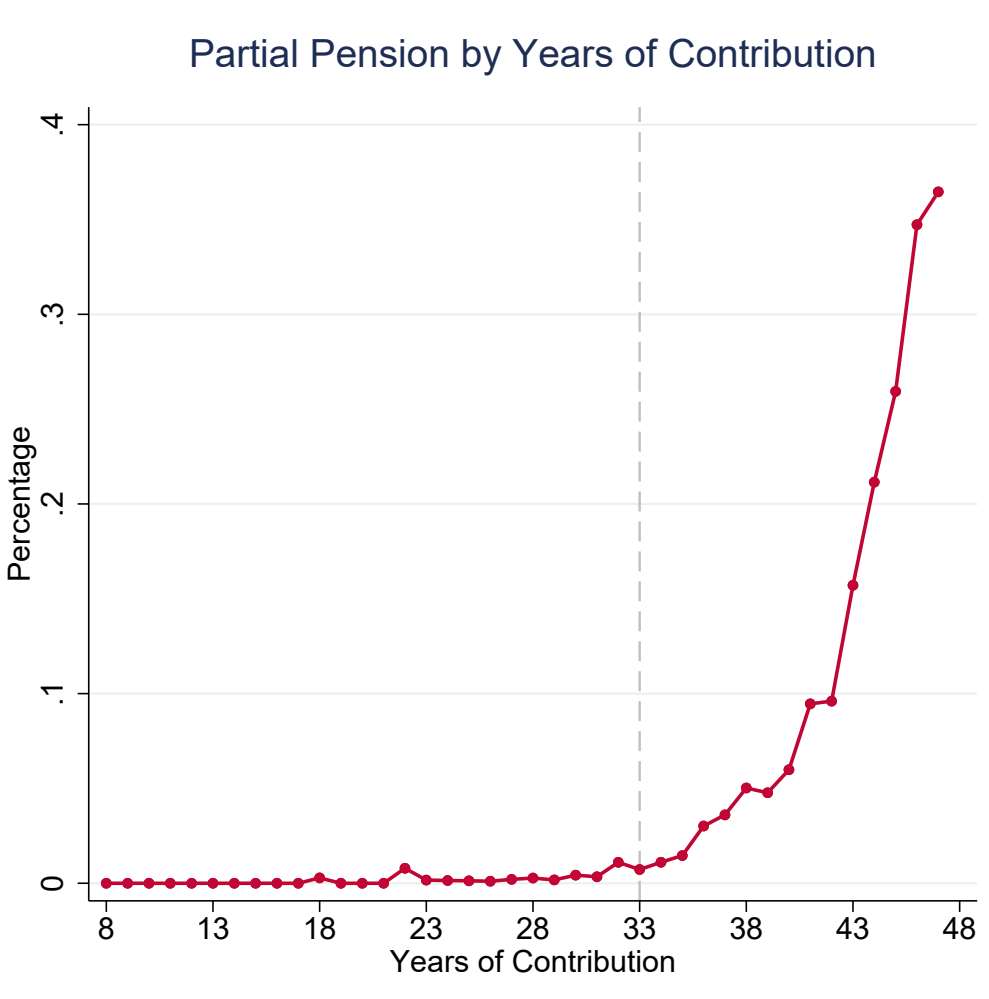
Figure A7: Classification of Industries by Self-value Index



Source: MCVL, cohorts 1938-1949.

Notes: This figure plots the different industry sectors classified by the degree of self-value (sense of achievement and recognition) that individuals working in these sectors are exposed to. We follow the O*NET for the definition of the self-value index.

Figure A8: Probability of Claiming Partial Pension by Years of Contribution



Source: MCVL, cohorts 1938-1949.

Notes: This figure plots the percentage of individuals that claim partial pension depending on the number of years of contribution.

Table A1: Sample Selection

	Sample Selection	
	Observations Dropped	Mortality 60-69 in Obs Dropped
Contributed in 1967	-0.006	0.018
	(0.012)	(0.011)
	[0.653]	[0.141]
Month-Year Birth FE	✓	✓
Controls	✓	✓
Contributed 1966-1967	✓	✓
Observations	32,361	5,233
R^2	0.033	0.034
Mean Dep. (Treated)	0.194	0.129
Mean Dep. (Control)	0.210	0.095

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of not being in the main sample due to having stopped contributing to the Social Security system before age 50, having claimed a disability pension before 50, not having at least 8 years of contribution, or having claimed the residual SOVI pension (Column 1). Column 2 reports the effect of the reform on mortality between the age 60 and 69 for the sample of individuals dropped from the main sample, obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. All standard errors are clustered at the birth year level, and wild-bootstrap p-values are reported in brackets.

Table A2: Smoothness of the Covariates

	Labor Market between the Ages of 30 and 40				
	Fraction active	Fraction employed	Blue-collar occ	Av. monthly contribution	Fraction selfemployed
Contributed in 1967	0.175	0.632	-0.006	29.172	2.620***
	(0.315)	(0.474)	(0.009)	(16.476)	(0.549)
	[0.609]	[0.251]	[0.521]	[0.113]	[0.003]
Month-Year Birth FE	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764
R^2	0.171	0.195	0.063	0.245	0.006

	Industry between the Ages of 30 and 40					
	Agriculture Minery Construction	Manufacturing	Trade Transportation	Public Health Education	Science Administrative	Services Hostelry Housekeeping
Contributed in 1967	0.002	-0.004	-0.002	-0.006	-0.000	0.000
	(0.007)	(0.002)	(0.002)	(0.007)	(0.001)	(0.003)
	[0.763]	[0.137]	[0.413]	[0.353]	[0.820]	[0.910]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764	25,764
R^2	0.045	0.012	0.008	0.044	0.004	0.004

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on a list of predetermined variables: fraction of time spent active (Column 1), the fraction of time spent employed (Column 2), probability of having been employed in a blue-collar occupation (Column 3), average monthly contribution (Column 4), the fraction of time self-employed (Column 5), and probability of being employed in the agriculture, minery or construction sectors (Column 6), manufacturing sector (Column 7), trade or transportation sectors (Column 8), public, health or educational sectors (Column 9), scientific or administrative sectors (Column 10), or services, hostelry or housekeeping sectors (Column 11). The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. All standard errors are clustered at the birth year level, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A3: Descriptive Statistics

Dependent Variables	N	Mean	SD	Min	Max
Regular Pension	25,764	0.47	0.49	0	1
Partial Pension	25,764	0.04	0.19	0	1
Disability Pension	25,764	0.33	0.47	0	1
No Pension	25,764	0.14	0.35	0	1
Age Last Employment	25,764	59.56	5.39	18.75	82.91
Age First Pension	21,901	60.93	4.26	50	79.41
Age Regular Pension	12,233	63.57	2.29	60	74
Age Disability Pension	8,630	57.16	3.76	50	79.41
Age Partial Pension	1,038	61.11	1.33	60	70.08
Dying 50-86 y.o.	25,764	0.32	0.46	0	1
Dying 50-59 y.o.	25,764	0.07	0.26	0	1
Dying 60-69 y.o.	23,848	0.11	0.31	0	1
Dying 70-79 y.o.	20,877	0.16	0.37	0	1
Dying 80-86 y.o.	17,398	0.02	0.16	0	1

Source: MCVL, cohorts 1938-1949.

