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Lifespan inequalities among the over 50 in Italy : evidence from administrative data

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Lifespan inequalities among the over 50 in Italy: evidence from administrative data[1]

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Abstract

English. In this study we provide novel evidence about lifespan inequalities in the Italian adult and elderly population, and about their policy implications for the pension system. For this purpose, we leverage a compendium of administrative data from the Italian Social Security Institute. Our analysis delivers three sets of findings. First, we document sizeable inequalities in residual longevity at retirement by former occupation, especially among men. We estimate that male retirees with a background in specific low-risk occupational categories enjoy an advantage of about 4-5 years in life expectancy at 65 compared to those with a background in specific high-risk categories. Second, we highlight some worrisome trends in the evolution of lifespan inequalities among the over 50 in Italy. Although mortality delay (increasing average age at death) and mortality compression (declining lifespan variability) are observed across all socio-economic strata, our analysis suggests that these improvements have not been equally shared. Indeed, we find that mortality improvements were reaped mostly at the top of the lifetime income distribution, notably in the case of men. Finally, we show that the distributional implications of unequal lifespans for the pension system are tangible. In particular, we document that the erosion in the profitability of pension contributions implied by heterogeneous longevity is stronger for male retirees at the bottom of the lifetime income distribution, and that such dynamics have become more pronounced over time. Overall, our study confirms the relevance of policy measures aimed at increasing flexibility in retirement for vulnerable categories of workers to alleviate the regressive effects of lifespan inequalities.

Italiano. Questo studio fornisce nuove evidenze sulle disuguaglianze di longevità nella popolazione adulta e anziana in Italia e sulle implicazioni per il sistema pensionistico, utilizzando gli archivi amministrativi dell'INPS. Dall'analisi emergono tre risultati principali. Primo, lo studio documenta l'esistenza di disparità sostanziali nella vita residua al momento del pensionamento per categoria occupazionale, soprattutto nel caso degli uomini. I pensionati maschi con un retroterra lavorativo in specifiche categorie occupazionali a basso rischio vantano un vantaggio di 4-5 anni nella vita attesa al 65 anni rispetto ai loro pari appartenenti a categorie occupazionali ad alto rischio. Secondo, si evidenziano alcuni trend preoccupanti nell'evoluzione delle disuguaglianze di longevità nella popolazione over 50. Sebbene si osservi per tutte le categorie socioeconomiche un aumento dell'età media alla morte e una riduzione nella variabilità della stessa, questi progressi non sono ugualmente distribuiti all'interno della popolazione. Infatti, l'analisi mostra come a godere maggiormente del miglioramento nei profili di mortalità siano gli individui nella parte più alta della distribuzione del reddito, soprattutto tra gli uomini. Infine, lo studio evidenzia le implicazioni distributive delle disparità di longevità per il sistema pensionistico. In particolare, documenta come la riduzione nel rendimento dei contributi conseguente alle disparità di longevità sia particolarmente tangibile per gli uomini a minor

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reddito e come tali dinamiche siano divenute più pronunciate nel tempo. In conclusione, lo studio la rilevanza di politiche volte a garantire una maggiore flessibilità nel pensionamento per le categorie di lavoratori più fragili per alleviare gli effetti regressivi delle disuguaglianze di mortalità.

Keywords - Life expectancy, lifespan variation, inequality, pension system, Italy

Parole chiave – Speranza di vita, variabilità nella durata di vita, diseguaglianze, sistema pensionistico, Italia

Introduction

Concerns about rising inequality in economic outcomes have come to dominate economic and political debates since the early 21st century. There is mounting evidence that inequality in income, wealth, and lifetime earnings has been increasing over time and across cohorts in several OECD countries (Kopczuk et al. 2010; Piketty 2013; Saez et al. 2016; Bourgignon, 2018). A key dimension of inequality, which is strongly related to economic inequality, is inequality in longevity (Cutler et al. 2006). While the causal nature of the relationship between socio-economic status and longevity remains a source of debate, the distribution of longevity is a key metrics of the distribution of well-being within a society. Moreover, lifespan inequalities have important implications when it comes to the design and the evaluation of healthcare and social security programs (Auerbach et al. 2017).

Previous studies have extensively documented the existence of tangible disparities in longevity by socio-economic status in Italy, especially among men (Leombruni et al. 2015; Lallo and Raitano 2018; Petrelli et al. 2019), discussing the challenges they pose to the equity and the sustainability of pension policies (Ardito et al. 2019; Caselli and Lipsi 2018; Mazzaferro et al. 2012). This literature presents, though, a number of limitations. First, it relies mostly on education and income to measure socio-economic status, overlooking inequalities which may emerge around specific occupational groups (Weeden and Grusky, 2012). While correlated, education, income and occupation cannot be used interchangeably. Indeed, if education predicts the ability of turning information into behavioural choices and income proxies the availability of material resources, occupation is more suited to measure social prestige and job control, and to account for exposure to work-specific risks and benefits over one's working life (Geyer et al. 2006; Cambois et al. 2020). From a policy perspective, tracking differences in mortality across specific occupational groups is highly relevant for setting key programs, ranging from targeted health prevention interventions to equitable retirement policies. This kind of information is paramount, for instance, to inform policies which aim at balancing the need for raising statutory retirement age with that of ensuring early retirement options for vulnerable categories of workers. Second, available studies for the Italian context are overwhelmingly cross-sectional in nature. Analyses on the evolution of longevity differentials by socio-economic status are scant and yield mixed conclusions (Luy et al. 2015; Costa et al. 2017). This gap is particularly relevant in the light of the growing number of studies documenting widening inequalities in longevity by socio-economic status in several OECD countries (Sasson 2016). Third, previous works focus exclusively on life expectancy differentials. As suggested by a growing strand of literature, though, life expectancy alone does not allow to fully capture the mortality profile of a given population, and of its evolution over time (Aburto et al. 2020). Indeed, life expectancy, which provides a concise and useful measure of average age-at-death, does not fully describe how deaths are distributed along the age distribution. In other words, it is not informative about the uncertainty surrounding the length of human life. The relationship between 'central longevity indicators' (Cheung et al. 2005), such as life expectancy, and variation in age-at-death is not straightforward. In fact, while historically life expectancy and lifespan variation have been found to be inversely correlated, recent evidence suggests that such relationship may not hold for all countries or population subgroups (van Raalte et al. 2018). Monitoring both *average* age-at-death and *variation* in age-at-death is thus crucial for gaining full insight about heterogeneity in population health. Fourth, discussions about the distributional implications of differential mortality for the Italian pension system are not supported by evidence based on real employment and contributory histories. In fact, previous studies rely mostly on simulation exercises or back-of-the-envelope calculations to illustrate the regressive effects of unequal lifespans (Caselli and Lipsi 2018; Mazzaferro et al. 2012). As such, little is known about the real degree of redistribution implied by heterogeneity in longevity in the Italian pension system.

Building on these considerations, in this work we seek to address all of these issues, by leveraging a compendium of administrative data provided by the Italian Social Security Institute (INPS). The contribution of this study is threefold. First, we investigate mortality patterns among Italian retirees aged 65-74, previously employed in both the private and public sector, by former occupation, defined on the basis of a highly detailed taxonomy encompassing more than thirty occupational categories. For a thorough assessment of the implications of such patterns, we project life expectancy at 65 for each occupational category. To the best of our knowledge, this study represents the first attempt to explore post-retirement mortality patterns and estimate life expectancy around retirement age by specific lifetime occupation in Italy, and in a low mortality country in general. Second, we document the evolution of life expectancy and lifespan variation by socio-economic status at 50 and at retirement age among individuals with an employment background in the private sector in Italy. For this purpose, we rely on INPS' archival data encompassing the universe of employment spells in the Italian private sector over years 1975-2017 and the universe of pension benefits disbursed by INPS between 1995 and 2017. We use these data to build two measures of lifetime income, i.e. mid-career employment income and pension income, that we use as main markers of socio-economic status. Using mortality records spanning nearly four decades, we then show how lifespan inequalities have evolved over birth cohorts (1930-1957) and calendar years (1995-2017) by lifetime income quintiles, for both men and women. Finally, we exploit the estimated cohort-specific mortality profiles to quantify the distributional implications of longevity differentials in the Italian pension system. Focusing on cohorts 1930-1950, we contrast the distribution of individual pension wealth and of the internal rate of return of pension contributions calculated under the assumption of homogeneous longevity with the distribution one obtains by accounting for heterogeneous mortality along the lifetime income dimension.

Background

This study integrates multiple strands of research on lifespan inequalities by socio-economic status, and about their policy implications.

First, our work adds novel evidence to the literature about lifespan inequalities along the occupational dimension. As recurrently documented across a number of countries, individuals belonging to upper non-manual and high-skilled occupational groups tend to live longer than individuals belonging to lower manual and low-skilled occupational groups (Mackenbach et al. 2019). Generally, this kind of evidence comes from studies which classify occupations on a broadly defined basis, with typically less than eight categories (Tanaka et al. 2019). Mortality analyses by specific occupation are rare. A couple of exceptions stand out. In a seminal study based on data from the U.S. National Longitudinal Mortality Study, Johnson et al. (1999) estimate relative all-cause mortality risks among individuals aged 20-64 using a detailed occupational taxonomy, documenting the existence of sizeable heterogeneities in mortality by specific occupation beyond those accounted for by social status, income and education. In a more recent work, Katikireddi et al. (2017) analyse patterns of all-cause mortality in the UK among working age-individuals (20-59) across more than sixty occupations based on linked census and mortality records spanning years 1991-2011. They find occupation-specific mortality rates to differ by more than three times between the lowest and highest observed rates in both men and women, excess mortality being concentrated among low-skilled manual occupations such as elementary construction, housekeeping and factory workers. In Italy, a few studies have investigated the relationship between occupational class, broadly defined, and mortality. Linking 2011 census data with mortality records over 2012-2014, Bertuccio et al. (2018) estimate all-cause and cause-specific mortality rates by occupation-based social class in the Italian working-age population (20-64) using the Erikson–Goldthorpe class schemes whereby occupations are classified into 7 categories.[2] Their analysis documents the existence of substantial heterogeneities among males, mortality for a large number of causes being higher among non-skilled manual workers. Instead, they find limited differences in mortality among working-age women, which are entirely accounted for by adjustments for education. These patterns are consistent with those documented by Leombruni et al. (2015), who find a clear gendered occupational gradient in post-retirement mortality among individuals formerly employed in the private sector, based on four occupational groups (blue-collar workers, white-collar workers, managers, self-employed). Using social security data spanning years 1974-2012, they estimate a gap of about 1.8 years in residual life expectancy at 65 between former blue-collar workers and managers in the case of men, but no tangible differences in the case of women. In a similar vein, Lallo and Raitano (2018) combine social security data with survey data from the Italian 2005 EU-SILC module to estimate life expectancy at 60 by macro-occupational class (employees, self-employed, farmers), adjusted for possible confounders such as education and household economic conditions. Their estimates, based on a mortality follow-up spanning years 2005 through 2009, document a difference of 5 years in remaining life expectancy at 60 between men with opposite socioeconomic statuses. As all these studies rely on relatively broad categorizations of occupational class, they may fail to detect important heterogeneities.

[2] Upper non-manual workers, routine non-manual workers, self-employees, farmers, skilled manual workers, non-skilled manual workers and agricultural labourers.

Second, our work contributes to the growing body of research about the evolution of lifespan inequalities by socio-economic status. A first strand of this literature has focused on the evolution of life expectancy differentials, particularly in the US. Recent works are unanimous in concluding that the longevity gap in the US has been rising over time, no matter how socio-economic status is measured. There is evidence of increase in life expectancy differentials by current income (Chetty et al. 2017), lifetime earnings (Waldron, 2007; Cristia, 2009; Burthless et al. 2016; Auerbach et al. 2017) and education (Pijoan Mas et al. 2014; Sasson, 2016; Tan et al. 2019). In Europe, research has concentrated mostly on trends in life expectancy differentials by education (Murtin et al. 2017) and broadly defined occupational class (Mackenbach et al. 2019). Research about evolution in the longevity gradient along the earnings distribution is less abundant, with some notable exceptions such as Denmark (Brønnum-Hansen et al. 2012; Brønnum-Hansen, 2017) and Germany (Kiebele et al. 2013; Wenau et al. 2019; Haan et al. 2019). A second strand of literature has sought to analyse the evolution of life expectancy differentials jointly with disparities in lifespan variation. As anticipated, lifespan variation encompasses a number of metrics capturing the dispersion of the age-at-death distribution. While life expectancy reflects the hypothetical average age-at-death in a population given its mortality profile, lifespan variation reflects the uncertainty surrounding such average. Although life expectancy and lifespan variation have been historically inversely correlated (Vaupel, 2011), a number of studies have shown that this relationship has been reversing in some countries or population subgroups, generally as a consequence of mid-life mortality crises which tend to display a clear socio-economic gradient (van Raalte et al. 2018). There is evidence of widening disparities in lifespan variation, due to lack of or slower compression of mortality among the most disadvantaged socio-economic groups, in Finland (van Raalte et al. 2014), in Denmark (Brønnum-Hansen 2017), in Spain (Permanyer et al. 2018) and in the US (Sasson 2016). For what concerns Italy, analyses on the evolution of longevity differentials by socio-economic status are scant and yield mixed conclusions. Focusing on the population of Turin, in the North-East of Italy, Costa et al. (2017) document that the longevity gap between individuals with low (primary) education and high (university) education from the early 1970s through the early 2010s has remained fairly constant at about 4-5 years for both men and women. Luy et al. (2015) apply the orphanhood method using data from the multipurpose survey on "Family, welfare institutions, and childhood conditions" conducted by the Italian National Institute of Statistics (ISTAT) in the years 1998 and 2003 to examine nation-wide trends in life expectancy by education and occupational class over the 1980-1994 period. They observe an increase in the longevity gap by education and occupational status at age 30 for men and a decrease in the case of women, a pattern attributable to differences in smoking habits. Belloni et al. (2012) study the association between pension income, used as a proxy for lifetime income, and mortality risk after 65 among Italian male retirees over the 1980s and the 1990s. While not estimating longevity differentials directly, their analysis suggests that the socio-economic gradient in old age survival remained stable for Italian male retirees over the observed period, after accounting for regional differences. As for the evolution of disparities in lifespan variation, to the best of our knowledge, no evidence is available for Italy.

Finally, our work contributes also to the literature about the distributional implications of differential mortality for social security programs. Evidence from the US suggests that widening longevity differentials have been increasingly offsetting the progressivity built in the Social Security benefit formula (Burtless et al. 2016; Tan et al. 2019). Auerbach et al. (2017) estimate that diverging trends in life expectancy will cause the gap between average lifetime programme benefits received by men in the highest and lowest lifetime earnings quintiles to widen by US$130,000 (in US$2009) over cohorts born between 1930 and 1960. Research based on Germany, where pension benefits have a stronger contributory link compared to the US, finds heterogeneous longevity makes the pension system regressive, and that regressivity has been sharpening across cohorts (Whitehouse et al. 2008; Haan et al. 2020). In Italy, research efforts have concentrated on the distributional implications of differential mortality under notional defined contribution pension rules, which will fully apply to cohorts born after the mid-1970s. Mazzaferro et al. (2012) run micro-simulations to compare pension contributions' profitability under defined benefit (DB) and notional defined contribution (NDC) pension rules for a representative sample of the Italian population consisting of individuals born between 1975 and 2000. Using cohort-invariant mortality rates differentiated by education, they show that while NDC rules improve inter-generational fairness, as compared to DB rules, they also imply redistribution from low to high socio-economic status individuals as they fail to account for heterogeneity in survival. Caselli and Lipsi (2018) use education-specific cross-sectional mortality data from the Italian National Institute of Statistics (ISTAT) to evaluate redistribution patterns across education levels under the Italian NDC scheme. Their analysis confirms that regressive distributional dynamics along the educational dimension are sizeable, and that they tend to become more accentuated as retirement age increases. We integrate this literature by analysing the distributional implications of sex-, cohort- and lifetime income-specific mortality profiles for a large sample of Italian retirees born between 1930 and 1950. Unlike previous works, which rely on simulation exercises, we use high quality administrative data which enables us to reconstruct real employment and contributory biographies.

Differential mortality by specific occupation among Italian retirees

In this part of the paper, we explore mortality differentials among Italian retirees by former occupation.

Data

We rely on two main datasets retrieved from the archives of the Italian Social Security Institute (INPS): the *Comunicazioni Obbligatorie* dataset and the *Casellario Pensioni* dataset. The *Comunicazioni Obbligatorie* dataset, originally provided by the Italian Ministry of Labour but accessible through INPS, keeps track of all events entailing the creation, cessation, and transformation of job relationships in both the private and public sector in Italy, between 2010 and 2019. For each event, we have information about the beginning and (when relevant) ending date of the job relationship, as well as about the occupational class and the education level of the individual which the event refers to. Occupational class is categorized according t the

Classificazione delle Professioni 2011 (CP2011) taxonomy compiled by the Italian National Institute of Statistics. The CP2011 classification represents the Italian version of the most recent International Standard Classification of Occupations (ISCO-08)[3] and is hierarchically structured, with five-digit occupational codes being the most detailed and one-digit occupational codes the least. The *Casellario Pensioni* dataset reports all pension benefits disbursed by INPS-managed social security schemes between 1995 and 2018. Pension benefits disbursed by INPS fall into four main categories: old-age/seniority pensions (pensions based on previous work contributions), disability pensions (paid to INPS-insured individuals of working age who are temporarily or permanently unable to work due to physical or mental impairment), social disability pensions (paid to all individuals, whose health conditions limit their work capacity completely and on a permanent basis) and social pensions (which include means-tested benefits for poor pensioners and attendance allowances). The *Casellario Pensioni* dataset provides also information about pensioners' place of residence and marital status. For each individual we further have basic demographic information including gender, month and year of birth, month and year of death (if relevant), month and year of retirement (if relevant). Demographic information is updated to December 31, 2019.

Dataset construction

The original *Comunicazioni Obbligatorie* dataset includes observations relative to 21,240,742 uniquely identified individuals. Given the objective of our study, we focus on job cessations that are plausibly linked to entry into retirement. For this purpose, we keep individuals who experience a job cessation between 2010 and 2018, and who retired in the same period, aged ≤70. We restrict our analysis to individuals whose last job relationship prior to retirement lasted at least 5 years. For these individuals, it is highly likely that their last occupation represents a reliable proxy of the occupation they predominantly held throughout their working life. Reassuringly, and consistently with historically lifelong employment relationships in the Italian labour market, the average length of the last job relationship for individuals in our dataset is 25 years. We further drop individuals who do not appear in the *Casellario Pensioni* dataset, as for these individuals we do not have information about place of residence and marital status, nor about reception of disability pension benefits. As further explained below, we perform Cox proportional hazard regression analysis using age as the analytic time variable, with entry to risk at age 65 and exit at age 74 or age attained by the end of 2019, whichever earlier. This implies that individuals who die before 65 or who have not turned 65 by December 31, 2018 are further excluded from the dataset. Our final dataset is made up of 620,146 individuals, 361,829 men and 258,317 women. Over the period of analysis (2010-2019), registered deaths amount to 19,092 (14,253 among men and 4,983 among women). Table 1 recapitulates all the steps taken in the construction of the sample, whose main descriptive statistics are reported in Table 2. Table 3a reports the sex-specific distribution of individuals and deaths over the period of analysis by CP2011 occupational class at the 1-digit and 2-digit

[3] In CP2011, occupations are classified from very specific classes (5-digit titles) to broad classes (1-digit titles), corresponding to ISCO-08 major groups.

level, encompassing eight and thirty-four categories respectively, excluding armed forces. In order to observe a sufficient number of deaths in each group, in our analysis we aggregate two-digit categories, within the same one-digit category, reporting less than 50 deaths over 2010-2019. Because of gender differences in former occupation, groupings differ between men and women (Table 3b).

Statistical analysis

We study the relationship between former occupational class and mortality among Italian retirees by means of Cox proportional hazard regression analysis, for men and women separately. We opt for Cox proportional hazard regression model as it allows to make no assumption about the nature of the hazard function (Cox, 1972). Following previous studies (Bessudnov et al. 2013; Lallo and Raitano, 2018), we use age as analytic time variable, setting entry time at age 65 or age at retirement, whichever later, and exit time at age 74 or age attained by the end of 2019, whichever earlier. We summarize these choices in a Lexis-type diagram reported in Figure S1. We choose to set 65 as minimum entry time because it is the age by which most individuals in our period of analysis enter into retirement. Likewise, we decide to impose a right-censoring at age 74 since the number of individuals in our dataset, who have turned older by the end of 2019 is negligible. As a consequence of using age as time of entry and exit, our dataset presents a large number of ties, i.e. contemporary entry and exit of individuals. We tackle this issue by applying the Efron method, which is particularly suited for handling multiple ties (Efron, 1977). We consider two specifications. In the baseline specification, we model the relationship between mortality and occupational class only, stratified by year of birth and year of retirement. The baseline specification looks as follows:

$$h_i(t) = h_0^{\sigma}(t) \times \exp\left(\beta_j \times Occupation_{i,j}\right)$$

where the subscripts i and j indicate individual i and occupation j, respectively, and $h_0^{\sigma}(t)$ is the baseline mortality hazard, stratified by year of birth and year of retirement (σ). In the extended specification, we add controls for factors which may plausibly correlate with occupational class and mortality, including educational level, marital status, macro-region of residence (including residence abroad), reception of disability benefits/social disability benefits.

In order to better assess the implications of heterogeneous mortality across occupational groups, one needs to translate the estimate mortality hazards into an index universal enough to provide a reliable measure of residual lifespan. For this purpose, we estimate both partial life expectancy at ages 65-74 and full life expectancy at age 65. Using the Kaplan-Meier method, we first estimate the survivor function for each occupational class between ages 65 and 74. Partial life expectancies are then computed as the areas below the occupation-specific survival curves, from age 65 to age 74. To estimate full life expectancies, we extrapolate survival curves using two-parameter Brass relational logit model, which is commonly used in the presence of incomplete survival curves (Brass, 1971; Wilmoth, 2011). The classical Brass relational model posits a linear relationship between the logits of any two human survival curves. One can therefore obtain complete survival profiles by relating the logits of any incomplete survival curve, Y_x, to the logits of a standard (complete and trustworthy) survival curve, Y_x^s:

$$Y_x = \alpha + \beta Y_x^s$$

where α and β are the parameters of the model, estimated via linear regression, and x is the subscript for age. Y_x and Y_x^s are derived directly from the survival curves by applying the following logit transformations:

$$Y_x = \frac{1}{2} \times \ln \left[\frac{l_{(x)}}{1 - l_{(x)}}\right]$$

$$Y_x^s = \frac{1}{2} \times \ln \left[\frac{l_{(x)}^s}{1 - l_{(x)}^s}\right]$$

where $l_{(x)}$ are the values of the incomplete survival curve (in this case, each of the simulated gender-specific survival curves for all occupational groups) and $l_{(x)}^s$ are the values of the complete survival curve (in this case, the official survival curve of the Italian population, by gender, certified by the Italian National Institute of Statistics)[4]. As further discussed below, a major limitation of this approach is that it assumes that survival profiles prevailing over the observed age range (65-74 in this case) will persist at older ages. Finally, full life expectancies are calculated as the areas below the complete occupation-specific survival curves, from age 65 to age 119.

Cox proportional hazard regression models

Tables 4a and 4b report results from Cox proportional hazard regression models for men, where occupations are classified based on 1-digit (macro) and 2-digit (micro) occupational codes respectively. Coefficients are expressed in the exponentiated form (hazard ratios). When stratifying for year of birth and year of retirement only, we document a clear occupational gradient in mortality at ages 65-74 across macro-occupational groups (Table 4a, Column 1). Compared to the reference group (*Clerical support workers*), individuals in upper non-manual occupations face substantially lower mortality risk between 65 and 74. Managers and senior officials display the lowest mortality risk (-35%), followed by professionals (-29%) and technicians (-13%). On the contrary, individuals in lower manual or unskilled groups face substantially higher mortality risk. Male retirees holding a background in elementary occupations face the highest mortality risk (+17%), followed by plant and machine operators/assemblers (+13%) and craft and related trade workers and skilled workers in agriculture, forestry and fishery (+11%). When adding controls for possible confounders

[4] We use the survival curves of the Italian population certified by the Italian National Institute of Statistics in 2018 (the most recent at the time of writing).

(Table 4a, Column 1), estimated hazards change slightly in magnitude, but occupational background remains a powerful determinant of males' post-retirement mortality. Cox proportional hazard regression analysis based on micro-occupational groups yields broadly consistent results, allowing to identify specific high- and low-risk occupational profiles (Table 1.4b). Looking at the extended specification (Table 4b, Column 3), male retirees holding an occupational background in engineering, architecture and similar professions display the lowest mortality risk (-28%) compared to the reference group (*General and keyboard clerks),* followed by former managing directors and chief executives (-22%). Comparatively high-risk profiles include unskilled sales workers, cleaners and helpers (+77%), labourers in mining, construction and manufacturing (+22%), and assemblers (+17%). While occupational inequalities in mortality are the core object of this study, there is also some interest in the estimated associations between mortality and control variables. Focusing on Table 4b, higher education comes with lower post-retirement mortality risk, all other things equal. Men with tertiary education (university degree) face a 17% lower mortality hazard compared to men with primary education. No statistically significant differences emerge, instead, for those holding secondary education. Marital status is a remarkably strong and consistent predictor of post-retirement survival. *Ceteris paribus*, widowed, separated/divorced, and unmarried men have all higher post-retirement mortality risk compared to married men: +25%, + 38% and +59%, respectively. Macro-region of residence is also significantly associated to mortality: for men living abroad and in the North-East and North-West of Italy, the mortality hazard ratios are respectively 30%, 16% and 8% higher compared to men living in the Centre, while no statistically significant differences emerge for those residing in the South-Islands and abroad, all other things equal. Finally, as one may expect, men who receive disability pension benefits face substantially higher mortality risk compared to non-recipients, *ceteris paribus* (41% higher in the case of ordinary disability benefits and 847% higher in the case of social disability benefits).

Results for women are reported in Tables 5a and 5b. In this case, we find limited evidence of occupation gradient in mortality over the considered ages across micro- and micro-occupational groups, in both the baseline and extended specifications. In fact, hazard ratios, albeit imprecisely estimated, suggest that some categories of women at the very top of the occupational hierarchy, such as managing directors and chief executives, may actually face *higher* post-retirement mortality risk compared to the category of reference (Table 5b). On the contrary, women belonging to manual or unskilled occupations, such as cleaners and helpers, display *lower* post-retirement mortality compared to the reference group. It is worth noting that the lack of a clear occupational gradient in mortality among female retirees aged 65-74 is consistent with the lack of a clear gradient over the educational dimension. Indeed, women with secondary and tertiary education do not face significantly lower mortality risk compared to women with primary education, other things equal. Instead, marital status is a strong predictor of mortality in the case of female retirees too. Focusing on Table 5b, widowed, separated/divorced and never married women face mortality hazard ratios which are 26%, 51% and 78% higher compared to married women, *ceteris paribus.* The same holds for disability benefits: women who receive ordinary and social disability benefits are exposed to a post-retirement mortality risk which is 70% and >1300% higher than non-recipients, other things equal. Finally, macro-regional disparities in post-retirement survival among women are qualitatively and quantitatively analogous to those recorded in the case of men.

The main assumption of the Cox model is the proportionality of hazards. We check this assumption by examining Schoenfeld residuals after fitting the baseline and the extended models, for men and women separately. Results for our main explanatory variables, i.e. the occupational category dummies, are largely reassuring. In all models, we find the proportional hazard assumption to hold for all occupational category dummies, both for men and women (Tables S1-S4).

Life expectancy estimates

We now examine how mortality differentials at ages 65-74 by former occupation translate into lifespan differentials. Figures 1a-1b display partial life expectancies between ages 65-74 for men, together with the respective 95% confidence intervals. Consistently with results delivered by Cox proportional hazards regression models, we document a fairly clear occupational gradient in residual lifespans. Partial life expectancies across macro-occupational groups range from 8.4 years for male retirees holding a background in elementary occupations and as machine operators/assemblers, to 8.7 for former managers and senior officials (Figure 1a). Looking at specific occupations, the highest partial life expectancy is recorded by former engineers, architects and similar professionals, followed by legislators and senior officials, and by managing directors and chief executives, while the lowest is displayed by numerical and material recording clerks, assemblers and labourers in mining, construction, and manufacturing. When extrapolating survival curves to obtain full life expectancies at 65, the gap between the bottom and the top of the lifespan distribution clearly widens. Between former managers and senior officials (e_{65}=20.27) and plant machine operators/assemblers (e_{65}=16.82) there is a gap in life expectancy of about 3.4 years (Figure 2a). Disparities by specific occupational class are even more pronounced. Indeed, at age 65 former engineers, architects and similar professionals (e_{65}=20.76) can expect to live 5 years longer than former protective service workers (e_{65}=15.73) (Figure 2b).

Results for women are displayed in Figures 3a-4b. In line with results yielded by Cox proportional hazard regression models, there is limited occupational gradient in female retirees' partial and full life expectancies. Indeed, the distribution of residual lifespans across occupational groups is markedly narrow, with hardly statistically discernible differences across most groups, as witnessed by overlapping confidence intervals. Focusing on macro-occupational groups, partial life expectancies at 65-74 range from 8.66 in the case of plant and machine operators/assemblers to 8.78 in the case of professionals (Figure 2a). In the case of specific occupations, teaching and research professionals boast the highest partial life expectancy (8.79) and clerical support workers the lowest (8.63) (Figure 2b). Looking at full life expectancies across macro groups, at 65 females with an occupational background as managers and senior officials can expect to live 2.4 years longer than former plant and machine operators/assemblers (Figure 4a). At the micro level, the lack of a clear occupational gradient becomes particularly visible. Indeed, female retirees holding a background in lower manual and unskilled occupations, such as cleaners and helpers (e_{65}=21.99) and unskilled sales workers (e_{65}=21.21), can expect to live longer than former managers (e_{65}=20.81) or legal, cultural and social professionals (e_{65}=20.46). It is worth noticing that in the case of women, tangible disparities in mortality emerge within macro-occupational groups themselves. For instance, legislators and senior officials (e_{65}=22.17) boast an advantage in life expectancy at 65 of about 1.4 years compared to managers (e_{65}=20.81), a group which includes managing directors, chief executives, and professional services managers. All estimates of partial and full life expectancies by sex and occupational group, along with their respective 95% confidence intervals, are reported in Tables S5-to S12 in the Appendix.

The evolution of lifespan inequalities among the over 50 in Italy

In this part of the paper, we investigate trends in life expectancy and lifespan variation by socio-economic status at age 50 and at statutory retirement age for individuals previously employed in the private sector in Italy.

Data

We rely on two main sources drawn from the INPS archives. First, we make use of annual data taken from the *Dichiarazioni UniEmens* archive, which keeps track of the universe of private employment spells in Italy. Second, we employ annual data from the *Casellario Pensioni* archive, which gives access to the universe of all types of pension benefits disbursed by pension schemes supervised by INPS. A major drawback of INPS data is the paucity of information about personal characteristics. We notably lack information about education, family status, and other family background characteristics. Information about place (province) of residence and marital status is available for beneficiaries of pension benefits only. For the latter, we can also match across spouses. For each individual, we have information about month and year of birth and, when applicable, death (updated to December 31, 2019).

The *Dichiarazioni UniEmens* archive

The *Dichiarazioni UniEmens* archive reports detailed information about the universe of private employment spells registered in Italy since 1975. Our observation period ends in 2017. For each spell, we have information about gross earnings, the number of days, weeks, and months worked, the broad occupational category (blue-collar, white-collar, middle-manager, manager) and the kind of job contract (full-time versus part-time, permanent versus temporary contract). We also have information about periods of absence from work due to family/parental leaves, sickness/injury, temporary suspension/reduction of working activities covered by the Wage Guarantee Fund (*Cassa Integrazione Guadagni*), and about the related monetary allowances. Our original dataset consists of 306,930,929 observations, relative to 21,966,659 individuals.

We use the *Dichiarazioni UniEmens* data to classify individuals by socio-economic status along two dimensions: employment income and broad occupational category, both measured at mid-career time (ages 45-49). As far as income is concerned, for each individual we calculate the inflation-adjusted average of non-zero gross employment earnings between ages 45-49, which we take as a proxy for lifetime income (Auerbach et al. 2017; Burtless et al. 2016; Milligan and Schirle 2021). It is important to stress that our data do not allow to distinguish periods of missing earnings due to inactivity or unemployment, self-employment, work under social security schemes not managed by INPS (e.g. public employment), or informal work. By relying solely on calendar years with positive earnings, we intend to construct a measure of earnings potential (lifetime income) which is not affected by unemployment, severe health problems, or missing information on earnings from work not covered by our data. We then classify individuals into lifetime income quintiles based on the distribution of their birth cohort, considering men and women separately. As for occupation, we assign individuals to the prevalent occupation category, broadly defined, recorded between ages 45-49, distinguishing between blue-collar (*operai*), white-collar (*impiegati*) and managers (*dirigenti*).[5]

We restrict our analysis to individuals born between 1930 and 1957, for whom we can observe earnings and occupation between ages 45-49 and perform a mortality follow-up of at least ten years. Since we are interested in analysing mortality after 50, we drop individuals who die before 50. Our final sample includes 6,949,246 individuals, 4,842,306 men and 2,106,940 women. Table 6 summarizes the steps taken in the construction of the sample, while Table 7 reports the distribution of the sample by cohort, together with survival information. To get a sense of the evolution of lifetime income across cohorts, we plot trends in inflation-adjusted average permanent earnings by sex and year of birth in Figure S2. For men, average lifetime income increases steadily for cohorts born between 1930 and the mid-1940s. They stall and then decline for later cohorts who were affected by the crisis of 1992 and by the recession of the early 2000s. Women, who record substantially lower lifetime income compared to men, experience a constant increase in average permanent earnings, except for later cohorts. As suggested by Figures S3, which plot average permanent earnings by lifetime income quintile, sex and birth cohort, the rise in average permanent earnings was driven mostly by individuals at the top of distribution, both for men and women. As for descriptive statistics by occupation, Tables S13, S14 and S15 report the distribution of prevalent occupational position, by sex and year of birth, respectively. The most salient aspect is the scarcity of women among managers, especially in the case of earlier cohorts.

The *Casellario Pensioni* archive

The *Casellario Pensioni* dataset reports information about the universe of pension benefits disbursed by INPS since 1995. Our observation period ends in 2017. For each pension benefit,

[5] The Italian labour law envisages a fourth broad occupational class consisting of white-collar employees with quasi-managerial responsibilities (*quadri* in Italian). Since this class is numerically residual and was introduced after 1985, we do not include it in our analysis.

we have information about the gross annual amount, the date in which the pension flow started, the date in which the pension flow ended (if this occurs by the end of 2017), the type of pension (old age, seniority, disability, etc.), the INPS pension scheme, and the years of contributions. We consider beneficiaries of pension benefits disbursed by INPS major pension scheme, i.e. FPLD (*Fondo Pensioni Lavoratori Dipendenti*), which represents the public pension scheme of private sector employees. We do not consider retirees covered by pension schemes for the self-employed, encompassing craftsmen, shopkeepers, and farmers, as for these categories pension represents a poor proxy of lifetime income (Belloni et al. 2012).[6] However, we consider former employees who also receive self-employment pension benefits if the latter represent a minor share (<50%) of their total pension income. We focus on beneficiaries of old-age (*vecchiaia*), seniority (*anzianità*) and early-retirement (*pre-pensionamento*) pension benefits, which are most clearly related to individuals' working life. We select individuals born between 1910 and 1950, who retired by and survive to age 67, which currently represents the statutory retirement age for calling old-age pension benefits. Since individuals belonging to these cohorts can be expected to retire at age 67 at the latest, age 67 is also the earliest age for which we can observe an entire distribution of pension benefits disbursed in each calendar year. We choose to focus on individuals born from 1910 onward because of the high proportion (>20%) of retirees with null or missing pension income among the older cohorts. We further select individuals who retired under defined-benefit or mixed (defined-benefit and defined-contribution) pension rules (further details below). Our final pensioners' sample includes 7,260,404 individuals 3,755,130 men and 3,505,274 women.

For each calendar year, we classify individuals into quintiles of pension benefits.[7] Assigning individuals to pension benefit quintiles raises two main issues. First, to define quintiles consistently, one should ideally consider pension benefits drawn at a specific reference age, such as statutory retirement age. In our case, this can be done only partially, since retirees belonging to older cohorts can be observed for the first time well after statutory retirement age. We thus proceed as follows. In the case of individuals born from 1928 onward, we consider pension benefits collected at age 67. In the case of individuals born between 1910 and 1927, instead, we consider pension benefits collected at age attained in 1995 (our first year of observation), and use cut-off values from the pension benefits distribution at age 67 of cohort 1928. Second, pension rules changed repeatedly, and significantly, over the period of analysis. The first major change occurred with the Dini reform in 1995, which determined a slow transition from defined-benefit (DB) to notional defined-contribution (NDC) pension rules.[8]

[6] This is due to historically low contribution rates impinging on self-employed workers as compared to employees.
[7] The distribution of pension benefits in the case of women appearing in the *Casellario Pensioni* archive is strongly concentrated, particularly around minimum pension values. In order to assign women to pension quintiles, we add to each individual pension income a random amount between +5 and -5 euro.
[8] Under the defined benefit pension regime, pension benefits are determined multiplying pensionable earnings by the number of working years and by an accrual rate. Under the NDC regime, contributions are (fictitiously) accumulated in an individual fund, and are re-evaluated in line with a moving average of GDP growth. Pension benefits are then computed by multiplying the re-evaluated contributions by a coefficient which depends on remaining life expectancy at retirement. Such coefficients are neutral with respect to gender and other relevant

Indeed, the phase-in period of the Dini reform was set to be very gradual. Workers with at least 18 years of contributions as of December 1995 were fully unaffected by the reform. Instead, those with a shorter contributory record were to be affected on a *pro rata* basis, the weight of DB depending on the ratio between pre-1995 to the overall contribution period upon retirement. The second major change occurred in 2011, with the so called Fornero reform, which accelerated the transition to full NDC rules, introducing a *pro-rata* contribution for all workers starting from January 1, 2012. In other words, all pensions awarded from this date onward have an NDC component, regardless of the 18-year contribution period mentioned above. Over the period of analysis (1995-2017), retirees may thus belong to four main groups: (i) those who retired by 1995 fully under defined-benefit rules, (ii) those who retired between 1996 and 2011 fully under defined-benefit rules having accumulated at least 18 years of contributions as of December 1995, (iii) those who retired between 1996 and 2011, under a mixed (*pro rata*) regime having accumulated less than 18 years of contributions as of December 1995, (iv) those who retired between 2012 and 2017 under a mixed (*pro rata*) regime. To account for differences in pension calculation formulas over the period of interest, we assign quintiles for those who retired fully under defined-benefit and mixed regime separately.[9] Table 8 shows the distribution by calendar year and pension regime, for men and women separately. To gain insights about the difference implied by the two calculation mechanisms (defined-benefit vs mixed regime), we inspect the evolution of median inflation-adjusted annual gross pension amount at age 67 for cohorts born from 1928 onward, distinguishing pensioners who retired under defined-benefit rules from the rest of the sample. As shown by Figure S4, the difference implied by the calculation mechanism is particularly relevant in the case of women, who are particularly penalized by defined-contribution due to shorter/more fragmented careers and lower contributory amounts.

Methods

Period vs cohort mortality

We construct period- and cohort-based mortality profiles for different socio-economic groups depending on data availability. In the period-based approach, one considers the mortality experienced by individuals belonging to a given population (a "synthetic" cohort) during a given period of time (e.g. a calendar year). In its most straightforward interpretation, period life expectancy measures the average lifespan that would prevail in the long run if the observed mortality conditions were held fixed. In the cohort-based approach, instead, one considers the mortality experienced by individuals belonging to the same birth cohort as the cohort ages. Cohort life expectancy thus measures the average lifespan that an individual belonging to a given cohort can be expected to live. While more suited to capture changes in mortality over time, the cohort-based approach is rarely adopted to track progresses in longevity. A major

socio-economic characteristics, but they are periodically updated to account for changes in official life expectancy projections.

[9] We ignore individuals who retired fully under defined-contribution rules given their paucity during the period of interest.

explanation for this lack of popularity owes to timeliness. Indeed, one needs a cohort to die out in order to compile its full mortality profile, which implies waiting at least a hundred years before being able to compute life expectancy for any given cohort (Guillot et al. 2019). In this paper, when studying lifespan inequalities from a cohort perspective, we thus resort to projections based on observed, albeit incomplete, cohort mortality profiles.

Measuring lifespan variation

The demographic literature offers an array of indices of lifespan variation, which tend to be all highly correlated (van Raalte and Caswell, 2013). In this paper, we opt for lifetable entropy, $\bar{H}$, which measures the elasticity of life expectancy with respect to mortality rates (Leser, 1995; Keyfitz, 1975; Keyfitz, 1977; Demetrius, 1978) and which has been used to study the evolution of lifespan inequality (Aburto et al. 2020). As shown by Goldman and Lee (1986) and Vaupel (1986), $\bar{H}$ can be expressed as follows:

$$\bar{H}(a) = \frac{e^{\dagger}(a)}{e(a)}$$

where $e^{\dagger}(a) = \int_a^{\infty} e(x)d(x)\, dx$, also known as life disparity, denotes the number of years lost to death at age a, and $e(a)$ denotes life expectancy at age a. As one can note, $e^{\dagger}$ is computed as the weighted average of the distribution of remaining life expectancies, $e(a)$, where the weights are given by the distribution of lifetable deaths $d(x)$. $\bar{H}$ is a dimensionless indicator, ranging between 0 and 1, where $\bar{H} = 1$ and $\bar{H} = 0$ indicate, respectively, maximum and null dispersion. As suggested by Alvarez et al. (2020), lifetable entropy is preferable to other indices of lifespan variation if one needs to compare lifespan variation at different ages. One reason is that lifetable entropy is, as said, a dimensionless indicator, as it does not depend on the level of mortality. In addition, unlike absolute measures of lifespan variation, such as life disparity or standard deviation, it does not hinge on the starting age of calculation a. Both properties are particularly useful if one needs to evaluate the distribution of lifespan at different starting ages, as in our case.

Cohort life tables by mid-career income and occupational class

We construct life tables starting from age 50 by mid-career employment income and broad occupational group for cohorts born between 1930 and 1957, using data from the *Dichiarazioni UniEmens* described above. We focus on individuals who survive to age 50, following them until 2018 or until the year of death, if this occurs earlier. Our data imply that we can construct heterogeneously incomplete mortality profiles across cohorts. Indeed, while we can observe individuals born in 1930 until age 88, for those born in 1957 the follow-up extends up to age 61 only. We tackle this issue by projecting mortality rates until 89 based on Gompertz' Law (Gompertz, 1825), following the approach adopted by Chetty et al. (2016). The Gompertz' Law posits a log-linear relationship between mortality, *M*, and age, *x*, which can be expressed as follows:

$$\ln(M_x) = \beta_0 + \beta_1 x$$

Such relationship has proved to hold well to ages as old as 90 (Gavrilov and Gavrilova, 2011). To build complete cohort mortality profiles we proceed as follows. First, we compute observed cohort mortality rates, by sex and socio-economic group, using data on death counts and population exposure. Specifically, for cohorts born before 1943, we calculate observed mortality rates from 50 through 75, while for cohorts born from 1943 onwards, we calculate observed mortality rates from 50 through the last observable age:

$$M_{x,s,g,c} = \frac{D_{x,s,g,c}}{P_{x,s,g,c}} \quad \forall\, x \in \{50, \dots, a)$$

where the subscripts *x, s, g, c* denote, respectively, age, sex, socio-economic group, and birth cohort, with $a = 75$ for cohorts 1930-1942 and $\mathrm{a} = 2018 - \mathrm{c}$ for cohorts 1943-1957. M denotes the mortality rate, computed as the ratio between death counts, D, and population exposure, P, measured in terms of person-years lived. We use the observed mortality rates to estimate Gompertz parameters β_0 and β_1 through ordinary least squares. For cohorts born before 1943, we estimate Gompertz parameters between 50 and 75, while for cohorts born from 1943 onwards, we estimate Gompertz parameters between 50 and the last observable age. We then use $\hat{\beta}_0$ and $\hat{\beta}_1$ to project mortality rates from age a to age 89, as $\widehat{M}_{x,s,g,c} = e^{\hat{\beta}_0 + \hat{\beta}_1 x}$. After 89, we apply age- and sex-specific mortality rates based on Italian population taken from Istat (2018).