Notes: This table reports summary statistics for the main outcome variables. The sample corresponds to individuals born between 1938 and 1949, registered in the Social Security (contributive workers and pensioners) at any point of their lives till 2020. We further restrict the same to individuals contributing to the Social Security system at age 50 with at least 8 years of employment.

Table A4: Impact of the Reform on the Type of Disability

	Type of Disability	
	Severe or Absolute	Partial or Professional
Contributed in 1967	0.032**	0.027*
	(0.011)	(0.013)
	[0.011]	[0.064]
Month-Year Birth FE	✓	✓
Controls	✓	✓
Contributed 1966-1967	✓	✓
Observations	25,764	25,764
R^2	0.040	0.051
Mean Dep. (Treated)	0.181	0.209
Mean Dep. (Control)	0.134	0.163

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of claiming absolute or severe disability (Column 1) and partial or professional disability (Column 2), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A5: Impact of the Reform on Reason for No Pension

		Reason for No Pension		
	No Pension	Still Working	Became Inactive	Died before Pension
Contributed in 1967	0.026***	0.002*	0.007	0.017***
	(0.007)	(0.001)	(0.005)	(0.005)
	[0.003]	[0.090]	[0.125]	[0.006]
Month-Year Birth FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764
R^2	0.054	0.008	0.080	0.031
Mean Dep. (Treated)	0.168	0.004	0.066	0.098
Mean Dep. (Control)	0.137	0.003	0.064	0.070

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labour market without claiming any pension (Column 1), continuing working (Column 2), becoming inactive (Column 3), and dying before claiming a pension (Column 4), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A6: Impact of the Reform on Age at Last Employment (in Brackets)

	Last Employment at Age								
	50-54	55-59	60	61	62	63	64	65	After 65
Contributed in 1967	0.011	-0.011*	-0.041***	-0.011**	-0.011**	-0.010***	0.006**	0.068***	0.016***
	(0.008)	(0.005)	(0.013)	(0.005)	(0.004)	(0.003)	(0.002)	(0.012)	(0.004)
	[0.192]	[0.068]	[0.009]	[0.029]	[0.012]	[0.006]	[0.017]	[0.001]	[0.004]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764	25,764	25,764	25,764	25,764
R^2	0.033	0.041	0.020	0.007	0.007	0.011	0.009	0.077	0.050
Mean Dep. (Treated)	0.199	0.249	0.059	0.047	0.042	0.047	0.054	0.236	0.085
Mean Dep. (Control)	0.177	0.255	0.109	0.060	0.054	0.059	0.049	0.164	0.065

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labour market between the ages of 50-54 (Column 1), 55-59 (Column 2), at 60 (Column 3), at 61 (Column 4), at 62 (Column 5), at 63 (Column 6), at 64 (Column 7), at 65 (Column 8), and after age 65 (Column 9), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A7: Impact of the Reform on Age at Regular Pension (in Brackets)

	Regular Pension at Age						
	60	61	62	63	64	65	After 65
Contributed in 1967	-0.100***	-0.020***	-0.032***	-0.031***	-0.020***	0.092***	0.036***
	(0.025)	(0.005)	(0.005)	(0.006)	(0.005)	(0.014)	(0.008)
	[0.001]	[0.005]	[0.001]	[0.001]	[0.001]	[0.001]	[0.003]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764	25,764	25,764
R^2	0.089	0.029	0.023	0.027	0.019	0.106	0.140
Mean Dep. (Treated)	0.030	0.014	0.007	0.009	0.020	0.280	0.159
Mean Dep. (Control)	0.149	0.041	0.042	0.044	0.043	0.188	0.111

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of claiming a regular pension between the ages of 50-54 (Column 1), 55-59 (Column 2), at 60 (Column 3), at 61 (Column 4), at 62 (Column 5), at 63 (Column 6), at 64 (Column 7), at 65 (Column 8), and after age 65 (Column 9), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A8: Impact of the Reform on Age at Disability Pension (in Brackets)

	Disability at Age			
	50-54	55-59	60-64	After 65
Contributed in 1967	0.013	0.017	0.029***	0.000
	(0.009)	(0.012)	(0.005)	(0.000)
	[0.162]	[0.161]	[0.001]	[0.335]
Month-Year Birth FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764
R^2	0.026	0.045	0.017	0.005
Mean Dep. (Treated)	0.114	0.168	0.106	0.002
Mean Dep. (Control)	0.091	0.136	0.068	0.001

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of claiming a disability pension between the ages of 50-54 (Column 1), 55-59 (Column 2), 60-56 (Column 3), and after age 65 (Column 4), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A9: Impact of the Reform on Pension Benefit by Type of Pension

	Regular Pensions				Disability Pensions				Partial Pensions				No Pension
	Mean Benefit	Base Benefit	Perc Base	Proxy Base	Mean Benefit	Base Benefit	Perc Base	Proxy Base	Mean Benefit	Base Benefit	Perc Base	Proxy Base	Proxy Base
Contributed in 1967	73.353***	25.875**	9.221***	41.753**	-24.547**	-12.882	0.340	-30.795*	-4.953	-12.882	0.416	-38.564	-41.402
	(13.003)	(10.783)	(1.558)	(11.774)	(6.707)	(22.500)	(0.473)	(13.028)	(20.290)	(22.500)	(0.362)	(22.580)	(25.196)
	[0.001]	[0.048]	[0.001]	[0.014]	[0.012]	[0.581]	[0.529]	[0.063]	[0.791]	[0.581]	[0.296]	[0.117]	[0.159]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	12,233	12,233	12,232	12,367	8,630	1,038	8,630	8,630	1,038	1,038	1,038	1,038	3,863
R^2	0.362	0.386	0.311	0.355	0.378	0.496	0.043	0.467	0.476	0.496	0.280	0.387	0.485
Mean Dep. (Treated)	1049.106	1063.049	88.605	1089.888	1255.342	1852.118	84.176	1235.933	1545.399	1852.118	81.723	1684.927	1231.647
Mean Dep. (Control)	952.156	1029.814	75.750	1028.816	1280.379	1856.496	84.164	1277.680	1544.278	1856.496	81.199	1712.329	1186.478