We build cohort life tables for each subgroup starting from mortality rates by applying standard lifetable techniques (Wachter, 2014), from which we extract lifespan indicators of interest, i.e. life expectancy and lifetable entropy. To build confidence intervals for life expectancy and lifetable entropy estimates, we draw new Gompertz parameters from a multivariate normal distribution with the means and covariance matrix obtained directly from the ordinary least squares estimation procedure for each sex, socio-economic group and cohort combination (Chetty et al. 2016). We make 1,000 draws for each sex, socio-economic group and cohort combination.[10] We then form our confidence intervals using the 2.5th and 97.5th percentiles of the resulting life expectancy and lifetable entropy distribution for each combination of interest.

Period life tables by pension income

We construct period life tables by pension income quintile starting from statutory retirement age, currently set at age 67, for calendar years 1995-2017, using data from the *Casellario Pensioni* archive described above. As said, we keep beneficiaries of old-age, seniority and early-retirement pension benefits, born between 1910 and 1950, who retired by 67. After such

[10] In other words, we perturb estimated Gompertz coefficients in order to build 1,000 life tables for each sex, socio-economic group and cohort combination.

age, we can expect most individuals to be retired. Our data allow us to follow the selected individuals from 1995 to 2017 or until the year of death, if this occurs earlier. This implies that we can track mortality from age 67 to age attained in 2017 for those born from 1928 onward, and from age attained in 1995 to age attained in 2017 for those born prior to 1928. The nature of these data makes cohort-based analysis poorly suitable for studying the evolution of lifespan inequalities at pensionable age. Indeed, for younger cohorts, i.e. those born from 1928 onward, the age span over which one may estimate reliable Gompertz parameters for further projections is too limited, if not null, while for older cohorts, i.e. those born prior to 1928, we are unable to observe mortality at 67. For these reasons, we adopt a period-based approach, implementing the following steps. First, for ages 67 through 85, we compute sex-, age-, and pension income quintile-specific mortality rates for each calendar year, as the ratio between death counts and population exposure (person-years lived):

$$M_{x,s,g,c} = \frac{D_{x,s,q,t}}{P_{x,s,q,t}} \quad \forall\, x \in \{67, \dots, 85)$$

where the subscripts x, s, q, t denote, respectively, age, sex, pension income quintile, and calendar year. We compute mortality rates based on observed data until 85 only, as this is the oldest age for which mortality is observable in 1995. We then use the observed mortality rates to extrapolate mortality rates at older ages (85+) by applying the Kannisto model, which is best suited for approximating mortality at very old ages (Thatcher 1988). According to the Kannisto model, mortality at older ages can be approximated as follows:

$$M_x = \frac{\alpha e^{\beta x}}{1 + \alpha e^{\beta x}}$$

We fit the Kannisto model through ages 75-85 and estimate parameters α and β through maximum likelihood for each sex, quintile and calendar year combination (see Appendix A), using the estimated Kannisto parameters to extrapolate mortality rates from 86 to 120. We build sex-specific period life tables for each pension quintile and calendar year starting from mortality rates. We estimate confidence intervals for life expectancy and lifetable entropy estimates by bootstrapping using Monte Carlo simulation methods, assuming death counts follow a binomial distribution (Chiang 1984; Andreev et al. 2010). Since the *Casellario Pensioni* dataset reports also information about pension beneficiaries' place (province) of residence, we construct sex-specific period life tables by pension quintiles both at the national and at the regional level. When constructing regional-level life tables, we assign individuals to pension quintiles based on region-specific pension distribution.

Results

Lifespan inequalities at 50

Figure 5 and Figure 6 display the evolution of life expectancy at 50, by lifetime employment income and broad occupational group, for men and women separately. Point estimates for each sex and socio-economic group have been averaged by decade of birth (estimates by single cohort are reported in Tables S16-S19). Results by lifetime income yield two main findings. First, there is a clear gradient in life expectancy in the case of men, which turns to be widening across cohorts, notably for individuals at the bottom of the distribution. Indeed, the gap in life expectancy at 50 between top and bottom quintile rises from approximately from 3 to 4.5 years comparing men born in the 1930s and in the 1950s. For women, on the contrary, we do not observe a clear gradient in life expectancy across the lifetime income distribution. Differences across quintiles are minimal and statistically not significant, as shown by overlapping confidence intervals. Results by broad occupational class yield a slightly different picture. We document a steep gradient in the case of men, which is stable across selected cohorts. Specifically, white-collar and managers boast an advantage of about 2 and 4.5 years respectively as compared to blue-collar workers. A modest gradient appears also in the case of women. Still, estimates come with considerable uncertainty, as suggested by the width of confidence intervals. Figure 7 and Figure 8 display the evolution of lifetable entropy at 50, by lifetime employment income and broad occupational group. In the case of men, we observe a clear gradient, which appears to be widening across cohorts, along both lifetime income and occupational group. In the case of women, we find a small gradient when measuring socio-economic status by occupational group, while differences across the income distribution remain negligible.

Our estimates of life expectancy and lifetable entropy at age 50 by lifetime employment income and occupation depend on Gompertz parameters which, for cohorts born from 1943 onward, are estimated over different age ranges. It is thus possible that widening inequalities observed by income in the case of men are due to selection effects rather than by truly worsening survival disparities. We address this issue in a twofold way. First, we calculate survival probabilities over ages 50-61, as this is an age range over which we can observe mortality for all the selected cohorts. Results are in line with those presented above. For individuals born in the 1930s, the difference in the probability of surviving to 61 at age 50 at the bottom and at the top of the permanent earnings distribution is about 2.5pp (Figure S5). For individuals born in the 1950s, the difference raises to 3.5pp. Figure S6 confirms, instead, the stability of survival differentials along the occupational dimension. Second, we construct cohort life tables based on observed mortality rates only. Specifically, for all cohorts born after 1928, we replace unobserved mortality rates until age 89 with those from the closest cohort for which such mortality rates are observed. For instance, we replace unobserved mortality rate at age 89 of cohort 1929 with that observed for cohort 1929. Likewise, we replace unobserved mortality rate at ages 88 and 89 of cohort 1930 with those observed for cohorts 1928 and 1929 respectively, etc. In this case too, results are qualitatively in line with those discussed above, both for mid-career earnings and occupational position (Figures S7 and S8).

Another issue arises from the presence of individuals with relatively low attachment to the labour market, at least in terms of private employment. Indeed, about 23% of individuals in the *Dichiarazioni Uniemens* dataset are observed for less than 4 years between ages 45-49 (Table S20). These might be individuals who alternate periods of dependent and autonomous work, or who transition back and forth between formal and informal work, or who move into or out of the public sector. These might also be individuals who leave the labour market for family or health reasons or who migrate abroad. In all these cases, average employment income between ages 45-49 measurable through the *Dichiarazioni Uniemens* dataset might be a poor proxy of permanent earnings. It is possible, for instance, that people in the bottom mid-career income quintile are individuals with low labour market attachment due to poor health or family issues. To attenuate these concerns, we repeat our analysis by dropping individuals who are observed for less than 4 years between 45 to 49 in the *Dichiarazioni Unienems* dataset. This leaves us with a sample of 5,373,049 individuals, 3,876,087 men and 1,496,962 women. Results are analogous to baseline ones, for both men and women (Figures S9 and S10). The same holds when performing such sensitivity analysis on results relative to prevalent mid-career occupational position.

Lifespan inequalities at statutory retirement age

Figure 9 and Figure 10 display the evolution of life expectancy and lifetable entropy at 67 by pension income at the national level for former private employees (FPLD), over calendar years 1995-2017, grouped by 5-year periods (3-year in the case of 2015-2017; estimates by single calendar year are reported in Tables S21-S24). We observe a widening gradient both in life expectancy and lifetable entropy by pension quintile among men. Over the examined period, the gap in LE at 67 between male FPLD pensioners at the top and the bottom of the pension income distribution doubles. Instead, we observe no such a gradient among women. If anything, female FPLD pensioners at the bottom of the pension income distribution appear to fare better in terms of both average and variation in age-at-death compared to counterparts at the top of the pension income distribution. We exploit the information about pensioners' province of residence to check whether such trends apply to the whole country. Figure 11 and Figure 12 plot the difference in life expectancy at 67 between individuals located at the top and at the bottom of the pension income distribution, for men and women separately, across Italian regions, in 1995-1999 and in 2015-2017. A few results stand out. First, among men, the life expectancy gap is larger among Northern than Southern-Central regions, with the notable exceptions of Molise.[11] It is noteworthy, though, that the life expectancy gap among men has widened in most Italian regions when comparing 1995-1999 to 2015-2017. In the case of women, region-level analysis confirms that differences in life expectancy at the top and at the bottom at the income distribution among women are mostly negligible (±1 year), and that in some regions women at the bottom of the pension income distribution can expect to live *longer* than women at the top of the pension income distribution. Although some regions display some

[11] Northern regions include Valle d'Aosta, Lombardia, Piemonte, Liguria, Veneto, Trentino Alto-Adige, Friuli-Venezia Giulia, Emilia-Romagna; Central regions include Toscana, Lazio, Umbria and Marche; Southern regions (including Islands) include Abruzzo, Molise, Puglia, Campania, Basilicata, Calabria, Sicilia and Sardegna.

visible changes when comparing life expectancy differences in 1995-1999 vs 2015-2017 (e.g. Marche and Valle d'Aosta), we detect no clear trend in the evolution average lifespan disparities among female retirees across Italian regions, consistently with nation-level results.

A possible explanation for the lack of a clear gradient in both life expectancy and lifespan variation among female FPLD retirees is that pension income is a poor proxy of socio-economic status for this category of women. It is possible, for instance, that women at the bottom of the pension income distribution are women who could afford to hold low-paying jobs or to opt for fragmented careers based on the availability of household resources. A first way to test for this hypothesis is to restrict the analysis to women with pension income above the minimum in each calendar year[12], i.e women whose pension income could be more revealing of socio-economic status. Still, (nation-level) results are qualitatively and quantitatively analogous to baseline ones, with no statistically discernible socio-economic gradient in both life expectancy and lifespan variation among female retirees (Figures S10-S11). An alternative approach is to relate women's post-retirement mortality to husbands' pension income, which serves as a proxy for household resources. For this purpose, we exploit the possibility of matching across spouses appearing in the *Casellario Pensioni* archive. Since the latter keep tracks of pension benefits disbursed between 1995 and 2017, we can only focus on female FPLD pensioners married to FPLD beneficiaries of old-age, seniority and early retirement pension benefits who were still alive in 1995. We restrict our analysis to women turning 67 between 1995 and 2017, i.e. those born from 1928 onward. We perform a mortality follow-up which extends up to 2017, or until their year of death, if this occurs earlier. We apply logistic survival analysis where yearly mortality risk of female FPLD pensioners is regressed against husband (cohort-specific) pension quintile, own (cohort-specific) pension quintile, year of birth, age difference with respect to husband, widowhood status, macro-region of residence, and macro-region of birth. We opt for not imposing any constraint on the baseline hazard. That is, we include in the model as many dummies as the maximum survival time observed. Since the earliest and last year of observation are 1995 and 2017 respectively, the maximum survival time is 23 years. Table 9 reports the results, in terms of odds ratios. Two findings stand out. First, in line with results presented above, we find that women's post-retirement mortality correlates *positively*, albeit non-linearly, with their own pension quintile. Women in the top pension quintile display a post-retirement mortality risk which is 16.5% higher than women in the bottom pension quintile, *ceteris paribus*. Second, we document the existence of an inverse relationship between women's post-retirement mortality and husband's pension income, which appears in particular at the top of the distribution. Indeed, women whose husbands locate in the respective top pension quintile have a post-retirement mortality risk which is 12% lower than women whose husbands locate at the bottom of the male pension income distribution, *ceteris paribus*. While data do not allow to properly study lifespan inequalities by spouse's income, these findings question the limited, if not inverse, socio-economic gradient in health

[12] The pension minimum for calendar years 1995-2017 is reported in Table S26.

and longevity among elderly women documented above, as well as in previous studies, based on women's own income.[13]

The distributional implications of longevity differentials

In the final part of this study, we evaluate the distributional consequences of longevity differentials within the Italian pension system. We focus on individuals born between 1930 and 1950 who retired under the private employees' pension scheme (FPLD). The frequency of changes in pension rules over the last decades in Italy, briefly outlined in Appendix B, poses some challenges. In particular, it makes difficult to disentangle changes in distributional dynamics due to changes in longevity differentials across birth cohorts, as individuals may face different retirement conditions depending on the retirement timing. While most individuals in cohorts 1930-1950 had their pension computed under defined-benefit rules, policy changes touching upon the contributory/age requirements, the reference period for the calculating pensionable earnings and the indexation mechanism, may imply that important discontinuities in retirement conditions exist within and between birth cohorts. With this caveat in mind, we proceed as follows. We first reconstruct the contributory biographies of a large sample of FPLD retirees based on the *Estratti Conto* archive. The *Estratti Conto* archive allows to track the contributory history of private sector workers covered by INPS-managed social security schemes. The *Estratti Conto* dataset provides a detailed record of all episodes in one's working life covered by INPS social security contributions: employment/self-employment job spells, parental/family leaves, sickness/injury episodes, unemployment spells covered by social benefits. Thus, compared to the *Dichiarazioni Uniemens*, the *Estratti Conto* allow to track spells falling outside the scope of private employment episodes. We then relate contributory histories to projected pension flows in order to evaluate distributional dynamics across the chosen cohorts. We look at two main measures: pension wealth at retirement (PW) and internal rate of return of pension contributions (IRR). To isolate the distributional implications of longevity differentials, we compare the distribution of PW and IRR based on cohort-, sex- and lifetime income quintile-specific mortality profiles previously estimated, with the distribution of PW and IRR based on cohort- and sex-specific mortality profiles, averaged across all lifetime income quintiles.

Data and methods

Pension contributions

We have access to the contributory histories, reported in the *Estratti Conto* archive, of a random sample of 260,584 FPLD retirees, who appear as recipients of old age, seniority or early retirement pension benefits in any year between 1995 and 2017 in the *Casellario Pension*

[13] We also analyze association between men's port-retirement survival and wife's pension income. We find a negative association between men's mortality and wives' pension quintile, but for men whose wives locate at the top of the female pension distribution (Table S225).

archive[14]. Out of this initial sample, we select individuals born between 1930 and 1950 who could be assigned to cohort-specific lifetime income quintile based on average gross employment earnings observed at ages 45-49 as recorded in *Dichiarazioni Uniemens*. We further focus on the subset of "stable" workers, i.e. individuals who whose contributory history, as tracked by the *Estratti Conto* dataset, does not contain substantial gaps (>5 years). We end with a final sample composed of 97,321 individuals (69,241 men and 28,180 women). Table 10 recapitulates the steps taken in the construction of the sample.

The *Estratti Conto* archive presents two major limitations for our purposes. First, for each contributory spell it does not report contributions directly, but only the social security taxable base, i.e. gross earnings. For this reason, we focus on contributory spells falling under the FPLD fund, as for the latter reliable information on historical contributory rates is made directly available by INPS (Figure S12). Second, the *Estratti Conto* archive provides reliable information about social security taxable base from 1974 onwards. Prior to 1974, information about gross earnings is missing for most contributory spells. This means that for most cohorts we have only a partial overview of individual lifetime earnings profiles, and consequently of their contributory biographies. In order to construct a measure of contributions paid over one's entire working life, which is crucial for our distributional analysis, we need first of all to impute gross earnings for years prior to 1974. This implies we need also to impute the age at which individuals start working for those who enter the labour market prior to 1974. For this purpose, we exploit information about years of contributions available for each FPLD retiree. Following Brugiavini and Peracchi (2003), we impute gross annual earnings for years prior to 1974 by fitting a simple fixed effects model for the logarithm of gross earnings, using age and the years of contribution as predictors, where age enters as a cubic polynomial while years of contribution enter linearly. The model looks as follows:

$$Earnings\ (log)_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Age_{it}^2 + \beta_3 Age_{it}^3 + \beta_4 Yrs\ of\ contributions_{it} + \gamma_i + \epsilon_{it}$$

where subscripts *i* and *t* identify individuals and years, respectively, and γ_i identifies individual fixed effects. We fit the model separately for men and women through ages 24-60 focusing on full-year, inflation-adjusted earnings.[15] Table 11 reports the estimated regression coefficients, that we use to impute earnings for years prior to 1974. For each retiree, we estimate the amount of individual contributions in each year by multiplying the imputed/observed gross earnings by the relevant contribution rate.

Pension wealth

[14] Individuals were randomly selected based on their unique identifier, conditional on appearing in the *Pensioni Casellario* as recipients of old age, seniority and early retirement pension benefits.

[15] That is, for each observation we exclude first and last year in the sample to account for the fact that people typically work only part of the year they enter / exit the sample. The model is estimated through ages 24-60 as 24 is the first age observed in the *Estratti Conto* for individuals born in 1930-1950, and average retirement age for individuals in the sample is below 60.

Pension wealth at retirement (PW) can be expressed as the sum of pension benefits received from retirement *R* until the expected age of death *T*:

$$PW_i = \sum_{s=R_i}^{T_i} p_{is}$$

Where p_{is} represents pension benefits received by individual *i* at age *s*, *R* is the age at retirement, and *T* is the expected age of death at retirement. Since the period coverage of *Casellario Pensioni* starts in 1995, we calculate pension wealth of individuals who survive to age 65, as this is the first age at which individuals born in 1930 can be observed in the dataset. We are able to calculate pension wealth at retirement for 93,260 individuals (Table 10). Since we have information about gross annual pension benefits from 1995 up to 2017, and there are some individuals who retire before 1995 and are still alive at the end of 2017, we must estimate the stream of individual pension benefits before 1995 and beyond 2017. For years prior to 1995, we discount annual pension benefits received in 1995 by the average growth rate of pension benefits observed from 1995 onward for each individual. For years between 2018 and 2021, we let annual pensions to grow following the official indexation schedule provided by INPS.[16] After 2021, we assume that the same indexation schedule of 2021 holds, with an inflation rate of 1.5%. Finally, we discount compound/discount all pension benefits to the year 2019 with the consumer price index/projected inflation.

Internal rate of return

From an individual perspective, pension wealth *per se* is not informative about the profitability of pension contributions. For this purpose, one needs a measure which allows to compare lifetime contributions with expected pension benefits. Here, we opt for the internal rate of return (IRR). The IRR can be seen as the interest rate that should apply on contributions for generating enough funds to ensure the pension flow from retirement until the (statistical) death of the individual. In practice, the IRR is the interest rate *r* that equalizes the stream of pension contributions *c* paid over one's working life and the expected stream of pension benefits *p* at retirement *R*:

$$\sum_{t=a_i}^{R_i-1} c_{it}(1+r_i)^{R_i-t} = \sum_{s=R_i}^{T_i} \frac{p_{is}}{(1+r_i)^{s-R_i}}$$

where c_{it} is the contribution paid by individual *i* at age *t*, p_{is} is the pension benefit received by individual *i* at age *s*, r_i is the internal rate of return for individual *i*, *a* is the age at entry in the

[16] Pension benefits in Italy are indexed to price inflation since 1993. The indexation rate is not homogeneous, but it depends on pension amount. Pensions below a certain threshold, defined as three times the minimum pension, are indexed perfectly. Pensions above the threshold are indexed only partially, at a decreasing rate. For each individual, INPS considers the relevant indexation rate based on the sum of all pension benefits, including disability pension benefits, survival pension benefits, etc. Here, we make the simplifying assumption that individuals receive old-age, seniority and early retirement pension benefits only.

labour market, R is the age at retirement, and T is the expected age of death at retirement. An alternative to IRR is represented by the net present value ratio (NPVR), defined as the ratio between the present value of pension benefits and the present value of lifetime contributions (Mazzaferro et al. 2012; Mazzaferro 2019). Albeit computationally simple, a major limitation of the NPVR is that it requires some arbitrary choice for the discount rate. Instead, the IRR allows to endogenously determine the rate of return which equalizes the present value of pension benefits and the present value of contributions. We calculate individual rates of return under heterogeneous and homogeneous longevity using contributions and observed/estimated pension benefits derived as described above. We compound/discount all contributions and pension benefits to the year 2019 with the consumer price index/projected inflation.

Results

Figure 13 and Figure 14 plot the distribution of pension wealth by lifetime income quintile across birth cohorts calculated with heterogeneous and homogeneous life expectancies, for men and women respectively. In both scenarios, pension wealth increases monotonically with lifetime income quintile as pension benefits are computed over higher lifetime earnings, in real terms. Distributional implications of heterogeneous longevity are strongly gender-specific. In the case of men, we find that pension wealth is higher under the assumption of heterogeneous longevity for the top two quintiles, while it declines for the lower quintiles. Consistent with widening longevity differentials, such patterns become more pronounced across cohorts. As shown by Figure 15, the top quintile of male cohorts 1930-1934 gains about 58,000€ (+5.3%) in pension wealth when accounting for heterogeneous mortality, while the bottom quintile loses about 13,000€ (-5.7%). For male cohorts 1945-1950, the gain and the loss implied by heterogeneous longevity amount to about 110,000€ (+10.8%) and 38,000€ (-10.1%) for the top and bottom quintile, respectively. Trends in cohort-specific Gini coefficients of pension wealth among men corroborate these results (Table 12, Panel A). While the Gini coefficients of pension wealth shrinks over the selected male cohorts, the difference between Gini coefficients under heterogeneous and homogeneous longevity increases from 0.0192 to 0.0292 between male cohorts 1930-1934 and 1945-1950. In the case of women, distributional consequences of heterogeneous longevity are hardly sizeable, and do not follow a clear pattern across lifetime income quintiles and cohorts (Figure 16). These findings are consistent with disparate trends in life expectancy by lifetime income among women documented in the previous part of the paper. Similarly, differences in Gini coefficients under heterogeneous and homogeneous longevity are also minimal in the case of women (Table 12, Panel B). We get analogous results when investigating trends in pension wealth by retirement year rather than by birth cohort.

Figure 17 and Figure 18 shows the distribution of IRR (%) by lifetime income quintile across birth cohorts calculated with heterogeneous and homogeneous life expectancies, for men and women respectively. A few patterns emerge. First of all, average internal rates of return for each sex-quintile-cohort combination are all largely positive, both under the heterogeneous and homogeneous longevity scenario. This implies that individuals in the sample can expect to receive more in pension benefits than what they have paid in contributions. Averaging across all birth cohorts and quintiles, under both scenarios male and female retirees can expect to receive about 1.035 and 1.054 for each euro of pension contributions, respectively. This reflects the well-known generosity of defined-benefit pension rules, which do not include any actuarial adjustment for expected post-retirement survival. Such system is particularly advantageous to individuals with low contributory levels and long retirement span. Second, IRRs decrease on average over cohorts, for both men and women. This decline in the profitability of pension contributions is consistent with longer working lives, higher contribution rates, and stronger weight of the defined-contribution formula in the computation of pension annuities. However, such decline is driven mostly by individuals in the bottom income quintiles, particularly in the case of men. The erosion in the progressivity of IRRs is remarkable. Under homogeneous longevity, the IRR of the bottom quintile of male cohorts 1930-1934 is about 7%, while it shrinks to about 2.7% for male cohorts 1945-1950. On the contrary, the IRR of the top quintile remains stable around 3% across all male cohorts. Similar findings apply to women. Under homogeneous longevity, the IRR of the bottom quintile of female cohorts 1930-1934 exceeds 14%, while it collapses to about 5% for cohorts 1945-1950. A modest decline in the IRR is observed also for women in the top quintile, from about 4.4% for cohorts 1930-1934 to 3.6% for cohorts 1945-1950. Third, the distributional implications of heterogeneous longevity for the profitability of pension contributions are sizeable in the case of men (Figure 19). For the bottom quintile, the IRR is significantly lower under the assumption of heterogeneous mortality as compared to the homogeneous longevity scenarios, while it increases for top quintiles. For male cohorts 1930-1934, average IRR is 0.14 percentage points lower at the bottom and 0.2 percentage points higher at the top. Such differences become pronounced across cohorts. Indeed, for male cohorts 1945-1950 IRRs under heterogeneous mortality are 0.3 percentage points lower at the bottom, and 0.25 percentage points higher at the top. In relative terms, these differences correspond to about a 14% decline and 10% increase, respectively. In other words, widening disparities in life expectancy among males magnify the erosion of progressivity in the Italian pension system implied by reforms aimed at tightening the link between contributions and pension benefits. As for women, consistently with patterns documented for pension wealth, differences in IRR under homogeneous and heterogeneous longevity are quantitatively negligible ($\pm$0.05 percentage points) (Figure 20). In this case too, we get analogous results when investigating the evolution of IRRs by retirement year rather than by birth cohort. In interpreting these findings, it is worth recalling that our analyses do not include types of pension benefits, such as survivors, disability and social pensions, which may alter the distribution of IRRs.

Finally, to better appreciate the determinants of contributions' profitability at the individual level, we regress IRRs calculated under heterogeneous longevity against retirees' characteristics available in the INPS archives (Table 13). Regression analysis delivers results consistent with patterns documented above. *Ceteris paribus,* IRR decreases with quintiles of lifetime income, albeit non-linearly, with retirement age and with years of contributions. It also significantly decreases with year of birth, starting from cohorts born in the mid 1930s, and for individuals who have their pension benefits partially computed under defined-contribution pension rules (mixed regime). Being a woman or a recipient of anticipated pension benefits is also associated with higher IRR.

Discussion

In this study, we leverage a compendium of administrative data provided by the Italian Social Security Institute to advance our knowledge about lifespan inequalities in the Italian adult and elderly population, and to evaluate their policy implications for the pension system.

First, we document that mortality patterns among Italian retirees by former occupation differ substantially between men and women. In the case of men, we find post-retirement mortality to follow a neat occupational gradient, which holds also when accounting for potential confounders, including education, marital status, macro-region of residence and physical/mental impairment proxied by the reception of disability benefits. Indeed, we observe increasing mortality risk moving from highly qualified, non-manual occupations (such as engineers and architects, legislators and public senior officials, managing directors and chief executives) to manual, low-skilled and generally labour-intensive occupations (such as labourers in mining, construction and manufacturing, unskilled sales workers and assemblers). Our projections for life expectancy at 65 suggest that male retirees with a background in specific low-risk occupational categories enjoy an advantage of about 4-5 years compared to those with a background in specific high-risk categories. Such disparities in mortality and longevity are substantially larger than those documented by previous studies employing broader categorizations of occupational profiles (Leombruni et al. 2015). We document no clear occupation-based mortality gradient, instead, among female retirees. This result is consistent with findings by Bertuccio et al. (2018), who observe no significant mortality differences among Italian women aged 20-64 by occupation-based social class when taking educational level into account. In fact, our analysis suggests that women with a background in specific upper non-manual and high-skilled occupations, such as former top managers, may face analogous, if not worse, survival chances into old-age compared to females previously employed in lower manual or elementary occupations. Such patterns of reversed mortality gradient among female retirees are in line with findings by Costa et al. (2017) based on the population of Turin, in northwest Italy. Using census data linked to mortality records, they show that the mortality profile of women in managerial and entrepreneurial careers is similar to that of women in skilled blue-collar occupations. A possible explanation relates to behavioural factors, such as smoking and increased age at first childbirth, which stood as hallmarks of women's emancipation for the considered cohorts and which represent established risk factors for women's premature mortality. It should be noted that in this study we make heavy use of extrapolation in the estimation of full life expectancies. Indeed, estimated mortality patterns across occupational groups beyond age 74 are mostly driven by patterns observed between ages 65-74. This approach may lead to over-estimation of differences in life expectancy across occupational groups if the occupation-mortality gradient attenuates, or even reverses, at older ages, due to frailty-related dynamics (Vaupel 1985).

Second, we shed light on some worrisome trends in the evolution of lifespan inequalities among the adult and elderly population in Italy. While mortality delay (increasing average age at death) and mortality compression (declining lifespan variability) are observed across all socio-economic strata, our findings suggest that these improvements have not been equally shared, particularly in the case of men. Indeed, cohort-based analysis reveals that disparities in life expectancy among men have been widening across cohorts, in particular when measuring socio-economic status by mid-career employment income. In addition, men who belong to the upper tail of the mid-career employment income distribution and who occupy managerial positions face increasingly less uncertainty in age-at-death compared to men of opposite socio-economic status. Period-based analysis delivers qualitatively consistent results, suggesting that male retirees at the top of the pension income distribution face increasingly higher life expectancy and increasingly lower lifespan variation compared to male retirees at the bottom of the pension income distribution. Period-based findings suggest that such disparities are particularly pronounced in Northern regions, although increasing disparities in life expectancy between the top and the bottom of the pension income distribution are observed across most Italian regions. In the case of women, instead, we find no clearly discernible gradient in life expectancy and lifespan variation, and no clear trends either from a cohort- or period-perspective, particularly when measuring socio-economic status based on own income. Still, it is possible that for the cohorts and periods considered, women's own income represents a poor proxy of women's true socio-economic status. Sensitivity analyses relating female retirees' mortality to husbands' pension income suggest that spouses' income should be jointly considered for a proper assessment of lifespan inequalities among women in Italy. It is important to stress that our analysis is exclusively based on individuals (formerly) employed in the private sector. As such, it does not cover individuals with either a public employment or self-employment background, and individuals with no formal employment background *tout court*. On the one hand, this limits the generalizability of our findings to the entire Italian population. On the other hand, this may also imply, though, that our analysis delivers lower bound estimates for lifespan inequalities between high and low socio-economic status individuals.

Third, we show that distributional implications of heterogeneous longevity for the pension system are tangible, notably in the case of men. In particular, we document that the erosion in the profitability of pension contributions implied by heterogeneous longevity is stronger for male retirees at the bottom of the lifetime income distribution, and that such dynamics have become more pronounced over time. In the case of women, the lack of a clear socio-economic gradient in mortality implies that the distributional consequences are limited, too. Interpretation of these results requires some caution, though. As stressed, our analysis does not account for specific types of pension benefits, such as disability or survivor benefits, which may alter distributional dynamics. Moreover, our estimates are based on individuals who retired mostly under defined-benefit pension rules. If pension benefits were entirely computed under notional defined-contribution rules, which set a tighter link between pension benefits and contributions assuming homogeneous residual lifespan at retirement, the distributional implications of heterogeneous longevity would be even larger (Mazzaferro et al. 2012).

Despite all its limitations, our study has important policy implications. In particular, it highlights the importance of having reliable estimates about lifespan inequalities across relevant dimensions such as gender, birth cohort, occupation and lifetime earnings. On the one hand, estimates of this type allow to track the distribution of health and well-being within society, and to monitor its evolution over time. On the other hand, they allow to properly evaluate the distributional implications of key public policies, notably those related to social security systems. Our study is particularly relevant for policymakers in Italy, and in countries confronting challenging reform needs to meet rising pressures posed by increased longevity. While raising statutory retirement age is generally presented as an unavoidable choice, there are mounting concerns that this kind of measures, if applied homogeneously, may penalize categories of workers facing unfavourable survival profiles compared to population average, advantaging those with better survival chances (Ayuso et al. 2017; Alvarez et al. 2020). Moreover, since longevity tends to be stratified by occupation and socio-economic status, these measures may amplify intra-generational inequalities emerging over individuals' working life. In the light of these considerations, our study confirms the relevance of policy measures aimed at increasing flexibility in retirement for vulnerable categories of workers to alleviate the regressive effects of unequal lifespans. In the case of Italy, it points at the need for extending the official taxonomy of arduous jobs (the so-called *lavori usuranti*), giving access to early retirement options. While population ageing makes reforms for ensuring the sustainability and the *inter*-generational equity of social security systems unavoidable, tangible and widening inequalities hiding behind population ageing makes the issue of *intra*-generational fairness of such reforms equally pressing.

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Tables

Table 1: Steps taken in dataset construction for estimating occupation-specific mortality profiles

	N individuals	N dropped
Initial dataset	21,240,742	
Keeping N with demografic information	21,221,344	19,398
Keeping N retired between 2010-2018	1,523,039	19,698,305
Keeping N with occupational class information (except armed forces)	1,480,953	42,086
Keeping N with last contract lasting ≤50 years	1,480,176	777
Keeping N with last contract lasting >5 years	1,187,904	292,272
Keeping N retiring at ≤70	1,173,217	14,687
Keeping N surviving to 65	1,158,895	14,322
Keeping N who reach 65 by the end of 2018	624,281	534,614
Keeping N appearing in *Pensioni Casellario*	620,146	4,135
Final dataset	620,146	
Men	361,829	
Women	258,317	

Table 2: Descriptive statistics of the sample used for estimating occupation-specific mortality profiles

Variable	Mean	SD	Min	Max
Age at retirement	62.7	2.8	55.0	70.0
Length oflast job relationship (years)	25.0	11.7	5.0	50.00
Education (%)				
Primary	17.0	37.0		
Secondary	65.0	48.0		
Tertiary	19.0	39.0		
Marital status (%)				
Married	78.0	50.0		
Widow	8.0	28.0		
Separated/Divorced	6.0	25.0		
Never married	8.0	27.0		
Macro-region of residence (%)				
Centre	23.0	42.0		
North-East	19.0	39.0		
North-West	24.0	43.0		
South	23.0	42.0		
Islands	12.0	32.0		
Abroad	1.0	8.0		
Disability pension	1.0	9.0		
Social disability pension	2.0	15.0		

Table 3a: Distribution of individuals and deaths by sex and occupation

Occupation (CP2011, 1digit)	Occupation (CP2011, 2digit)	N individuals		N deaths	
		F	M	F	M
Managers & senior officials	Legislators & senior officials	3647	9203	70	323
	Managing directors & chief executives	1646	10601	39	299
	Professional services managers	426	1786	10	53
Professionals	Engineers, architects & similar professions	141	2647	2	58
	Health professionals	4071	13650	46	418
	Legal social & cultural professionals	18307	25282	354	902
	Life science professionals	1598	1904	26	66
	Science professionals	446	3544	5	88
	Teaching & research professionals	51818	18171	826	610
Technicians	Business & administration technicians	15585	28813	334	1016
	Life science technicians	16535	11231	301	413
	Public service technicians	13037	4042	327	195
	Science & engineering technicians	1615	23282	28	727
Clerical support workers	Customer service clerks	6139	7355	109	287
	General & keyboard clerks	42837	41786	760	1637
	Numerical & material recording clerks	1683	4512	40	167
	Other clerifcal support workers	2485	5982	30	179
Service & sales workers	Personal care workers	3847	1485	58	67
	Personal service workers	6530	3438	129	196
	Protective service workers	6580	6343	138	268
	Sales workers	8145	7665	139	320
Craft & related trade workers/skilled agricultural, forestry & fishery workers	Electrical & electronic trades workers	763	19230	17	751
	Food processing wood working garment & related trade workers	6119	6313	83	294
	Handicraft & printing workers	1044	2646	16	88
	Mining building & related trade workers	5708	16864	132	867
	Skilled agricultural forestry & fishery workers	274	2831	6	173
Plant & machine operators, assemblers	Assemblers	6332	12511	99	476
	Drivers & mobile plant operators	252	21607	2	929
	Machine operators in agricultural & forestry	373	924	7	36
	Stationary plant operators	945	7987	16	273
Elementary occupations	Cleaners & helpers	6446	706	120	36
	Labourers in mining construction manufacturing	2067	8744	49	444
	Unskilled agricultural forestry & fishery	3400	4504	117	278
	Unskilled sales workers	17476	24240	404	1319

Table 3b: Grouping of occupational 2-digit CP2011 occupational categories

Grouping	2-digit CP2011 categories
	WOMEN
Managers	Managing directors and chief executives, Professional services managers
Other professionals	Engineers architects and similar professions, Health professionals, Life science professionals, Science professionals (mathematics, computer science, chemistry, physics, biology)
Other clerical support workers	Numerical and material recording clerks, Other clerical support workers
Other craft and related trade workers	Electrical and electronic trades workers, Food processing wood working garment and related trade workers, Electrical and electronic trades workers, Food processing wood working garment and related trade workers, Handicraft and printing workers, Skilled agricultural forestry and fishery workers
Plant and machine operators	Drivers and mobile plant operators, Machine operators in agricultural and forestry, Stationary plant operators
Unskilled workers in agriculture, forestry, fishery, mining, construction, manufacturing	Labourers in mining construction manufacturing, Unskilled agricultural forestry and fishery
	MEN
Machine operators in agricultural/food industry, drivers & mobile plant operators	Drivers and mobile plant operators, Machine operators in agricultural and forestry

Table 4a: Cox proportional hazards regression models – Men

	(1) HR	(2) HR
Occupation (ref: Clerical support workers)		
Managers and senior officials	0.643***	0.847***
	(0.028)	(0.040)
Professionals	0.713***	0.908**
	(0.022)	(0.031)
Technicians	0.867***	0.978
	(0.026)	(0.029)
Service and sales workers	1.078†	1.092*
	(0.044)	(0.044)
Craft and related trade workers, skilled agricultural, forestry and fishery workers	1.106***	1.153***
	(0.034)	(0.036)
Plant and machine operators, assemblers	1.132***	1.208***
	(0.037)	(0.040)
Elementary occupations	1.174***	1.147***
	(0.036)	(0.036)
Marital status (ref: married)		
Widow		1.251***
		(0.046)
Separated/Divorced		1.386***
		(0.046)
Never married		1.577***
		(0.043)
Region of residence (ref: Centre)		
Abroad		1.290*
		(0.139)
Islands		0.968
		(0.029)
North-East		1.081**
		(0.031)
North-West		1.160***
		(0.030)
South		1.019
		(0.025)
Education (ref: Primary)		
Secondary education		0.985
		(0.022)
Tertiary education		0.837***
		(0.031)
Social disability pension		8.451***
		(0.177)
Disability pension		1.400***
		(0.085)
Observations	361,829	361,829

HR= hazard ratios. Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1.

Table 4b: Cox proportional hazards regression models - Men

	(1) HR	(2) SE	(3) HR	(4) SE
Occupation (ref: General & keyboard clerks)				
Legislators & public senior officials	0.629***	(0.039)	0.853*	(0.057)
Managing directors & chief executives	0.629***	(0.040)	0.785***	(0.051)
Professional services managers	0.767†	(0.107)	0.834	(0.117)
Science professionals (maths, computer science, chemistry, physics, biology)	0.680***	(0.075)	0.822†	(0.091)
Engineers, architects & similar professions	0.563***	(0.075)	0.717*	(0.098)
Life science professionals	0.740*	(0.093)	1.079	(0.140)
Health professionals	0.664***	(0.037)	0.921	(0.059)
Legal, social & cultural professionals	0.795***	(0.033)	0.900*	(0.038)
Teaching & research professionals	0.650***	(0.031)	0.832***	(0.044)
Science & engineering technicians	0.866**	(0.039)	0.945	(0.043)
Life science technicians	0.877*	(0.049)	0.983	(0.055)
Business & administration technicians	0.853***	(0.034)	0.932†	(0.038)
Public service technicians	0.860*	(0.065)	0.928	(0.071)
Customer service clerks	0.977	(0.063)	0.804***	(0.052)
Other clerifcal support workers	0.917	(0.073)	0.935	(0.075)
Numerical & material recording clerks	1.075	(0.088)	1.024	(0.084)
Sales workers	1.048	(0.064)	1.046	(0.064)
Personal service workers	1.237**	(0.094)	1.189*	(0.091)
Personal care workers	1.008	(0.126)	0.980	(0.123)
Protective service workers	1.017	(0.067)	1.004	(0.066)
Mining, building & related trade workers	1.043	(0.044)	1.076†	(0.046)
Electrical & electronic trades workers	1.159***	(0.052)	1.173***	(0.053)
Handicraft & printing workers	1.000	(0.110)	0.999	(0.110)
Skilled agricultural, forestry & fishery workers	1.167†	(0.094)	1.108	(0.089)
Food processing, wood working, garment & other craft & related trades workers	1.133*	(0.072)	1.129†	(0.073)
Stationary plant operators	1.000	(0.066)	1.036	(0.069)
Assemblers	1.170**	(0.062)	1.178**	(0.063)
Machine operators in agricultural/food industry, drivers & mobile plant operators	1.147***	(0.047)	1.204***	(0.050)
Unskilled sales workers, cleaners & helpers	1.777***	(0.044)	1.109*	(0.042)
Unskilled agricultural, forestry & fishery workers	1.053	(0.069)	1.002	(0.066)
Labourers in mining, construction, manufacturing	1.219***	(0.066)	1.184**	(0.064)
Marital status (ref: married)				
Widow			1.250***	(0.046)
Separated/Divorced			1.387***	(0.046)
Never married			1.587***	(0.044)
Region of residence (ref: Centre)				
Abroad			1.296*	(0.140)
Islands			0.975	(0.029)
North-East			1.085**	(0.032)
North-West			1.164***	(0.031)
South			1.021	(0.025)
Education level (ref: Primary)				
Secondary education			0.982	(0.022)
Tertiary education			0.833***	(0.033)
Social disability pension			8.476***	(0.178)
Disability pension			1.411***	(0.086)
Observations	361,829		361,829	

HR= hazard ratios. SE=standard errors. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1.

Table 5a: Cox proportional hazards regression models - Women

	(1) HR	(2) HR
Occupation (ref: Clerical support workers)		
Managers and senior officials	1.000	1.211†
	(0.098)	(0.123)
Professionals	0.845***	0.987
	(0.037)	(0.048)
Technicians	0.948	1.000
	(0.045)	(0.048)
Service and sales workers	0.969	0.990
	(0.056)	(0.058)
Craft and related trade workers, skilled agricultural, forestry and fishery workers	0.950	0.919
	(0.069)	(0.068)
Plant and machine operators, assemblers	1.030	1.031
	(0.100)	(0.101)
Elementary occupations	1.050	0.981
	(0.054)	(0.052)
Marital status (ref: married)		
Widow		1.260***
		(0.050)
Separated/Divorced		1.513***
		(0.073)
Never married		1.762***
		(0.072)
Region of residence (ref: Centre)		
Abroad		1.462*
		(0.260)
Islands		0.917†
		(0.048)
North-East		1.193***
		(0.055)
North-West		1.225***
		(0.053)
South		0.972
		(0.042)
Education (ref: Primary)		
Secondary education		13.640***
		(0.494)
Tertiary education		1.673**
		(0.277)
Social disability pension		0.991
		(0.040)
Disability pension		0.917
		(0.053)
Observations	258,317	258,317

HR= hazard ratios *** p<0.001, ** p<0.01, * p<0.05, † p<0.1.