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on monthly pension benefit (Columns 1, 5, and 9), pension base (Column 2, 6, and 10), the pension adjustment factor (Column 3, 7 and 11), and the proxy of the pension base (calculated using years of contribution for those individuals that claimed regular pension and total years of activity for the rest) by type of pension claimed by the individual, obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.
*** p<0.01, ** p<0.05, * p<0.1.

Table A10: Impact of the Reform on Labour Market Outcomes between the Ages of 45 and 55

	Labor Market between the Ages of 45 and 55				
	Fraction active	Fraction employed	Blue-collar occ	Av. monthly contribution	Fraction selfempoyed
Contributed in 1967	0.600**	2.055***	0.016***	3.760	-0.640
	(0.240)	(0.612)	(0.004)	(13.818)	(0.361)
	[0.035]	[0.004]	[0.010]	[0.796]	[0.104]
Year Birth FE	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764
R^2	0.113	0.128	0.412	0.434	0.304
Mean Dep. (Treated)	96.186	87.044	0.471	1162.989	17.722
Mean Dep. (Control)	93.362	82.020	0.438	1098.854	16.050

	Industry between the Ages of 45 and 55					
	Agriculture Minery Construction	Manufacturing	Trade Transportation	Public Health Education	Science Administrative	Services Hostelry Housekeeping
Contributed in 1967	0.001	0.001	-0.019***	-0.027**	-0.006*	-0.008**
	(0.005)	(0.004)	(0.004)	(0.009)	(0.003)	(0.003)
	[0.799]	[0.829]	[0.004]	[0.023]	[0.087]	[0.029]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764	25,764
R^2	0.249	0.078	0.046	0.094	0.042	0.068
Mean Dep. (Treated)	0.135	0.142	0.088	0.316	0.059	0.030
Mean Dep. (Control)	0.123	0.136	0.111	0.346	0.078	0.044

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on a list of labour market outcomes when the individual is between 45 and 55 years old: fraction of time spent active (Column 1), the fraction of time spent employed (Column 2), probability of having been employed in a blue-collar occupation (Column 3), average monthly contribution (Column 4), the fraction of time self-employed (Column 5), and probability of being employed in the agriculture, minery or construction sectors (Column 6), manufacturing sector (Column 7), trade or transportation sectors (Column 8), public, health or educational sectors (Column 9), scientific or administrative sectors (Column 10), or services, hostelry or housekeeping sectors (Column 11), obtained from the estimation of regression 1. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A11: Impact of Age at Last Employment on Mortality with Different Controls

	Probability of dying between the ages 60 and 69		
	(1)	(2)	(3)
IV:	0.043***	0.044***	0.051***
Impact of Age at Last Employment	(0.010)	(0.010)	(0.014)
	[0.001]	[0.004]	[0.008]
Month-Year Birth FE	✓	✓	✓
Controls	✓	✓	✓
Contributed 1966-1967	✓	✓	✓
Proxy Pension Base		✓	✓
LM Controls 45-55			✓
Observations	23,848	23,848	23,848
Mean Dep. Variable (Treated)	0.132	0.132	0.1312
Mean Dep. Variable (Control)	0.099	0.099	0.099
F-stat FS	50.500	67.340	35.474

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 60 and 69 with no controls (Column 1), controlling for the proxy of the base of the pension benefit (Column 2), and also controlling for the labour market outcomes when the individuals were between 45 and 55 years old (Column 3), obtained from the estimation of regression 2. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A12: Descriptive Statistics of Individuals that Started Contributing in 1966

Variables	Individuals Started Contributing in 1966		
	Reg Pension at 60 Mean	**All Others** Mean	**Difference** [P-value]
Frac. Active 45-55	90.05	93.44	1.880** [0.038]
Frac. Employed 45-55	62.87	84.85	-16.370*** [0.000]
Frac. Self-employed 45-55	11.44	17.36	-4.714*** [0.003]
Mean Contribution 45-55	818.30	1126.30	-187.485*** [0.000]
Last Industry with High Workplace Accidents	0.47	0.50	0.013 [0.462]
Last Industry with High Psychosocial Exposure	0.49	0.51	-0.034* [0.067]
Last Industry with High Self-value	0.31	0.28	0.001 [0.948]
Last White-collar Occupation	0.34	0.35	-0.035** [0.038]
More than 33 Years of Contribution	0.45	0.48	-0.001 [0.967]
Observations	2,263	11,903	

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the summary statistics for individuals that started contributing in 1966. Column 1 includes individuals that started contributing in 1966 and claimed a regular pension before age 61, while column 2 includes those that also started contributing in 1966 but did not claim a regular pension before 61. The third column shows the coefficient and wild-bootstrap p-value from the regression of all the variables on the dummy variable, indicating if the individual claimed a regular pension before age 61. In this regression, we also control for gender, year of birth, and month of birth fixed effects.

*** p<0.01, ** p<0.05, * p<0.1.

Table A13: Impact on Mortality by Psychosocial Exposure: Division by 3 Groups

	Probability of Dying between 60 and 69		
	Psychosocial Exposure		
	High	Medium	Low
Reduced Form:			
Contributed in 1967	0.429***	0.767***	0.501***
	(0.115)	(0.153)	(0.135)
	[0.005]	[0.005]	[0.004]
IV:			
Impact of Age at Last Employment	0.065***	0.042***	0.008
	(0.021)	(0.011)	(0.020)
	[0.004]	[0.000]	[0.727]
Month-Year Birth FE	✓	✓	✓
Controls	✓	✓	✓
Contributed 1966-1967	✓	✓	✓
Mean Dep. (Treated)	0.150	0.130	0.121
Mean Dep. (Control)	0.105	0.092	0.113
F-stat FS	15.845	24.323	13.212
P-value Diff High-Low		0.057	