Table 5b: Cox proportional hazards regression models - Women

	(1)	(2)	(3)	(4)
	HR	SE	HR	SE
Occupation (ref: General & keyboard clerks)				
Legislators & public senior officials	0.909	(0.114)	1.102	(0.144)
Managers	1.159	(0.172)	1.256	(0.187)
Other professionals	0.754*	(0.090)	0.779*	(0.099)
Legal, social & cultural professionals	1.002	(0.065)	0.989	(0.066)
Teaching & research professionals	0.798***	(0.041)	0.952	(0.054)
Other technicians	0.957	(0.064)	0.964	(0.065)
Business & administration technicians	1.018	(0.069)	0.981	(0.067)
Public service technicians	0.864*	(0.060)	0.947	(0.066)
Customer service clerks	0.974	(0.101)	0.746**	(0.079)
Other clerical support workers	1.048	(0.133)	1.076	(0.136)
Sales workers	0.964	(0.090)	1.008	(0.095)
Personal service workers	0.987	(0.095)	0.945	(0.092)
Personal care workers	0.922	(0.127)	0.848	(0.118)
Protective service workers	0.975	(0.092)	0.965	(0.093)
Mining, building & related trade workers	1.003	(0.096)	0.855	(0.084)
Other craft and related trade workers	0.892	(0.088)	0.921	(0.092)
Plant & machine operators	1.109	(0.226)	1.103	(0.225)
Assemblers	1.011	(0.110)	0.972	(0.106)
Unskilled sales workers	1.149*	(0.073)	1.029	(0.066)
Cleaners & helpers	0.886	(0.090)	0.780*	(0.084)
Unskilled workers in agricultural, forestry, fishery, mining, construction, manuf.	0.966	(0.086)	0.898	(0.080)
Marital status (ref: married)				
Widow			1.257***	(0.050)
Separated/Divorced			1.511***	(0.073)
Never married			1.772***	(0.073)
Region of residence (ref: Centre)				
Abroad			1.545*	(0.279)
Islands			0.920	(0.049)
North-East			1.189***	(0.056)
North-West			1.224***	(0.053)
South			0.974	(0.043)
Education level (ref: Primary)				
Secondary education			0.969	(0.040)
Tertiary education			0.914	(0.055)
Social disability pension			13.656***	(0.495)
Disability pension			1.695**	(0.281)
Observations	258,317	258,317	258,317	258,317

HR= hazard ratios. SE=standard errors. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Other professionals include: Engineers, architects, and similar professions; science professionals; life science professionals; health professionals. Other technicians include: science technicians; engineering technicians; life science technicians.

Table 6: Construction of the *Dichiarazioni Uniemens* sample

	N. individuals
Starting sample	21,966,659
Dropping individuals born prior to 1930 or after 1957	14,909,172
Dropping individuals who die before 50	44,229
Dropping individuals who retire before 50	64,012
Final sample	6,949,246
Final sample men	4,842,306
Final sample women	2,106,940

Table 7: *Dichiarazioni Uniemens* sample
Observations by year of birth and survival as of 2018

Year of birth	Not dead	Dead	Total
1930	84,650	160,286	244,936
1931	91,959	147,374	239,333
1932	99,232	135,492	234,724
1933	110,470	129,806	240,276
1934	120,000	119,003	239,003
1935	131,024	109,624	240,648
1936	132,594	95,077	227,671
1937	145,496	88,668	234,164
1938	161,377	85,105	246,482
1939	168,150	76,769	244,919
1940	171,667	69,184	240,851
1941	160,376	57,076	217,452
1942	161,946	51,392	213,338
1943	160,420	45,724	206,144
1944	164,204	40,805	205,009
1945	159,569	35,021	194,590
1946	214,160	40,940	255,100
1947	218,456	35,896	254,352
1948	228,316	33,320	261,636
1949	230,081	29,298	259,379
1950	232,994	26,598	259,592
1951	234,950	23,095	258,045
1952	240,056	20,928	260,984
1953	249,935	19,013	268,948
1954	265,463	17,590	283,053
1955	277,681	15,993	293,674
1956	291,203	14,597	305,800
1957	305,807	13,336	319,143
Total	5,212,236	1,737,010	6,949,246

Table 8: *Casellario Pensionati* sample
Observations by calendar year and pension regime

	Men			Women		
Calendar year	Defined-benefit	Mixed	Total	Defined-benefit	Mixed	Total
1995	1,151,882	0	1,151,882	1,082,289	0	1,082,289
1996	1,219,103	84	1,219,187	1,147,169	224	1,147,393
1997	1,295,201	259	1,295,460	1,220,438	803	1,221,241
1998	1,361,474	653	1,362,127	1,289,098	1,773	1,290,871
1999	1,422,691	1,282	1,423,973	1,354,721	2,998	1,357,719
2000	1,476,454	2,513	1,478,967	1,416,304	4,379	1,420,683
2001	1,525,513	9,171	1,534,684	1,482,811	6,546	1,489,357
2002	1,554,662	22,235	1,576,897	1,545,931	9,254	1,555,185
2003	1,568,684	32,977	1,601,661	1,598,854	12,968	1,611,822
2004	1,589,493	43,689	1,633,182	1,658,625	17,706	1,676,331
2005	1,612,341	55,973	1,668,314	1,715,611	25,278	1,740,889
2006	1,634,862	69,16	1,704,022	1,745,741	58,631	1,804,372
2007	1,653,253	82,944	1,736,197	1,737,001	121,318	1,858,319
2008	1,658,256	95,267	1,753,523	1,711,853	169,539	1,881,392
2009	1,658,801	107,48	1,766,281	1,684,505	215,542	1,900,047
2010	1,657,874	121,105	1,778,979	1,654,131	260,326	1,914,457
2011	1,658,079	134,69	1,792,769	1,621,687	304,348	1,926,035
2012	1,650,774	147,859	1,798,633	1,583,819	346,047	1,929,866
2013	1,668,696	167,582	1,836,278	1,557,399	401,33	1,958,729
2014	1,683,656	186,649	1,870,305	1,529,429	453,63	1,983,059
2015	1,693,572	211,949	1,905,521	1,492,706	511,126	2,003,832
2016	1,711,681	237,729	1,949,410	1,459,618	565,071	2,024,689
2017	1,702,947	264,531	1,967,478	1,418,551	617,323	2,035,874
Total	35,809,949	1,995,781	37,805,730	34,708,291	4,106,160	38,814,451

Table 9: Women's post-retirement mortality and husbands' pension

	(1)
	Odds ratio
Woman's pension quintile [Ref: 1st (bottom)]	.
2nd	1.001
	(0.00959)
3rd	1.050***
	(0.0103)
4th	1.049***
	(0.0107)
5th (top)	1.165***
	(0.0129)
Husband's pension quintile [Ref: 1st (bottom)]	
2nd	0.987
	(0.00941)
3rd	0.997
	(0.00956)
4th	0.957***
	(0.00951)
5th (top)	0.881***
	(0.00945)
Constant	6,092***
	(9,123)
Observations	7,805,622

Notes. Results from logistic survival analysis based on female retirees from the FPLD fund, who retired between 1995 and 2017, whose husband was alive in 1995 and also retired between 1995 and 2017. The mortality follow-up extends from the year women turn 67 to the end of 2018 or the year of their death, if the latter occurs earlier. Dependent variable is a dummy taking value 1 if the woman dies by the end of the year, 0 otherwise. Pension quintiles are cohort-specific for both women and husbands. Control variables: year of birth, age difference with respect to husband, widowhood status, macro-region of residence, macro-region of birth, and 23 duration dummies.

Table 10: Sample construction - *Estratti Conto*

	Women	Men	All	Dropped
Initial sample	109,515	151,069	260,584	
Dropping N with no measurable employment income at 45-49	30,976	73,053	104,029	-156,555
Dropping contributions to funds other than FPLD	30,975	73,036	104,011	-18
Dropping observations prior to 1974	30,968	72,961	103,929	-82
Dropping observations with zero or missing income	30,966	72,937	103,903	-26
Dropping N with just one observation after 1974	30,894	72,796	103,690	-213
Dropping N with gaps > 5 years	28,180	69,141	97,321	-6,369
Sample used to estimate lifetime earngins profile	28,180	69,141	97,321	
Dropping N who die prior to 65	27,465	65,795	93,260	-4,061
Sample used for distributional analysis	27,465	65,795	93,260	

Table 11: Regression coefficients (lifetime earnings)

	(1) Men	(2) Women
Age	0.199***	0.202***
	(0.006)	(0.013)
Age^2 (squared)	-0.004***	-0.001***
	(0.000)	(0.000)
Age^3 (cubic)	0.000***	-0.000
	(0.000)	(0.000)
Years of contributions	-0.002	-0.128***
	(0.004)	(0.009)
Constant	6.234***	4.267***
	(0.110)	(0.257)
Observations	1,484,456	55,2550
N individuals	69,141	28,180
R-squared	0.207	0.191

Results from OLS regressions. Standard errors in parentheses. *** p-value <0.001. ** p-value <0.01. * p-value < 0.05.

Table 12: Gini of pension wealth at retirement (Euro, 2019 real values)

Cohort	Homogeneous mortality	Heterogeneous mortality	Difference
	Panel A: Men		
Cohort	Homogeneous mortality	Heterogeneous mortality	Difference
1930-1934	0.2736	0.2927	0.0192
1935-1939	0.2709	0.2897	0.0188
1940-1944	0.2550	0.2784	0.0235
1945-1950	0.2262	0.2554	0.0292
	Panel B: Women		
Cohort	Homogeneous mortality	Heterogeneous mortality	Difference
1930-1934	0.2514	0.2521	0.0007
1935-1939	0.2748	0.2737	-0.0011
1940-1944	0.2886	0.2910	0.0024
1945-1950	0.2613	0.2651	0.0038

Table 13: Individual determinants of IRR

	(1) Coeff
Woman	0.893***
	(0.016)
Age at retirement	-0.189***
	(0.002)
Years of contribution	-0.202***
	(0.002)
Anticipated pension	0.350***
	(0.016)
Mixed retirement regime	-1.713***
	(0.042)
Quintile of lifetime earnings [Ref: 1st (bottom)]	
Quintile 2	-1.642***
	(0.036)
Quintile 3	-1.884***
	(0.035)
Quintile 4	-1.800***
	(0.034)
Quintile 5 (top)	-1.702***
	(0.033)
Macro-region of residence [Ref: Centre]	
Abroad	-1.484***
	(0.243)
North-East	0.053*
	(0.021)
North-West	-0.013
	(0.018)
South	0.002
	(0.025)
Birth cohort [Ref: 1930]	
Birth cohort 1931	0.169**
	(0.057)
Birth cohort 1932	0.154**
	(0.052)
Birth cohort 1933	0.127*
	(0.052)
Birth cohort 1934	0.161**
	(0.053)

Table 13: Individual determinants of IRR (continued)

Birth cohort 1935	0.090
	(0.052)
Birth cohort 1936	-0.052
	(0.050)
Birth cohort 1937	-0.092
	(0.050)
Birth cohort 1938	-0.171***
	(0.048)
Birth cohort 1939	-0.232***
	(0.047)
Birth cohort 1940	-0.242***
	(0.044)
Birth cohort 1941	-0.290***
	(0.044)
Birth cohort 1942	-0.314***
	(0.043)
Birth cohort 1943	-0.395***
	(0.044)
Birth cohort 1944	-0.432***
	(0.043)
Birth cohort 1945	-0.377***
	(0.045)
Birth cohort 1946	-0.412***
	(0.044)
Birth cohort 1947	-0.420***
	(0.043)
Birth cohort 1948	-0.410***
	(0.045)
Birth cohort 1949	-0.347***
	(0.049)
Birth cohort 1950	-0.305***
	(0.050)
Constant	22.843***
	(0.163)
Observations	93,260
R-squared	0.429

Notes. Results from OLS regressions. Robust standard errors in parentheses. *** p-value <0.001. ** p-value <0.01. * p-value < 0.05.