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 60-and 69 by the psychosocial exposure (mental stress, social stress, and temporal load) experienced by the individual just before retirement, measured following Kroll (2011). The first panel reports the effect of the reform on mortality (reduced form effect using regression 1). The IV estimates, obtained from the estimation of regression 2, are reported in the second panel. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for a proxy of the pension base. At the bottom, we report the First Stage F-statistic and the p-value of the differences between the high and the low groups in the IV estimation. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A14: Impact on Mortality by Gender

	Age at Last Employment	
	Men	Women
First Stage	0.273**	1.053***
Contributed in 1967	(0.101)	(0.102)
	[0.035]	[0.001]
	Probability of Dying between 60 and 69	
Reduced Form:	0.023***	0.018**
Contributed in 1967	(0.005)	(0.006)
	[0.003]	[0.013]
IV:	0.082***	0.018**
Impact of Age at Last Employment	(0.030)	(0.006)
	[0.005]	[0.023]
Month-Year Birth FE	✓	✓
Controls	✓	✓
Contributed 1966-1967	✓	✓
Observations	17,105	6,743
Mean Dep. (Treated)	0.151	0.057
Mean Dep. (Control)	0.129	0.039
F-stat FS	8.802	107.568
P-value Difference (IV Est.)	0.030	

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 60-and 69 for men (Column 1) and women (Column 2). The first panel reports the first stage of the IV estimation (the reform's effect on the age at last employment, using 1). The second panel shows the second stage; the effect on the probability of dying between 60 and 69 years old. First, we report the reduced form effect of the reform on mortality using regression 1. After that, we report the IV estimates obtained from the estimation of regression 2. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for a proxy of the pension base. At the bottom, we report the First Stage F-statistic and the p-value of the differences between groups in the IV estimation. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A15: Robustness: Impact by Availability of Flexible Retirement

	Baseline sample		23 to 43 years of contribution		28 to 38 years of contribution	
	< 33	≥ 33	< 33	≥ 33	< 33	≥ 33
	Partial Retirement					
Contributed in 1967	0.003*	0.046***	0.004*	0.027**	0.002	0.017**
	(0.002)	(0.011)	(0.002)	(0.009)	(0.003)	(0.007)
	[0.068]	[0.005]	[0.021]	[0.006]	[0.415]	[0.026]
	Age at Last Employment					
First Stage:	0.322***	0.821***	0.295**	0.698***	0.337**	0.320**
Contributed in 1967	(0.081)	(0.148)	(0.109)	(0.129)	(0.126)	(0.111)
	[0.009]	[0.004]	[0.076]	[0.003]	[0.056]	[0.041]
	Probability of Dying between 60 and 69					
Reduced Form:	0.022***	0.017**	0.029***	0.020***	0.027*	0.004
Contributed in 1967	(0.004)	(0.007)	0.006)	(0.006)	(0.015)	(0.019)
	[0.005]	[0.018]	[0.010]	[0.012]	[0.095]	[0.850]
IV:	0.068**	0.020***	0.102***	0.028***	0.082*	0.013
Impact of Age at Last Employment	(0.022)	(0.008)	(0.037)	(0.009)	(0.047)	(0.056)
	[0.013]	[0.012]	[0.020]	[0.014]	[0.067]	[0.830]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓
Observations	12,169	11,679	6,347	8,370	3,012	3,283
Mean Mortality Rate (Treated)	0.155	0.109	0.178	0.130	0.203	0.186
Mean Mortality Rate (Control)	0.109	0.087	0.140	0.105	0.176	0.168
F-stat FS	15.546	30.492	7.233	29.111	6.390	8.929
P-value Difference (IV Est.)	0.047		0.081		0.319	

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 60 and 69 for individuals with less (Columns 1, 3, and 5) or more than 33 years of contribution (Columns 2, 4, and 6), using different samples. Columns 1 and 2 report our baseline estimates from Table 7. Columns 3 and 4 reduce the sample to individuals that have between 23 and 43 years of contribution, while Columns 5 and 6 to individuals that contributed between 28 and 38 years. Only individuals with more than 33 years of contribution when claiming a pension can access the partial retirement scheme. The first panel reports the reform's effect on the probability of claiming a partial pension, using 1. The second panel reports the first stage of the IV estimation (the reform's effect on the age at last employment, using 1). The third panel shows the second stage; the effect on the probability of dying between 60 and 69 years old. First, we report the reduced form effect of the reform on mortality using regression 1. After that, we report the IV estimates obtained from the estimation of regression 2. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for a proxy of the pension base. At the bottom, we report the First Stage F-statistic and the p-value of the differences between groups in the IV estimation. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A16: Robustness: Age Start FE

	Type of Pension				Age at			
	Regular Pension	Partial Pension	Disability Pension	No Pension	Last Employment	Regular Pension	Disability Pension	Partial Pension
Contributed in 1967	-0.098**	0.025***	0.052**	0.020**	0.525**	1.362***	0.331**	-0.244**
	(0.032)	(0.006)	(0.021)	(0.009)	(0.163)	(0.156)	(0.109)	(0.104)
	[0.014]	[0.005]	[0.023]	[0.036]	[0.022]	[0.001]	[0.040]	[0.048]
Age Start Contributing FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764	12,233	8,630	1,038
R^2	0.135	0.069	0.086	0.054	0.083	0.219	0.033	0.228
Mean Dep. (Treated)	0.394	0.048	0.390	0.168	59.830	64.636	57.350	61.097
Mean Dep. (Control)	0.531	0.035	0.297	0.137	59.386	63.032	56.986	61.131

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labour market through regular pension (Column 1), partial pension (Column 2), disability pension (Column 3), not claiming any pension (Column 4), age at last employment (Column 5), age at claiming regular pension (Column 6), age at claiming disability pension (Column 7), and age at claiming partial pension (Column 8), obtained from the estimation of regression 1 using age at first contribution fixed effects instead of month and year of birth fixed effects. This robustness check estimates the impact of losing access to early retirement for people that start working at the same age. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender and age at first contribution fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the age of the first contribution, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A17: Robustness: No Controls

	Type of Pension				Age at			
	Regular Pension	Partial Pension	Disability Pension	No Pension	Last Employment	Regular Pension	Disability Pension	Partial Pension
Contributed in 1967	-0.097***	0.019***	0.058**	0.020**	0.481***	1.400***	0.353***	-0.198**
	(0.029)	(0.005)	(0.021)	(0.006)	(0.095)	(0.169)	(0.069)	(0.059)
	[0.005]	[0.002]	[0.011]	[0.011]	[0.001]	[0.000]	[0.010]	[0.011]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls								
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓	✓
Observations	25,764	25,764	25,764	25,764	25,764	12,233	8,630	1,038
R^2	0.087	0.036	0.063	0.017	0.010	0.157	0.005	0.160
Mean Dep. Variable (Treated)	0.394	0.048	0.390	0.168	59.830	64.636	57.350	61.097
Mean Dep. Variable (Control)	0.531	0.035	0.297	0.137	59.386	63.032	56.986	61.131

Source: MCVL, cohorts 1941-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labour market through regular pension (Column 1), partial pension (Column 2), disability pension (Column 3), not claiming any pension (Column 4), age at last employment (Column 5), age at claiming regular pension (Column 6), age at claiming disability pension (Column 7), and age at claiming partial pension (Column 8), obtained from the estimation of regression 1 not controlling for any of the labor market outcomes when the individuals were between 30 and 40 years old. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A18: Robustness: Cohorts 1941 to 1949

	Type of Pension				Age at			
	Regular Pension	Partial Pension	Disability Pension	No Pension	Last Employment	Regular Pension	Disability Pension	Partial Pension
Contributed in 1967	-0.157***	0.025***	0.096***	0.036***	0.388***	1.669***	0.189	-0.168**
	(0.022)	(0.007)	(0.016)	(0.006)	(0.130)	(0.061)	(0.095)	(0.053)
	[0.002]	[0.002]	[0.000]	[0.004]	[0.006]	[0.000]	[0.254]	[0.025]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓	✓
Observations	18,185	18,185	18,185	18,185	18,185	9,506	5,338	993
R^2	0.130	0.062	0.087	0.063	0.075	0.270	0.042	0.200
Mean Dep. (Treated)	0.405	0.068	0.373	0.154	60.060	64.831	57.307	61.010
Mean Dep. (Control)	0.599	0.046	0.242	0.113	59.580	62.853	57.056	61.094

Source: MCVL, cohorts 1941-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labour market through regular pension (Column 1), partial pension (Column 2), disability pension (Column 3), not claiming any pension (Column 4), age at last employment (Column 5), age at claiming regular pension (Column 6), age at claiming disability pension (Column 7), and age at claiming partial pension (Column 8), obtained from the estimation of regression 1 restringing the sample to cohorts born between 1941 and 1949. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A19: Robustness: No Self-employed

	Type of Pension				Age at			
	Regular Pension	Partial Pension	Disability Pension	No Pension	Last Employment	Regular Pension	Disability Pension	Partial Pension
Contributed in 1967	-0.113***	0.024***	0.051**	0.038***	0.466***	1.561***	0.313**	-0.156**
	(0.030)	(0.006)	(0.021)	(0.007)	(0.096)	(0.172)	(0.076)	(0.053)
	[0.002]	[0.000]	[0.029]	[0.000]	[0.003]	[0.000]	[0.026]	[0.037]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓	✓
Observations	21,336	21,336	21,336	21,336	21,336	9,210	7,228	1,035
R^2	0.160	0.067	0.113	0.069	0.058	0.183	0.032	0.245
Mean Dep. (Treated)	0.333	0.060	0.397	0.210	59.106	64.320	57.139	61.095
Mean Dep. (Control)	0.496	0.041	0.301	0.162	58.773	62.608	56.792	61.128

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labour market through regular pension (Column 1), partial pension (Column 2), disability pension (Column 3), not claiming any pension (Column 4), age at last employment (Column 5), age at claiming regular pension (Column 6), age at claiming disability pension (Column 7), and age at claiming partial pension (Column 8), obtained from the estimation of regression 1 restringing the sample to individuals that are not in one of the self-employed pension regimes. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A20: Robustness: Mortality Outcomes

	Prob. of Dying between 60-69				
	Baseline	Age start FE	No Controls	Cohorts 1941-1949	Drop Self-employed
Contributed in 1967	0.021***	0.019***	0.020***	0.026***	0.025***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.006)
	[0.001]	[0.001]	[0.002]	[0.06]	[0.002]
IV: Age at Last Employment	0.044***	0.030***	0.035***	0.056**	0.043***
	(0.010)	(0.011)	(0.009)	(0.013)	(0.012)
	[0.004]	[0.009]	[0.005]	[0.011]	[0.003]
Month-Year Birth FE	✓		✓	✓	✓
Age Start Contributing FE		✓			
Controls	✓	✓		✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓
Observations	23,848	23,848	23,848	17,000	19,490
Mean Dep. (Treated)	0.132	0.132	0.132	0.125	0.148
Mean Dep. (Control)	0.099	0.099	0.099	0.086	0.106
F-stat FS	67.340	15.070	60.567	43.198	48.224

textitSource: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of age at last employment on the probability of dying between the ages of 60-69 using the baseline specification (Column 1), using age at first contribution fixed effects instead of month and year of birth fixed effects (Column 2), no controlling for any labor market outcome of the individuals were between 30 and 40 years old (Column 3),restringing the sample to cohorts born between 1941 and 1949 (Column 4), and restringing the sample to individuals that are not in one of the self-employed pension regimes (Column 5). The first panel reports the effect of the reform on mortality (reduced form effect using regression 1). The IV estimates, obtained from the estimation of regression 2, are reported in the second panel. The estimation sample includes individuals that started contributing 12 months before and after January 1st, 1967. All specifications control for gender fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. The IV estimation also controls for a proxy of the pension base. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A21: Robustness: Correction of the Year Start Contributing

	Baseline Correction 1966-1967		No Correction		Correction 1966-1967 Removing months 12-1966 and 1-1967	
	Age Last Employment	Mortality Age 60-69	Age Last Employment	Mortality Age 60-69	Age Last Employment	Mortality Age 60-69
Contributed in 1967	0.397***	0.021***	0.533**	0.015***	0.264**	0.018**
	(0.071)	(0.004)	(0.216)	(0.002)	(0.081)	(0.008)
	[0.003]	[0.001]	[0.017]	[0.000]	[0.017]	[0.026]
IV: Age at Last Employment		0.044***		0.020***		0.052**
		(0.010)		(0.006)		(0.024)
		[0.004]		[0.000]		[0.036]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓
Observations	25,764	23,848	54,917	52,977	18,087	16,852
R^2	0.085	0.027	0.058	0.008	0.083	0.023
Mean Dep. (Treated)	59.830	0.132	61.109	0.088	60.066	0.122
Mean Dep. (Control)	59.386	0.099	60.430	0.069	59.759	0.096
F-stat FS		67.340		8.967		29.380