Figures

Figure 1a: Partial life expectancies 65-74 by former occupation
Men

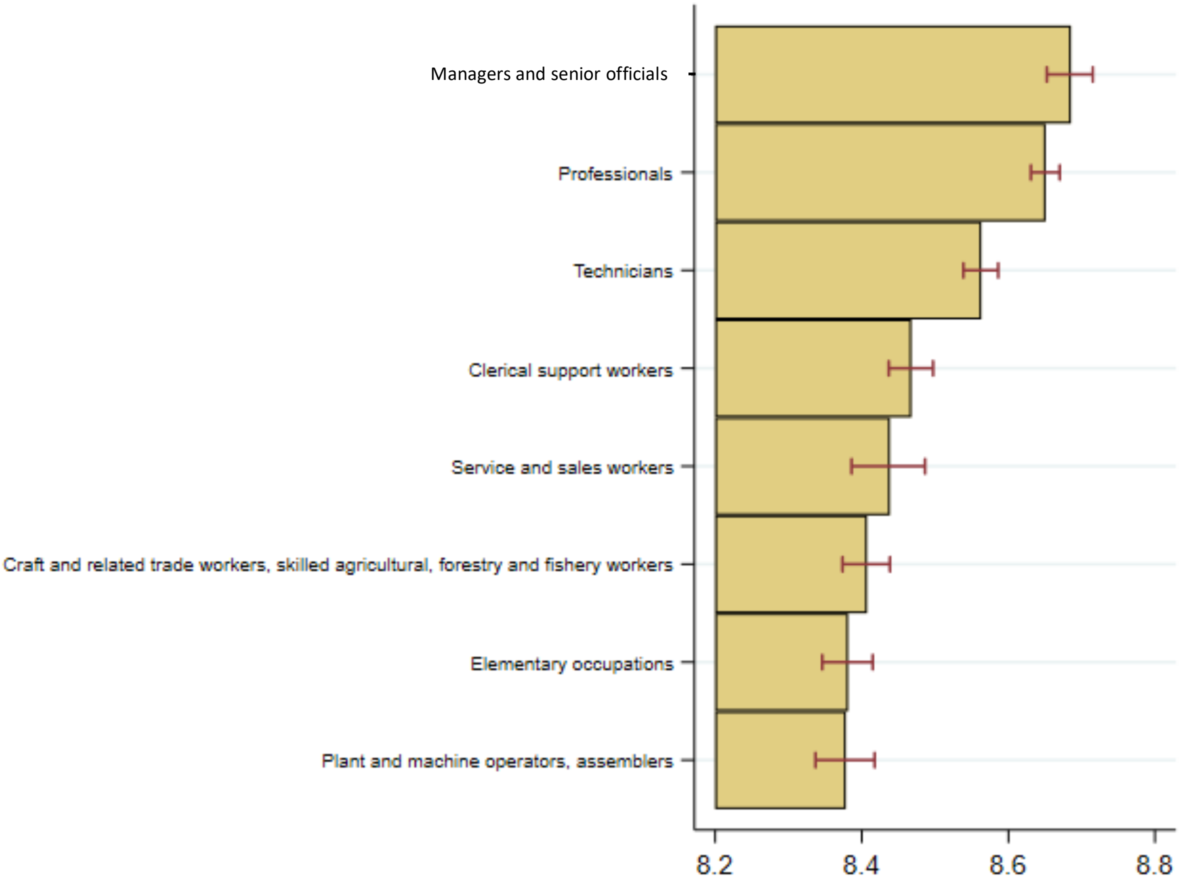


Figure 1b: Partial life expectancies 65-74 by former occupation
Men

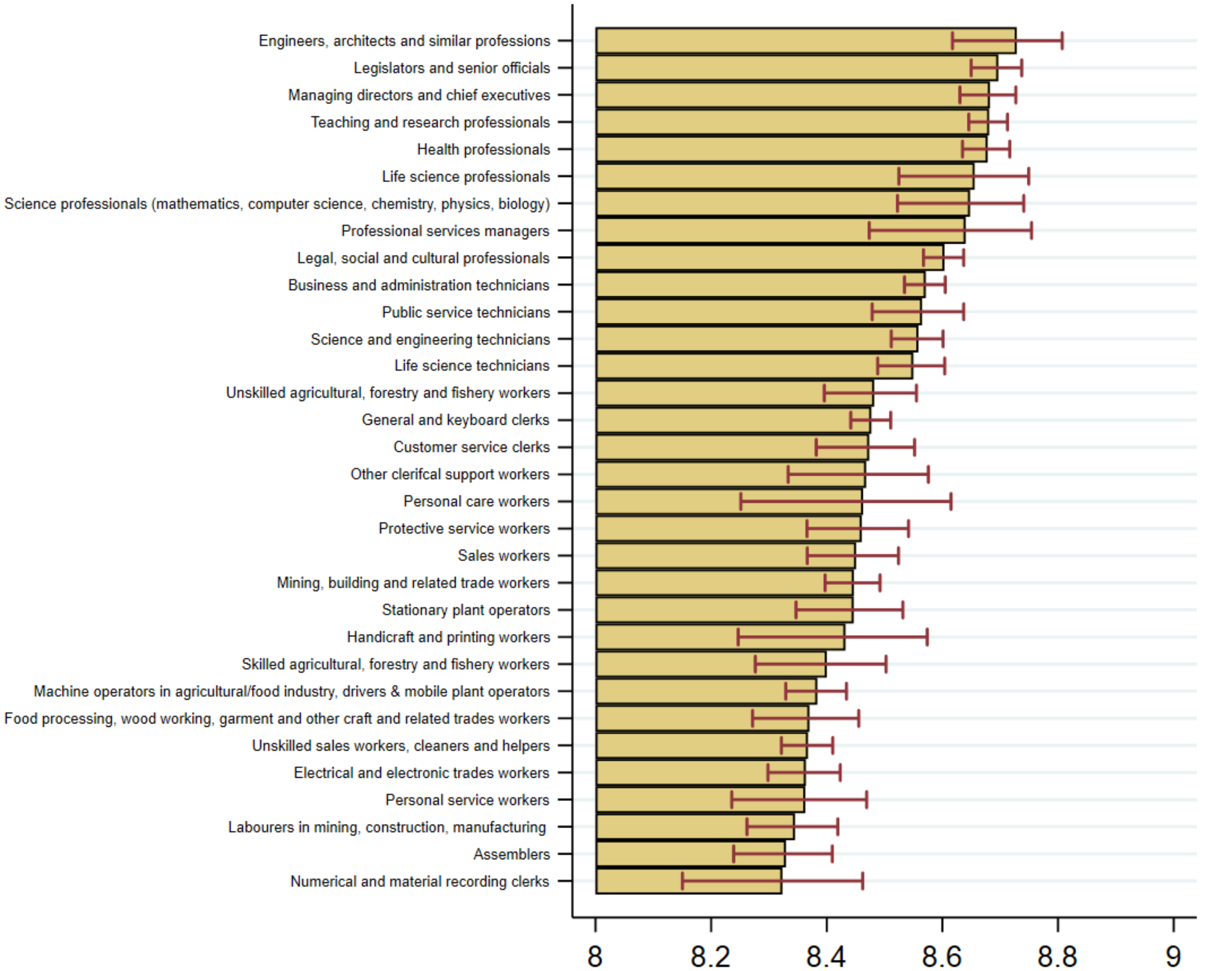


Figure 2a: Full life expectancies at 65 by former occupation
Men

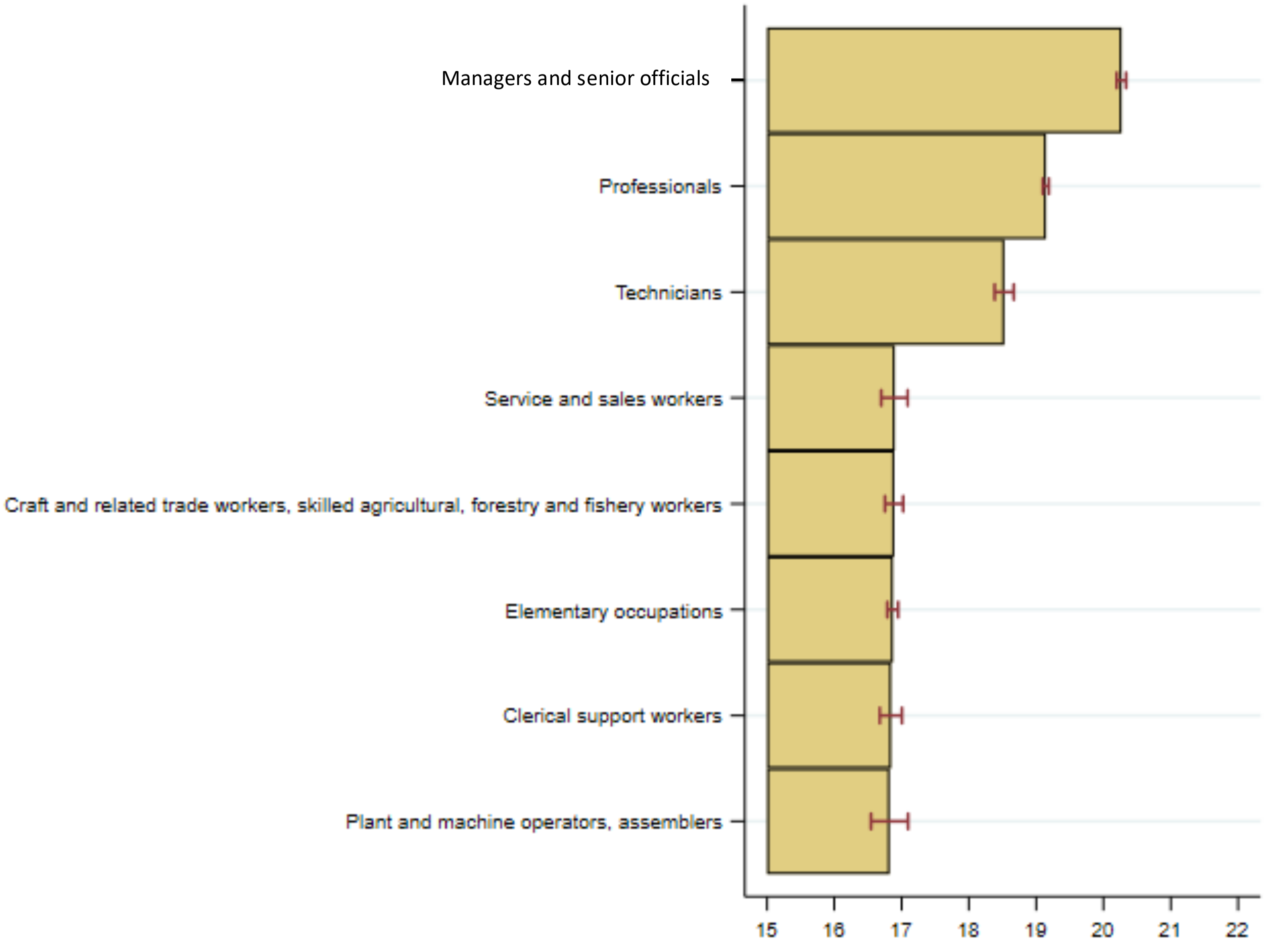


Figure 2b: Full life expectancies at 65 by former occupation
Men

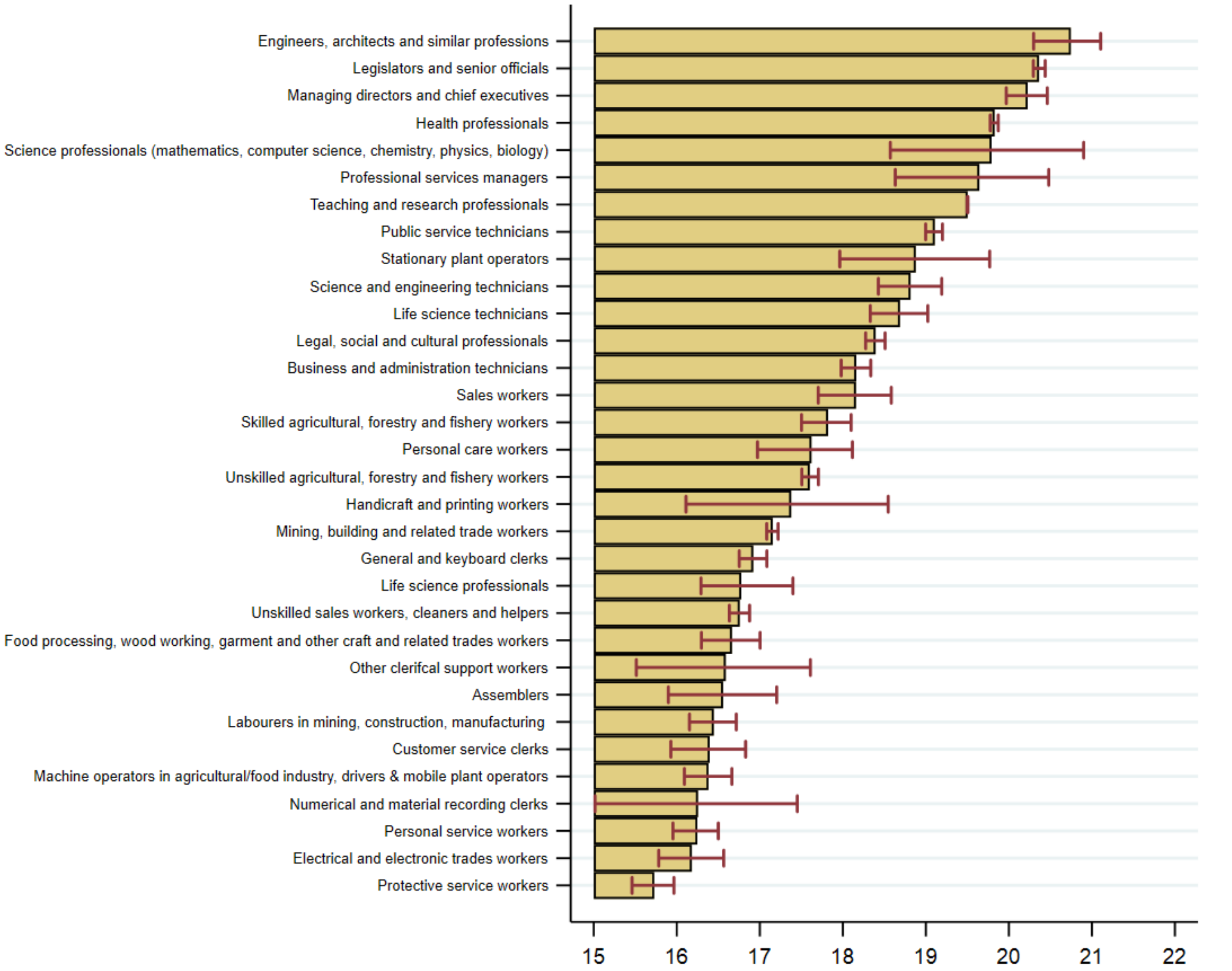


Figure 3a: Partial life expectancies 65-74 by former occupation
Women

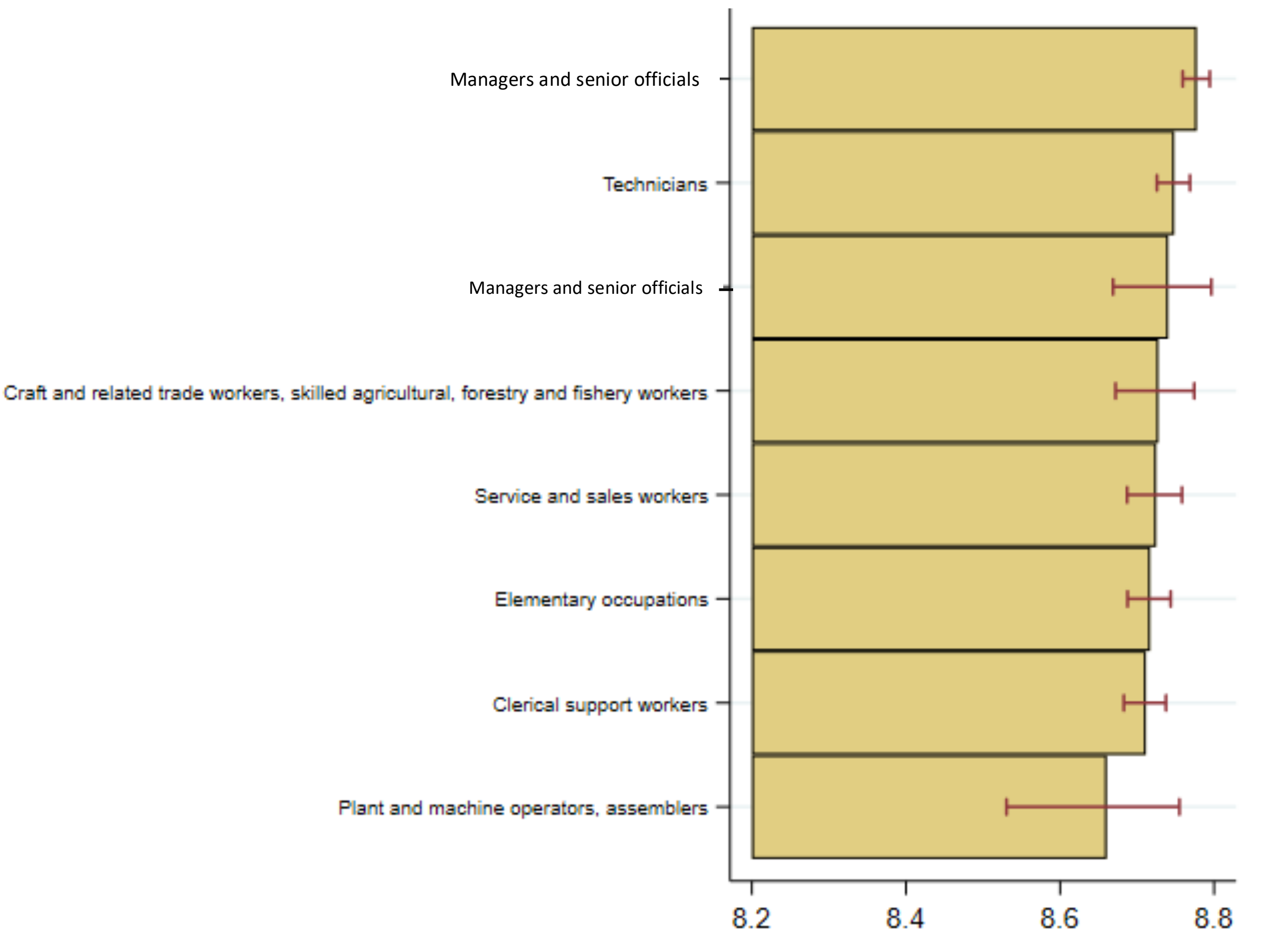


Figure 3b: Partial life expectancies 65-74 by former occupation
Women

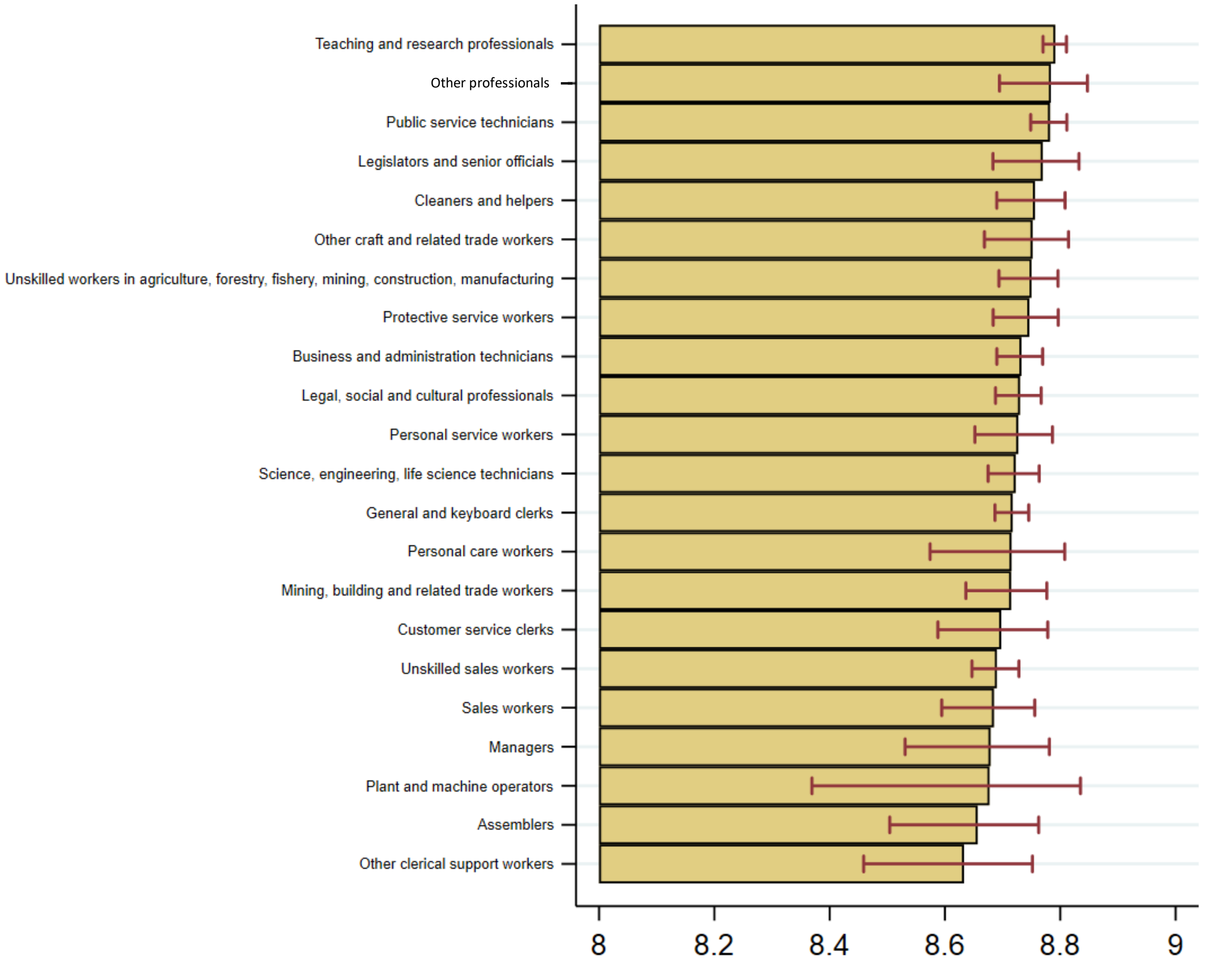


Figure 4a: Full life expectancies at 65 by former occupation
Women

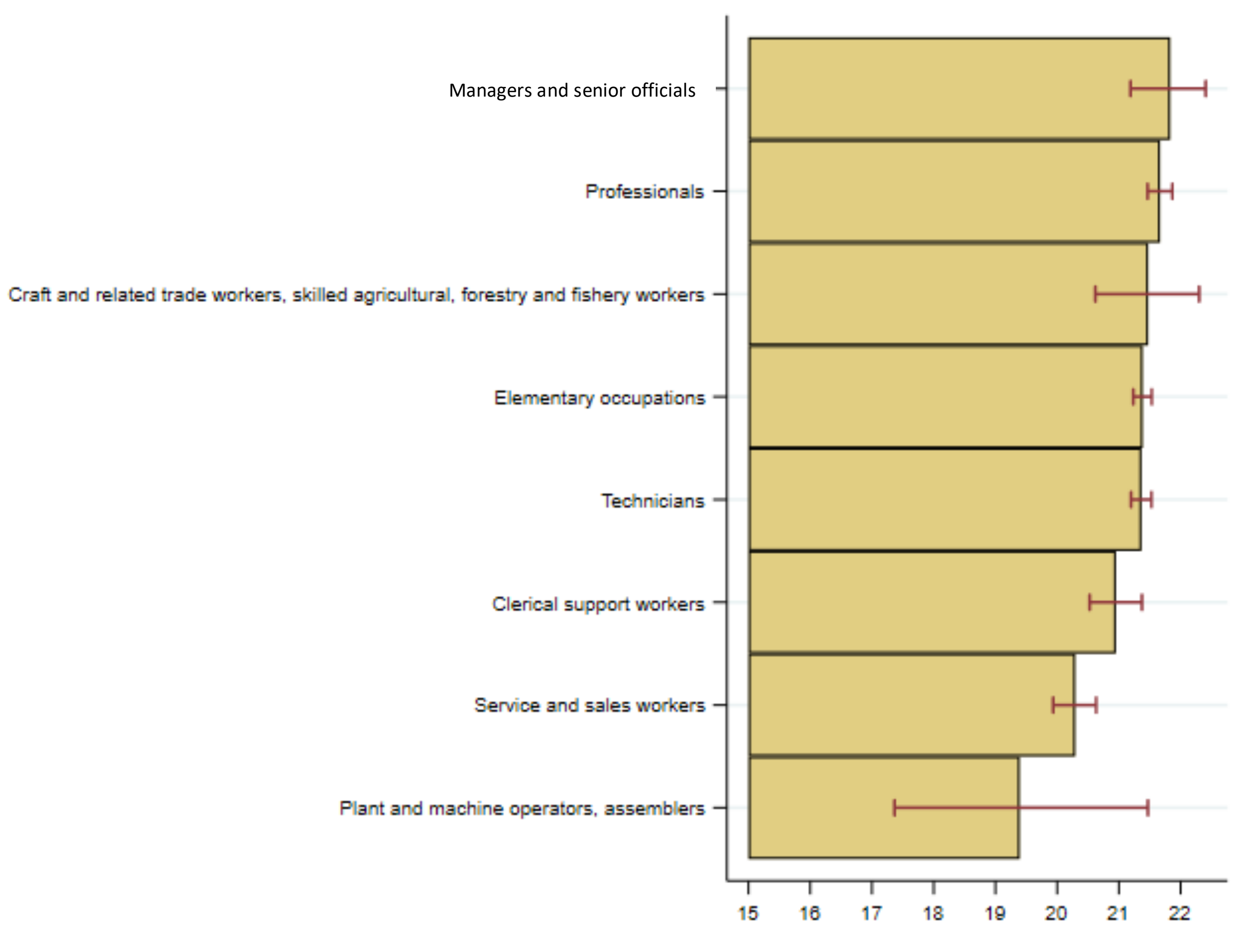


Figure 4b: Full life expectancies at 65 by former occupation
Women

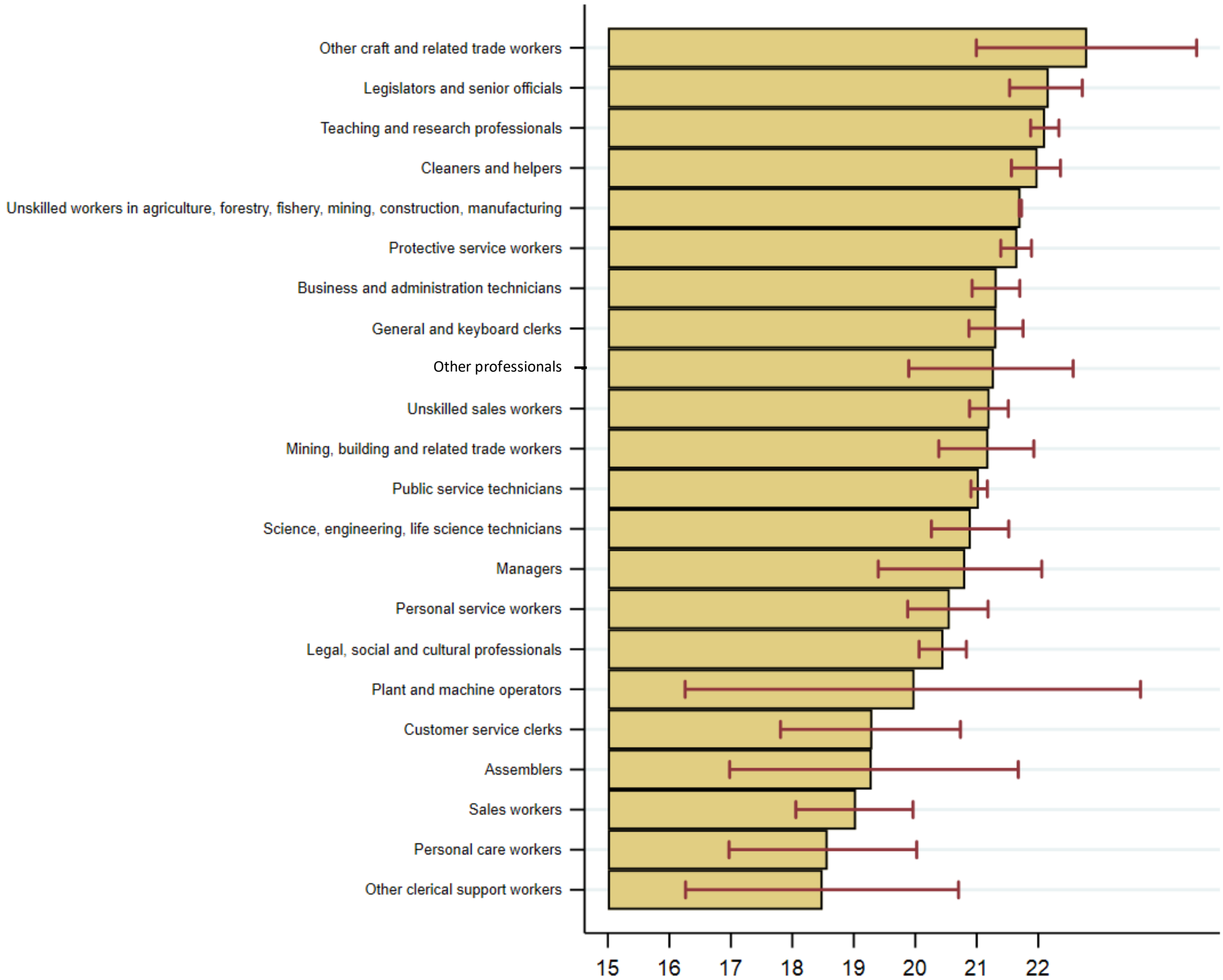
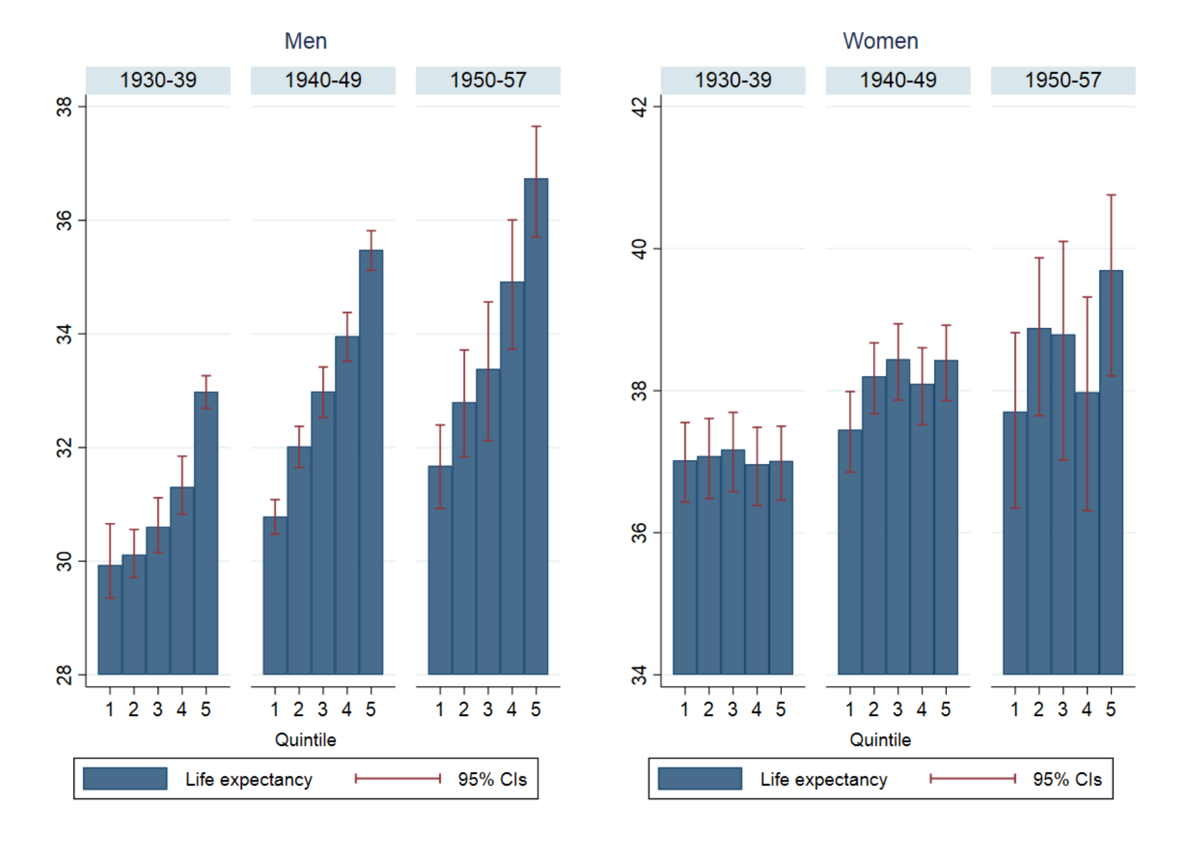
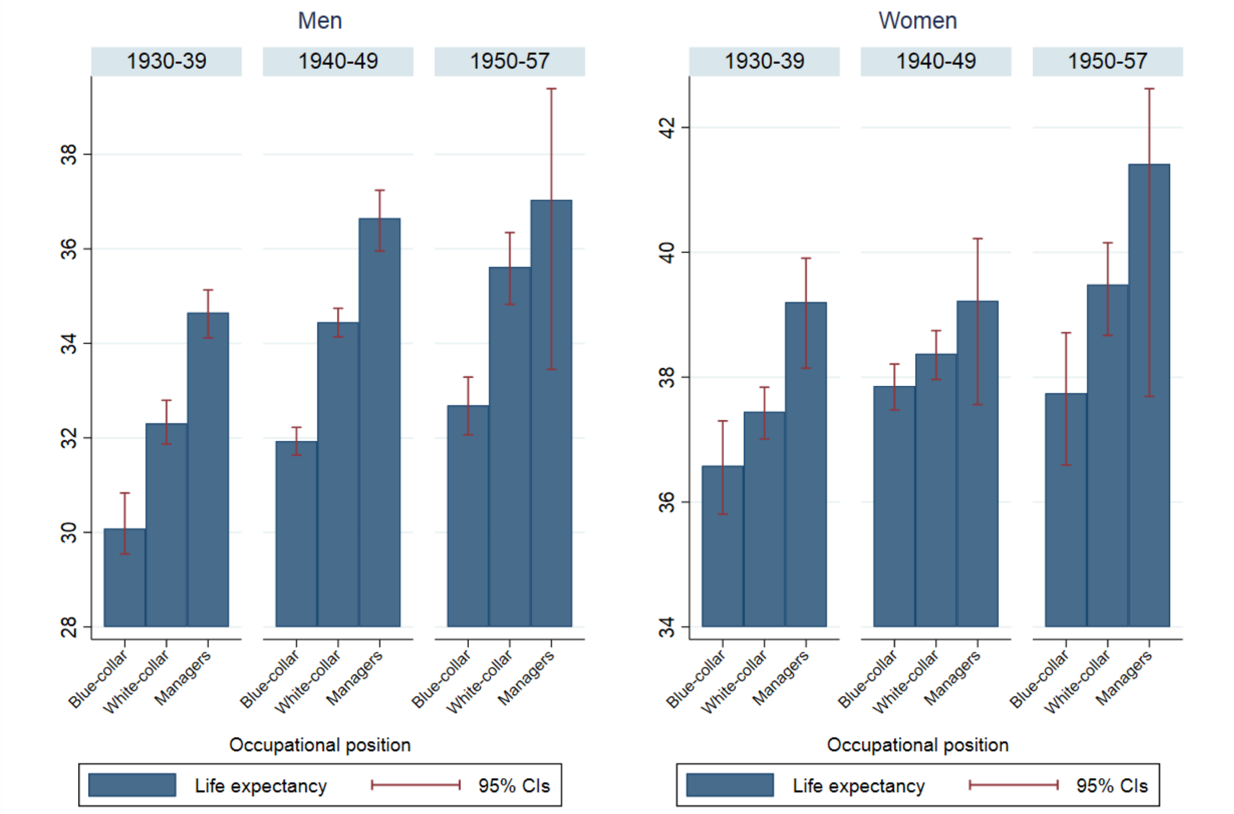