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the age at last employment (Columns 1, 3, 5 and 7) and the probability of dying between the ages 60 and 69 (Panel A of Columns 2, 4, 6 and 8), obtained from the estimation of regression 1 using different corrections for the years that individuals started contributing reported in the affiliation data. Panel B of Columns 2, 4, 6 and 8 reports the IV estimates of the impact of age at last employment on the probability of dying between the ages of 60 and 69, obtained from the estimation of regression 2 using different corrections for the years that individuals started contributing reported in the affiliation data.The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. Columns 1 and 2 correct the reported date of the first contribution by subtracting the total number of years of contribution from the date they claimed a pension for those who reported having started contributing in 1966 and 1967. If the corrected year of starting contributions is before the reported date of the first contribution, we make this correction. Columns 3 and 4 do not make any correction. Columns 5 and 6 make the same correction of Columns 1 and 2 but for all years. Finally, Columns 7 and 8 makes the same correction of Columns 1 and 2 but dropping the last month of 1966 and the first month of 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A22: Robustness: Dropping Individuals Not Attached to the Labour Market

	Baseline sample Drop Active<50 y.o Disability<50 y.o. Active<8 years SOVI		Drop Active<50 y.o Disability<50 y.o. Active<8 years		Drop Active<50 y.o Disability<50 y.o. SOVI		Drop Active<50 y.o. Active<8 years SOVI	
	Age Last Employment	Mortality Age 60-69	Age Last Employment	Mortality Age 60-69	Age Last Employment	Mortality Age 60-69	Age Last Employment	Mortality Age 60-69
Contributed in 1967	0.397***	0.021***	0.327***	0.018***	0.328***	0.020***	0.376***	0.020***
	(0.071)	(0.004)	(0.062)	(0.004)	(0.087)	(0.004)	(0.071)	(0.004)
	[0.003]	[0.001]	[0.000]	[0.000]	[0.008]	[0.000]	[0.003]	[0.000]
IV: Age at Last Employment		0.044***		0.044***		0.050***		0.044***
		(0.010)		(0.010)		(0.014)		(0.011))
		[0.004]		[0.001]		[0.004]		[0.001]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1966-1967	✓	✓	✓	✓	✓	✓	✓	✓
Observations	25,764	23,848	26,445	24,559	26,234	24,303	26,151	24,211
R^2	0.085	0.027	0.102	0.028	0.077	0.027	0.084	0.027
Mean Dep. (Treated)	59.830	0.132	60.388	0.125	59.767	0.131	59.824	0.132
Mean Dep. (Control)	59.386	0.099	60.185	0.095	59.356	0.099	59.399	0.099
F-stat FS		67.340		66.722		31.818		67.332

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the age at last employment (Columns 1, 3, 5, and 7) and the probability of dying between the ages 60 and 69 (Panel A of Columns 2, 4, and 6), obtained from the estimation of regression 1 modifying the definition of individuals not attached to the labor market. Panel B of Columns 2, 4, 6, and 8 reports the IV estimates of the impact of age at last employment on the probability of dying between the ages of 60 and 69, obtained from the estimation of regression 2 modifying the definition of individuals not attached to the labor market. Columns 1 and 2 drop those individuals that became inactive before the age of 50, got a disability pension before the age of 50, have less than 8 years of activity during her/his working life, or received a SOVI pension. Columns 3 and 4 drop those individuals that became inactive before the age of 50, got a disability pension before the age of 50, or had less than 8 years of activity during her/his working life. Columns 5 and 6 drop those individuals that became inactive before the age of 50, got a disability pension before the age of 50, or received a SOVI pension. Columns 7 and 8 drop those individuals that became inactive before the age of 50, have less than 8 years of activity during her/his working life, or receive a SOVI pension. The estimation sample includes individuals that started contributing 12 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A23: Robustness: Augmented Sample 1965-1968

	Type of Pension				Age at			
	Regular Pension	Partial Pension	Disability Pension	No Pension	Last Employment	Regular Pension	Disability Pension	Partial Pension
Contributed in 1967	-0.341***	0.108***	0.203***	0.031**	1.448***	2.451***	0.530*	0.202*
	(0.030)	(0.016)	(0.014)	(0.009)	(0.224)	(0.290)	(0.262)	(0.067)
	[0.000]	[0.001]	[0.000]	[0.013]	[0.002]	[0.000]	[0.088]	[0.066]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1965-1968	✓	✓	✓	✓	✓	✓	✓	✓
Observations	47,797	47,797	47,797	47,797	47,797	25,922	12,981	2,766
R^2	0.151	0.101	0.110	0.091	0.101	0.280	0.036	0.207
Mean Dep. Variable (Treated)	0.493	0.078	0.293	0.136	60.686	64.445	57.489	61.123
Mean Dep. Variable (Control)	0.590	0.039	0.251	0.121	59.774	62.908	57.200	61.075

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labor market through regular pension (Column 1), partial pension (Column 2), disability pension (Column 3), not claiming any pension (Column 4), age at last employment (Column 5), age at claiming regular pension (Column 6), age at claiming disability pension (Column 7), and age at claiming partial pension (Column 8), obtained from the estimation of regression 1 augmenting the sample to individuals that started contributing from 1965 to 1967. The estimation sample includes individuals that started contributing 24 months before and after 1 January 1967. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

Table A24: Robustness: Hole 1965 vs. 1968

	Type of Pension				Age at			
	Regular Pension	Partial Pension	Disability Pension	No Pension	Last Employment	Regular Pension	Disability Pension	Partial Pension
Contributed in 1967	-0.370***	0.143***	0.167***	0.060***	1.618***	2.437***	-0.807	0.587***
	(0.034)	(0.022)	(0.014)	(0.004)	(0.253)	(0.319)	(0.561)	(0.073)
	[0.000]	[0.001]	[0.000]	[0.000]	[0.003]	[0.000]	[0.213]	[0.003]
Month-Year Birth FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Contributed 1965 or 1968	✓	✓	✓	✓	✓	✓	✓	✓
Observations	22,033	22,033	22,033	22,033	22,033	13,689	4,351	1,728
R^2	0.139	0.122	0.076	0.168	0.094	0.306	0.043	0.225
Mean Dep. Variable (Treated)	0.575	0.102	0.214	0.110	61.393	64.336	57.697	61.133
Mean Dep. Variable (Control)	0.686	0.046	0.175	0.093	60.412	62.751	57.797	61.005

Source: MCVL, cohorts 1938-1949.