Figure 5: Life expectancy at 50 by cohort and quintiles of mid-career employment income



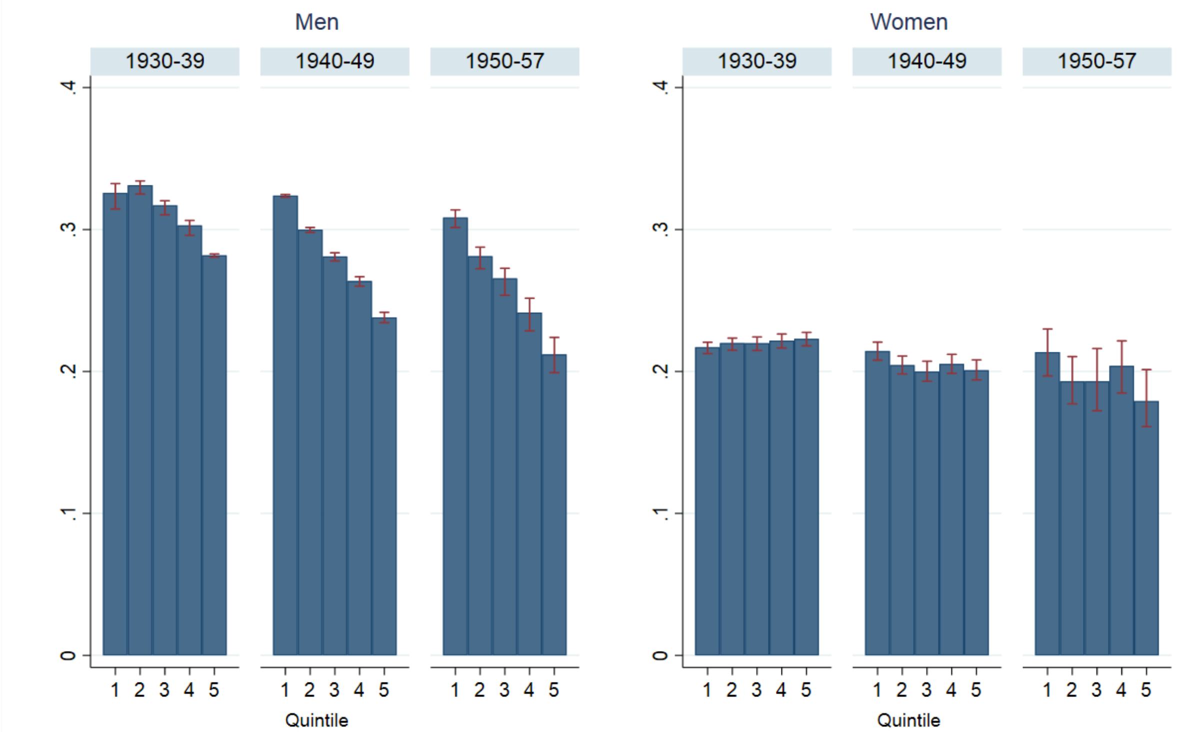
Notes. The graph plots the evolution of life expectancy at 50 by average mid-career private employment earnings, sex and birth cohort, along with 95% confidence intervals.

Figure 6: Life expectancy at 50 by cohort and broad occupational group



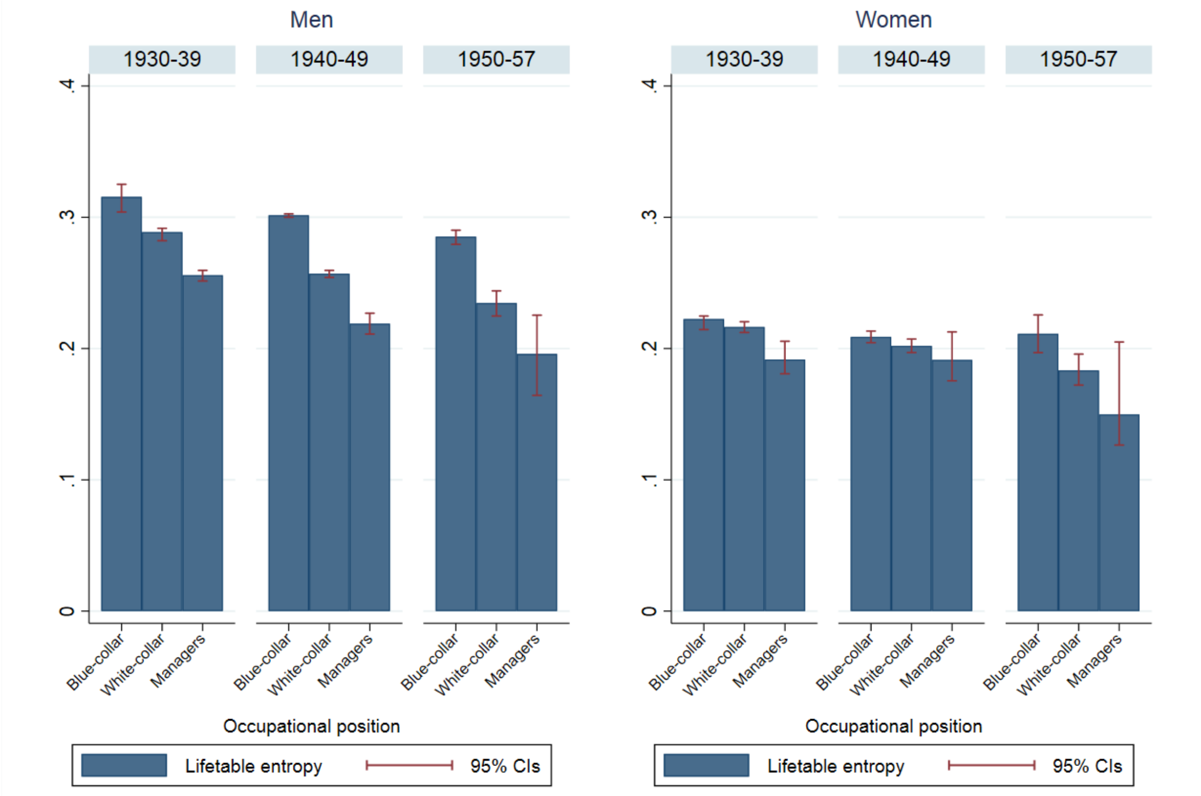
Notes. The graph plots the evolution of life expectancy at 50 by prevalent mid-career occupational position (private employees), sex and birth cohort, along wth 95% confidence intervals.

Figure 7: Lifetable entropy at 50 by cohort and quintiles of mid-career employment income



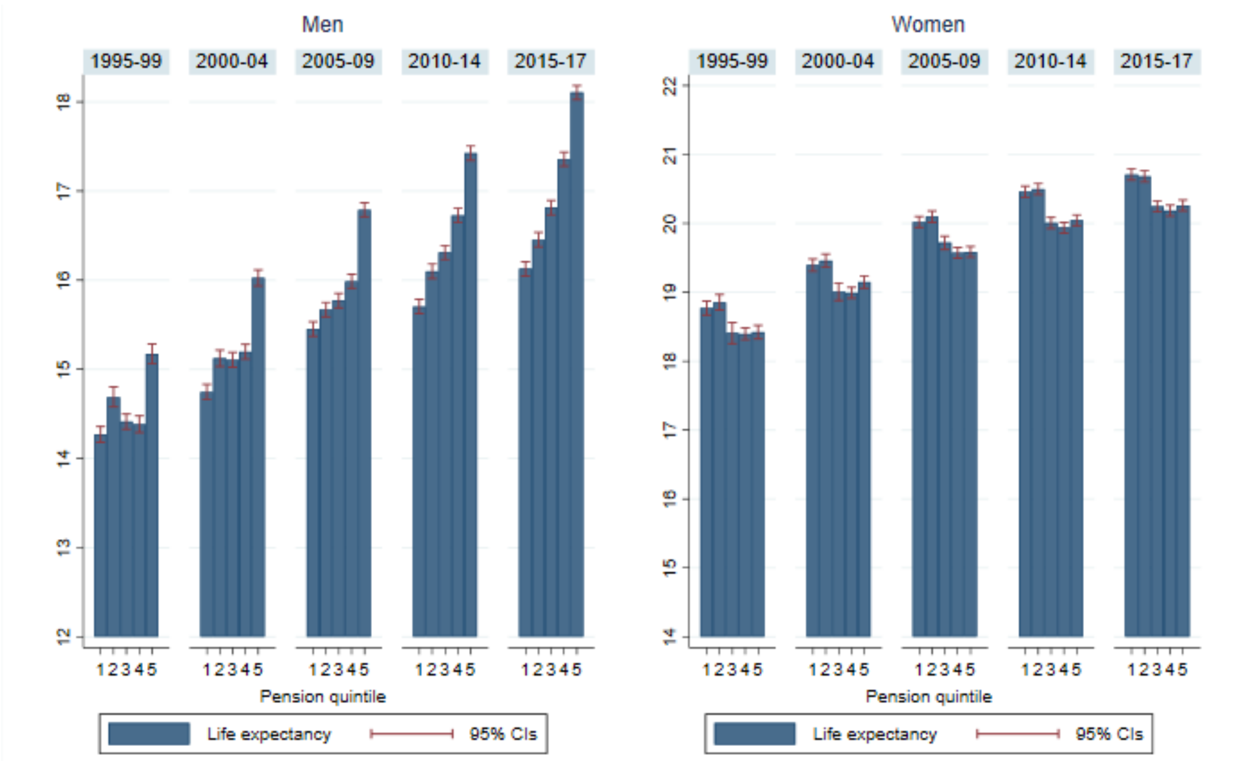
Notes. The graph plots the evolution of lifetable entropy at 50 by average mid-career private employment earnings, sex and birth cohort, along with 95% confidence intervals.

Figure 8: Lifetable entropy at 50 by cohort and broad occupational group



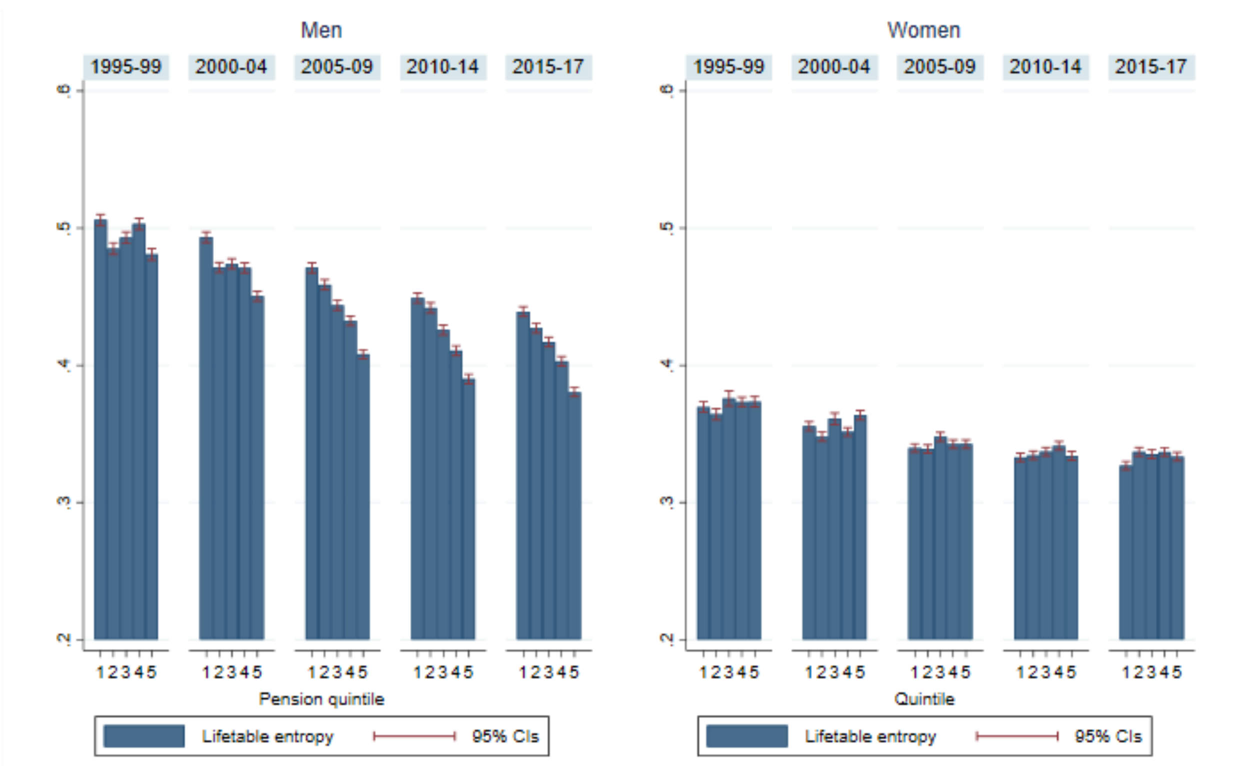
Notes. The graph plots the evolution of lifetable entropy at 50 by prevalent mid-career occupational position (private employees), sex and birth cohort, along with 95% confidence intervals

Figure 9: Life expectancy by quintiles of pension income at 67
Years 1995-2017



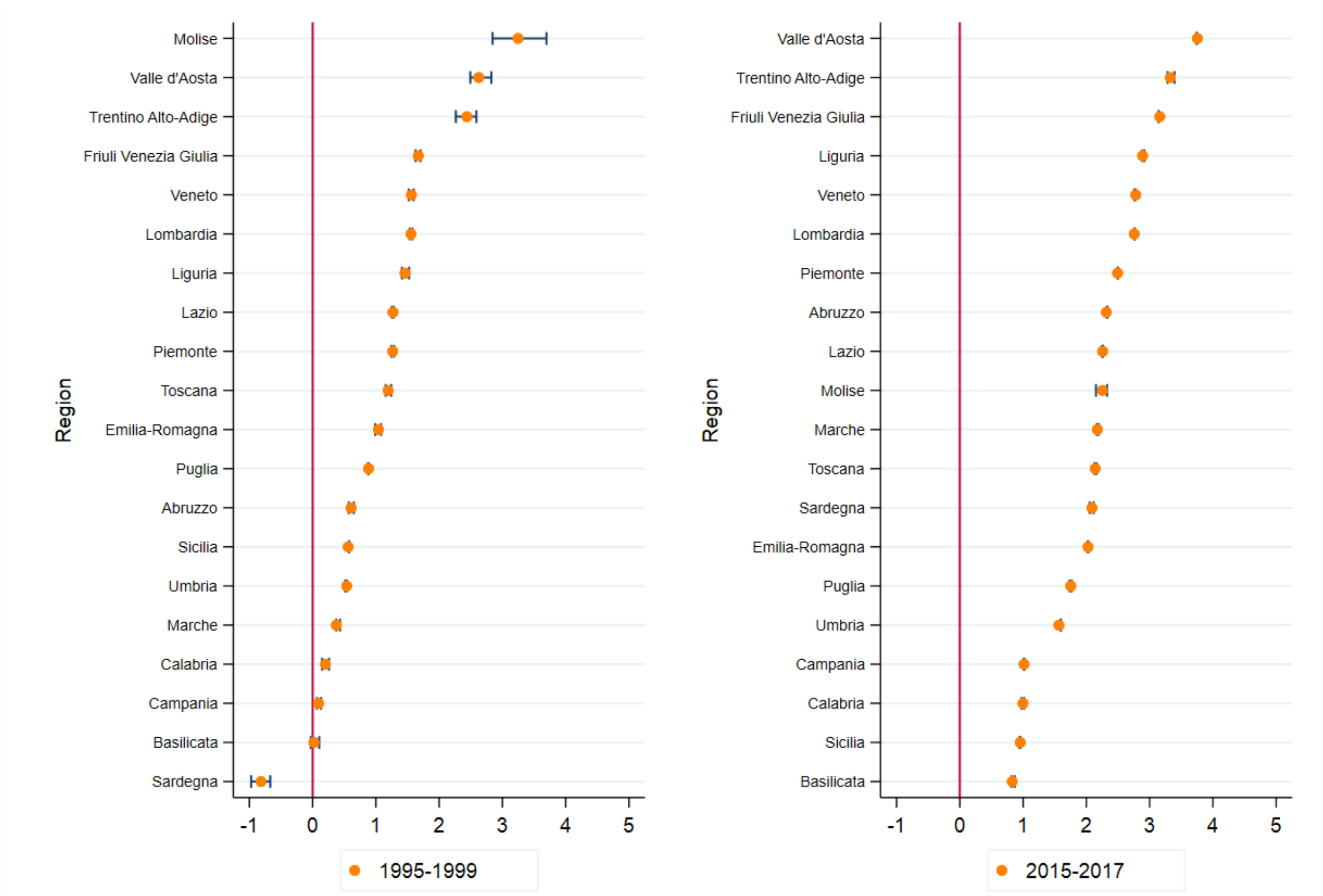
Notes. The graph plots the evolution of lifetable expectancy at 67 by pension quintile, sex and period, along with 95%confidence intervals.