Notes: This table reports the impact of the reform on the probability of leaving the labor market through regular pension (Column 1), partial pension (Column 2), disability pension (Column 3), not claiming any pension (Column 4), age at last employment (Column 5), age at claiming regular pension (Column 6), age at claiming disability pension (Column 7), and age at claiming partial pension (Column 8), obtained from the estimation of regression 1 comparing individuals that started contributing in 1965 with those that started contributing in 1968. All specifications control for gender, year of birth, and month of birth fixed effects. Each regression also includes the following controls measured when the individuals were between 30 and 40 years old: average monthly contribution, fraction of time employed, fraction of time active, fraction of time in self-employment, and highest occupation and industry sector fixed effects. All standard errors are clustered at the year of birth, and wild-bootstrap p-values are reported in brackets.

*** p<0.01, ** p<0.05, * p<0.1.

B More Details on the Spanish Pension System

The current old-pension system for the elderly in Spain is a pay-as-you-go system, with an average replacement rate of around 80% (one of the highest in the European Union). The key elements of the existing Spanish pension system were established in 1967.[1] Prior to 1967, a fixed-amount pension financed by employers and the state was available for low-income or disabled workers. This pension, which was basic and insufficient, was complemented by the Mutual societies (*Mutualidades Laborales*), which were specific to each occupation/sector.

In 1967, the General Social Security Law (*Ley General de Seguridad Social*) unified the pre-existing insurance systems into a single institution, called 'Social Security'. In the new system, further modified by the 1985, 1997, and the 2002 reforms,[2] the statutory retirement age became 65 years of age. Initially, individuals needed a minimum of eight years of contributions to gain access to the pension, which gradually increased to 15 years after the 1997 reform. The pension benefits were calculated based on the average contributions during the 15 years preceding a claim. In addition, full benefits are given to individuals with 35 contribution years. Finally, the penalty for insufficient years of contributions is 2 percent per year.[3]

The pension of all the individuals considered in our sample is regulated by the same pension law and face a statutory retirement age of 65 years, with a minimum contribution period of eight years (further modified to 15 years after the 1997 reform). However, individuals from the selected cohort (1938 - 1949) who contributed before 1 January 1967,[4] even by one day, maintained an indefinite right to early retirement from the old-age pension system. These individuals could freely retire early from age 60, though with some financial penalties.[5] Around 13% of the individuals who started contributing in 1966 claimed a regular pension at the age of 60.

On the other hand, individuals from the selected cohorts (1938 - 1949) who contributed after 1 January 1967 faced a statutory retirement age of 65. They can now only retire early under the involuntary early retirement scheme, set in the 2001 law, which allows individuals to retire as early as age 61 (again with some financial penalties, between 6 and 8 percent, depending on the years of contribution, per year of advancement) under certain conditions. These individuals need

[1] It was then further developed in the 1970s. In the last four decades, the system has experienced six important reforms, in 1985, 1997, 2002, 2007, 2011, and 2013. See Boldrin et al. (1999), Boldrin et al. (2004) and García-Gómez et al. (2012) for a detailed explanation of all the reforms of the old-age pension system in Spain.

[2] Ley 26/1985, de 31 de julio, de medidas urgentes para la racionalización de la estructura y de la acción protectora de la Seguridad Social, Ley 24/1997, de 15 de julio, de Consolidación y Racionalización del Sistema de Seguridad Social, and Ley 35/2002, de 12 de julio, de medidas para el establecimiento de un sistema de jubilación gradual y flexible.

[3] It is important to note that in many cases, the claim of a regular retirement pensions is preceded by a period of unemployment that can last for a considerable time. To assist older workers in long unemployment spells, since 1989, those unemployed at age 52 or above who have exhausted their contributive benefits have been allowed to receive unemployment assistance benefits until their pension-claiming age. The only prerequisite is to reach the minimum contribution years to become eligible for an old-age pension. This unemployment assistance paid 75% of the minimum wage. Moreover, a reform in 2002 also created the possibility of combining unemployment insurance claims with labor earnings. Older workers could receive 50% of their unemployment insurance entitlement and work simultaneously, with the employer paying the remaining wages.

[4] The January 1967 deadline was set at a later date for workers in specific sectors, such as construction, mining, fishing, and the railway. We control for these specific deadlines for workers in these sectors.

[5] The penalty for early retirement is 8 percent per year of early claim. After the 2001 reform, the yearly penalty for early retirement was reduced (up to 6 percent per year) as a function of the years contributed.

to have been unemployed (involuntarily) for at least six months and have contributed to the Social Security system for at least 30 years. Due to these stringent requirements, a very small proportion of workers have taken up this involuntary early retirement option.

Because the law was published on 30 December 1966, there is little room left to manipulate the date of the first social security contribution. This feature, therefore, allows us to compare individuals who started contributing before and after 1 January 1967. As we can see in Figure 1, individuals who contributed before 1967 (independently of their birth year) could voluntarily retire early at the age of 60. For those who contributed after 1967, the only other way to receive early retirement was to claim involuntary early retirement at the age of 61; otherwise, the earliest an individual can voluntarily claim a pension is at the age of 65. Therefore, we expect individuals who started contributing after 1967 to increase their retirement age considerably.

In addition to the regular retirement pathway, there are two alternative pathways: permanent disability and partial retirement pensions. Permanent disability benefits have been used extensively in Spain as an early retirement mechanism (Boldrin et al., 1999; García-Gómez et al., 2012). This option has thus prompted several reforms since 1985 that have tightened the eligibility criteria in order to maintain a steady level of applications into the disability system henceforth. Nevertheless, disability insurance is an important way by which to exit the labor market. Additionally, from 2002, partial retirement options became available, allowing the combination of income from work with old-age pension benefits. The partial retirement option enables individuals aged 60 years and older, with at least 33 years of contribution and six years of tenure in the same company, to claim up to 85% pension while working 15% of the time (up to 75% of benefits after the 2011 reform). The partial retirement option requires the firm's agreement because the worker must be replaced with a new employee. In this paper, we investigate the impact of the reform on the age of the individual when claiming disability, partial and regular retirement pensions, and the probabilities of choosing these alternative exit routes from the labor market.

C More Details on Data and Sample

C.1 A novel data source

This paper uses novel administrative data of an extended sample from the Continuous Sample of Working Histories (Muestra Continua de Vidas Laborales (MCVL)) provided by the Spanish Social Security system. The dataset contains a 10% random sample of individuals born between 1938 and 1949 who have registered with the Social Security (such as contributive workers and pensioners) at any point in their lives up until 2020.

Therefore, we use a non-publicly available version of the MCVL provided by the Spanish Social Security administration. Access to this data is, however, possible after submitting a formal request via email (solicitudes.sala-investigacion@seg-social.es). A Committee of Experts will evaluate the application. In case it is approved, the necessary data will be prepared, access to which will be allowed through one of their three Safe Data Rooms in Madrid, Barcelona, or Albacete.

There are two main differences between the dataset we use in this paper and the publicly available one. First, the publicly available MCVL is only available from 2005 but contains all the employment histories of the individuals that had some contact with the Social Security adminis-

tration since then. Therefore, it is not possible to observe individuals that died or became inactive before that date. The dataset that we use in this paper allows us to observe contributive workers and pensioners prior to 2005. This data advantage makes it possible to explore a representative sample of workers affiliated with the Spanish Social Security at any point in their working lives and examine their mortality responses. Secondly, the reform we examine impacted only individuals born in certain cohorts. Therefore, we asked for a 10% random sample of individuals born in those cohorts, 1938 and 1949. The publicly available MCVL only contains a 4% random sample of all the individuals affiliated with the Social Security administration.

C.2 Sample construction

Our main sample covers Spanish individuals born between 1938 and 1949 who started contributing to the Social Security system 12 months before and after 1 January 1967. We drop individuals who are unlikely to be affected by pension reform, i.e., people who have weak labor market attachment and who do not fulfill the pension access requirement. Specifically, we drop people who are not active in the labor market at age 50, people who have claimed a disability pension before age 50, and people who have less than 8 years of contribution (the minimum requirement to gain access to a pension). We further drop people who have claimed a SOVI pension (Seguro Obligatorio de Vejez e Invalidez or Compulsory Old Age and Disability Insurance). A SOVI pension is a residual pension from the old system for individuals that, at the age of 65, are not entitled to a pension from the current contribution-based Spanish pension but can prove that they contributed at least 1,800 days to the previous system. A SOVI pension is a means-tested pension available to all Spanish citizens aged over 65, or 60 in the case of disabilities, earning below a threshold (€5,164.60 per year in 2018). We drop SOVI claimants because, regardless of their year of starting contributions, they are not eligible for the contribution-based old-age pension. In total, we drop 20% of observations due to these restrictions. The final sample contains 25,764 individuals, of whom 27% are female.

In Table A22, we perform robustness checks by modifying the definition of individuals who are unlikely to be affected by pension reform. We present three alternative selections: removing the "claimed SOVI" criterion, removing the "less than 8 years of contribution" criterion, and removing the "claimed disability before age 50" criterion. The reduced-form impacts of contributing before 1967 on age at last employment and mortality rate between ages 60 and 69 are similar to the estimates in the baseline sample. Moreover, the IV estimates of the impact of age at last employment on mortality are robust to the sample selection.

In Table A1, we verify that our sample is not selected. First, we check if the reform has impacted the probability of not being in the main sample, and we find no significant differences. Moreover, we also show no significant mortality differences among individuals not included in the main sample.

C.3 Correction of the variable "year started contribution"

The variable "year started contribution" is poorly recorded for some individuals, especially those who started contributing around 1967, as the administrative dataset started to be constructed at the end of the 60s. The top graph in Figure A1 shows the distribution of years the individuals in

our sample started contributing, as recorded in the original dataset. We can observe that there is bunching in the years 1966 and 1967.

Moreover, we observe some "administrative bunching" as a result of administrative practices. Figure 2 shows that the monthly distribution in the starting year is normal in the years before 1965 and after 1967, indicating that the bunching problem is limited to the years 1965, 1966, and 1967. We see people are more likely to report to start contributing in January 1965, January 1967, and December 1966. The distribution is smooth in other years. This is likely caused by administrative bunching. At the time of retirement, individuals need to prove that their first contribution was before 1967 to the pension office in order to gain eligibility for the "old regime". If they manage to show a payslip made before 1967, the pension office is likely to simply record "December 1966" as their first date of the contribution, even though they might have shown that they started working many years before 1967. If they fail to convince the pension office they started working before 1967, the pension office tends to record "January 1967" as their first date of contribution. The bunching in January 1965 seems to be due to similar reasons. These wrongly assigned starting dates can make our treated and control groups less comparable. This is because those bunch in January 1967 or December 1966 could have, in fact, started working in different years and could have different characteristics. In fact, in Figure A3 a), we can observe that a sizeable mass (around 20 percent) of individuals who originally were recorded as having started contributing in 1967 retiring at age 60, which is legally not possible. This limitation is the reason we cannot use a Regression Discontinuity Design.

To deal with the "administrative bunching", we correct the reported date of the first contribution by using the number of years of contribution and the date individuals claim a regular pension, which are accurately recorded. We subtract the total number of years contributed from the year they claim a regular pension. If the corrected year of starting contributions is before the reported date of the first contribution, we make this correction. This correction is only possible for individuals who have claimed a regular pension, as only for them the total number of years contributed is reported. We perform this correction for the years 1965, 1966, and 1967. However, in our main sample, which only includes individuals that started contributing in 1966 or 1967, the correction of 1965 does not matter. After this correction, we see in Figure A1 that the bunching has been greatly reduced. Figure A3 b) also shows that, after the correction, fewer individuals started contributing in 1967 and retired early at 60. The mass is much subdued and reduced to 8 percent. This comparison between Figure A3 a) and b) shows that our correction does a decent job reassigning year start contribution.

We also perform an alternative method of correction. In addition to correcting for individuals with reported year start contributing in 1966 and 1967, we also drop the individuals who are bunching due to administrative practices based on the density figures. Those are the ones who reported starting contributing in December 1966 and January 1967. Table A21 reports the robustness check for our main results to correction methods. We show the estimated reform impacts on age at last employment and mortality rate between ages 60 and 69 in the first row. The second row shows the IV estimates of the impact of age at last employment on the mortality rate between 60 and 69. All estimates are robust to this alternative correction method. Moreover, Table A21 shows that estimates when using a sample without any correction are also not too different.