Figure 10: Lifetable entropy by quintiles of pension income at 67
Years 1995-2017



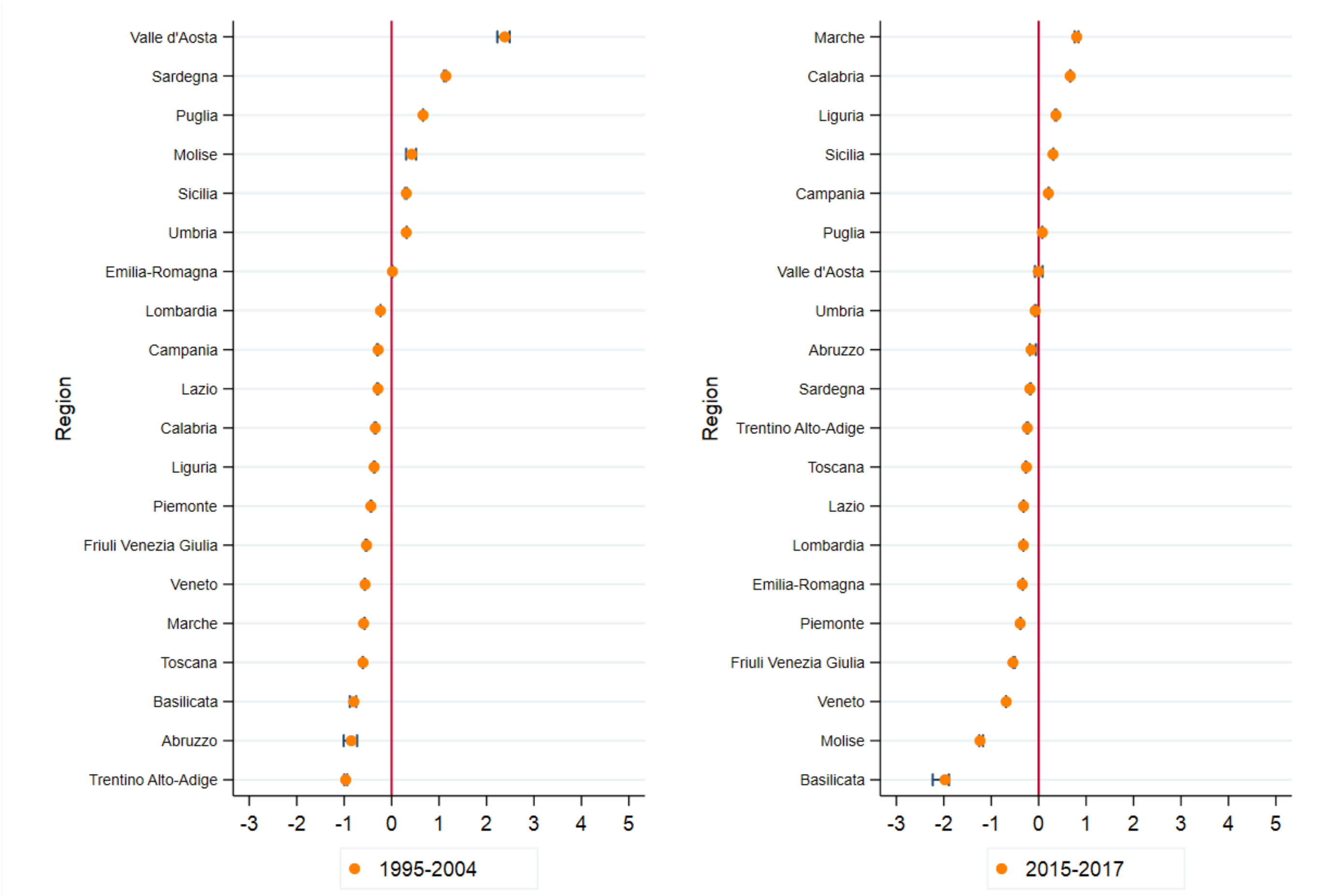
Notes. The graph plots the evolution of lifetable entropy at 67 by pension quintile, sex and period, along with 95%confidence intervals.

Figure 11: Difference in life expectancy at 67 between top and bottom pension income quintile by region – Men Years 1995-1999 vs Years 2015-2017



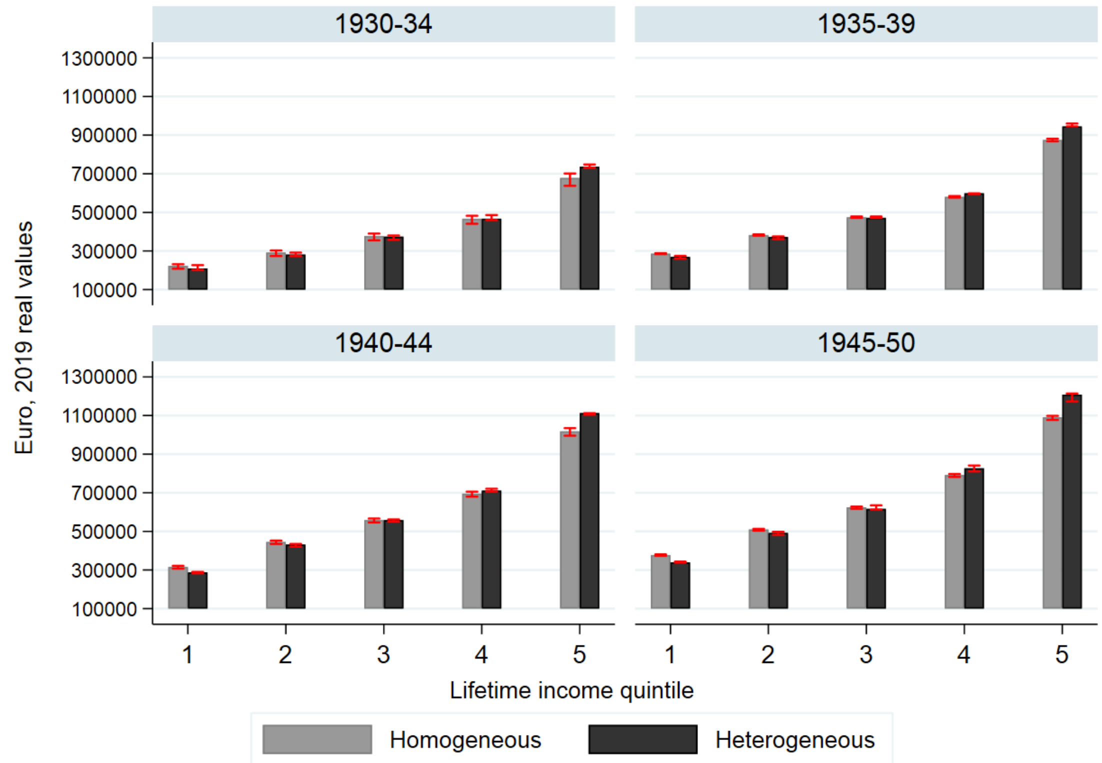
Notes. The graph plots the difference in life expectancy at 67 between top and bottom pension quintile for period 1995-1999 vs period 2015-2017 for each Italian region, along with 95% confidence intervals (in blue).

Figure 12: Difference in life expectancy at 67 between top and bottom pension income quintile by region – Women
Years 1995-1999 vs Years 2015-2017



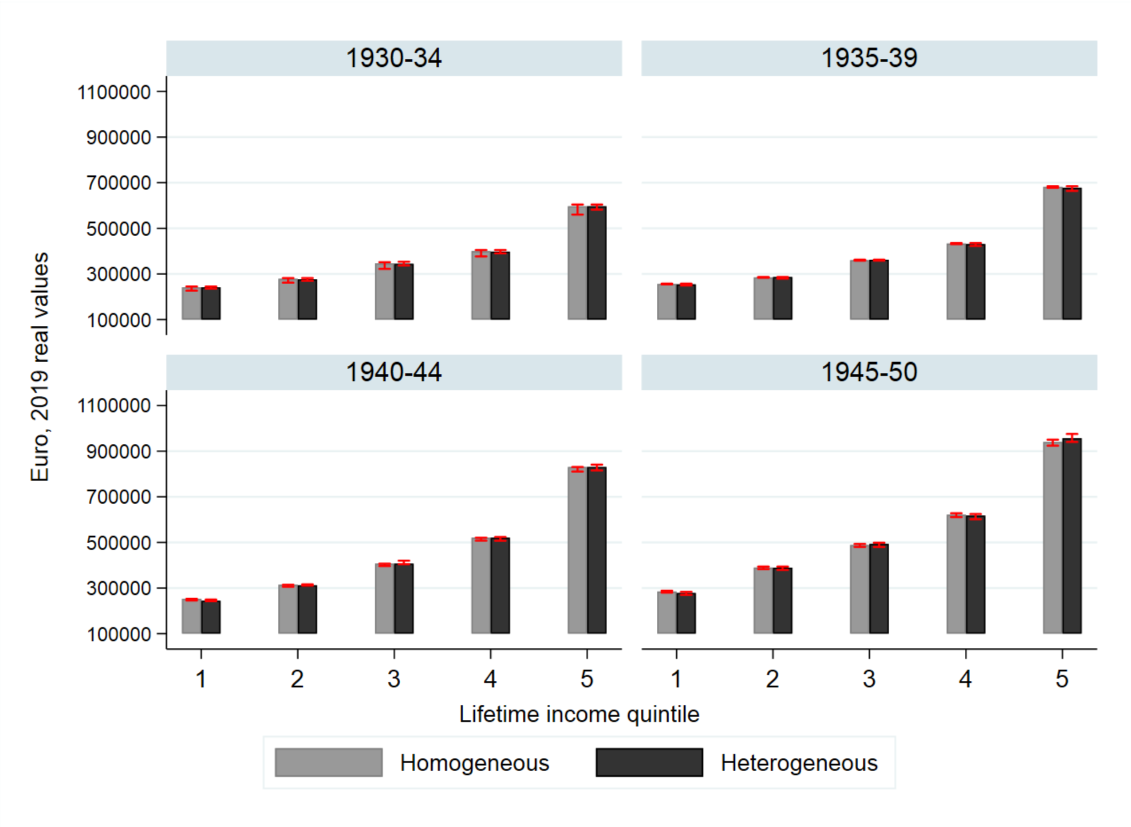
Notes. The graph plots the difference in life expectancy at 67 between top and bottom pension quintile for period 1995-1999 vs period 2015-2017 for each Italian region, along with 95% confidence intervals (in blue).

Figure 13: Pension wealth at retirement by cohort and lifetime income quintile - Men (homogeneous vs heterogeneous mortality)



Notes. Red bars represent 95% confidence bands accounting for uncertainty in mortality estimates.

Figure 14: Pension wealth at retirement by cohort and lifetime income quintile – Women (homogeneous vs heterogeneous mortality)



Notes. Red bars represent 95% confidence bands accounting for uncertainty in mortality estimates.

Figure 15: Difference in pension wealth at retirement with and w/o heterogeneous mortality - Men

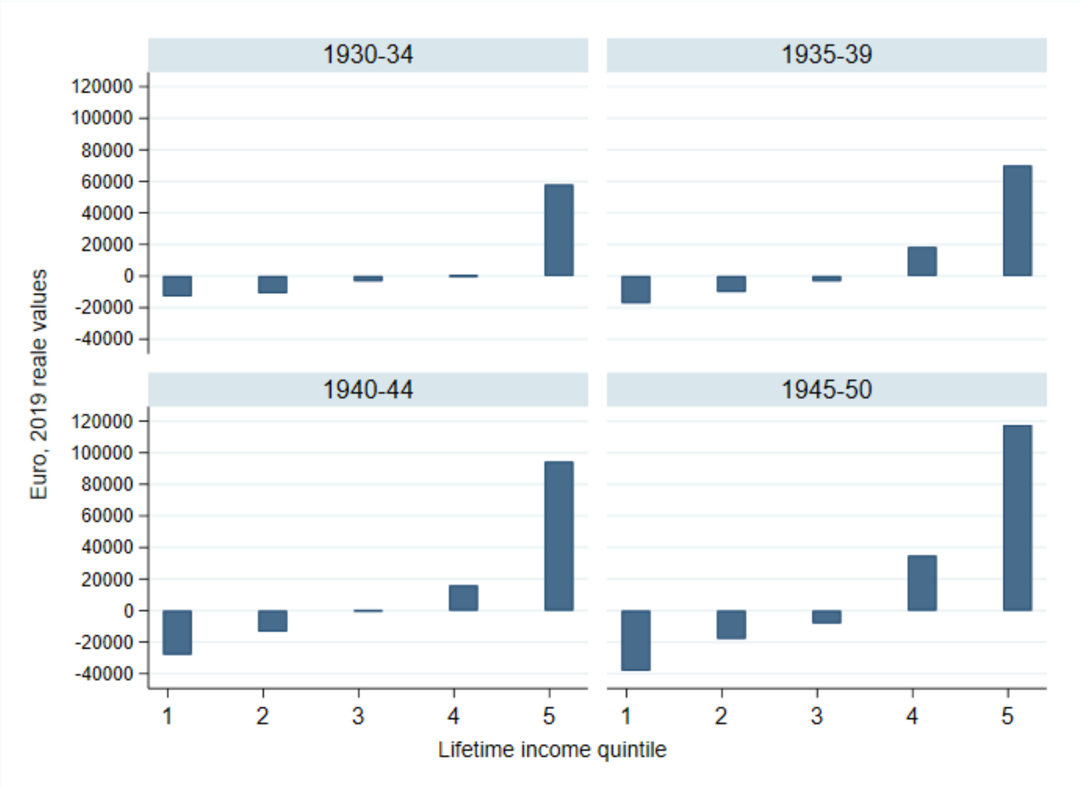


Figure 16: Difference in pension wealth at retirement with and w/o heterogeneous mortality - Women

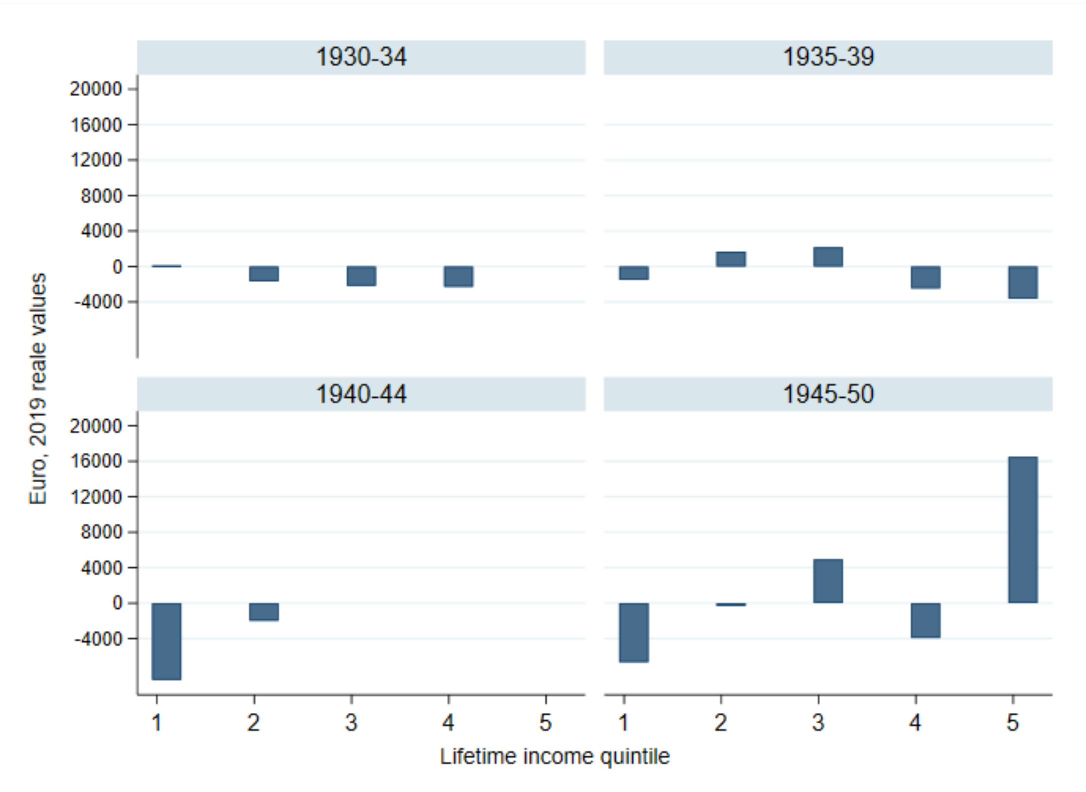
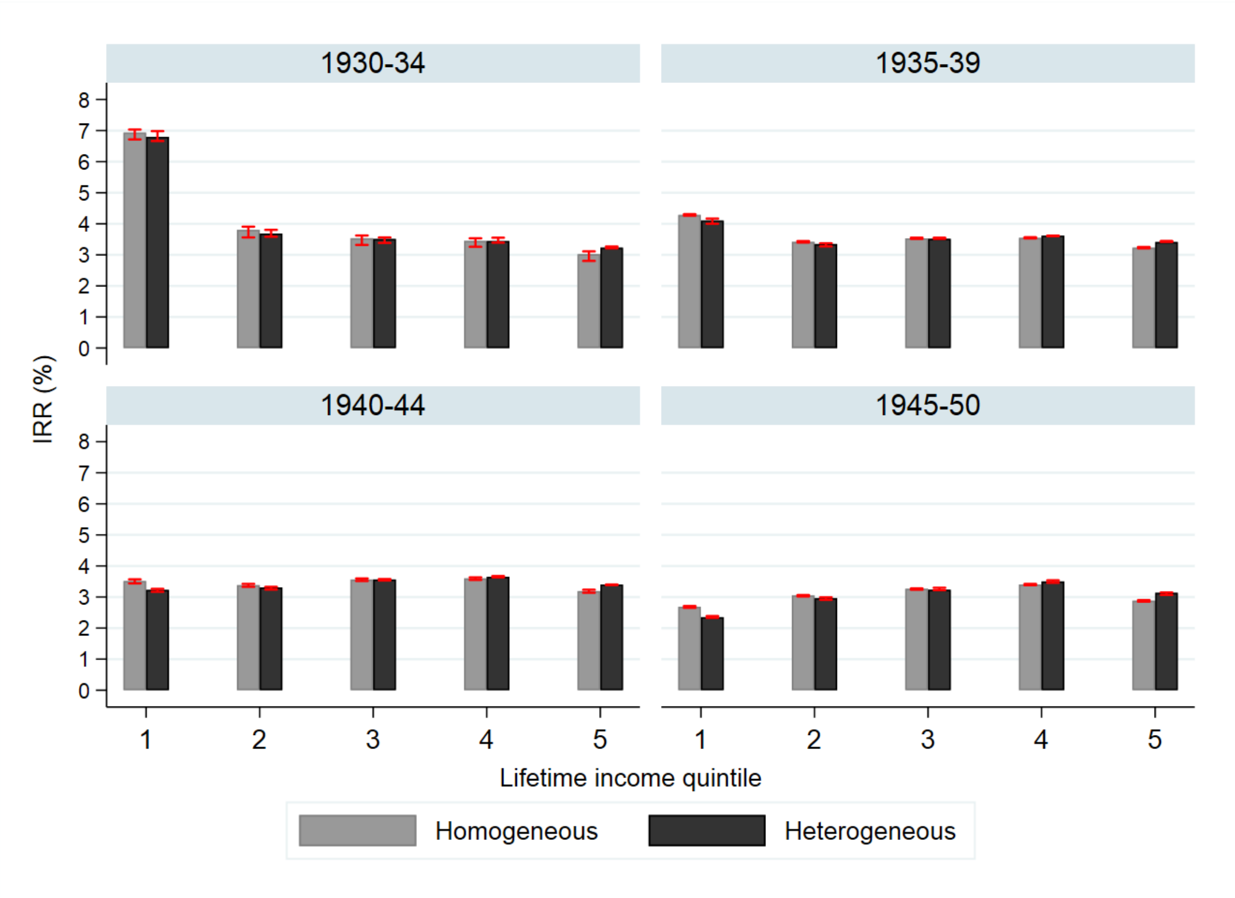
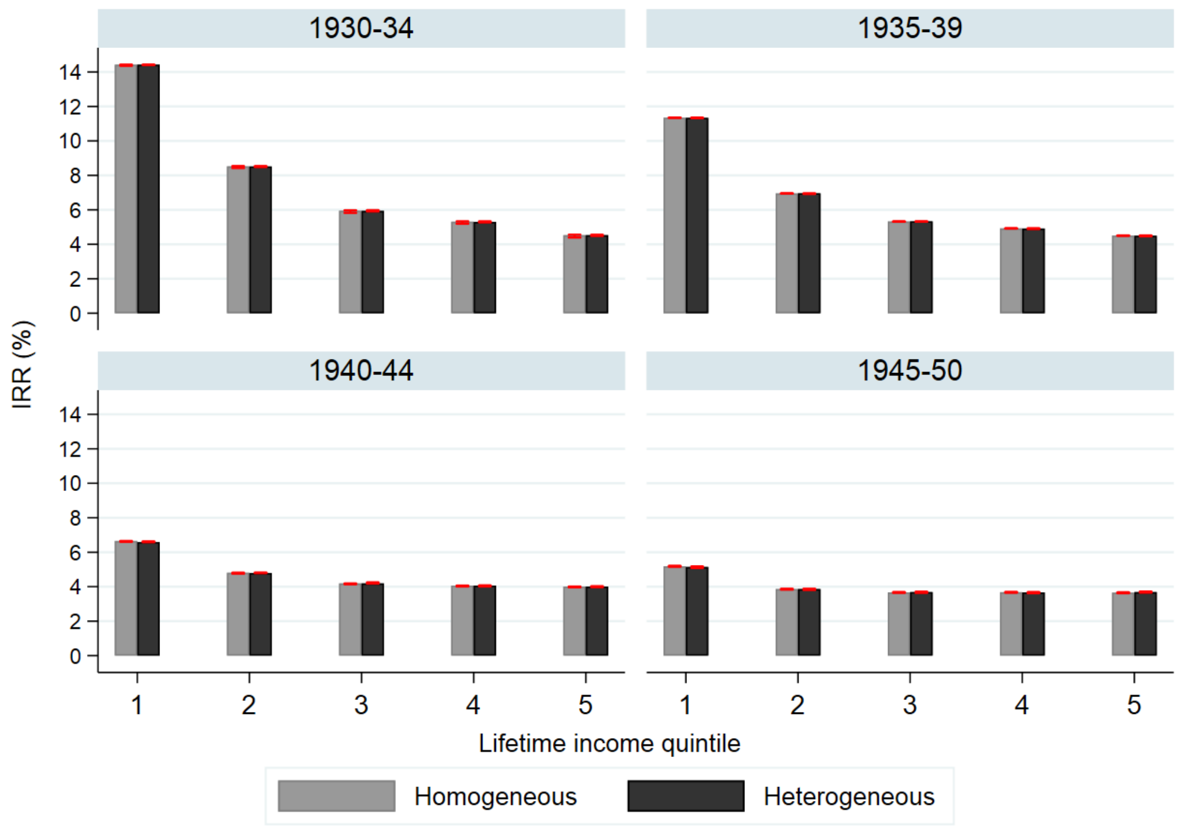


Figure 17: Internal rate of return by cohort and lifetime income quintile – Men (homogeneous vs heterogeneous mortality)



Notes. Red bars represent 95% confidence bands accounting for uncertainty in mortality estimates.

Figure 18: Internal rate of return by cohort and lifetime income quintile – Women (homogeneous vs heterogeneous mortality)



Notes. Red bars represent 95% confidence bands accounting for uncertainty in mortality estimates.

Figure 19: Difference in internal rate of returns with and w/o heterogeneous mortality - Men

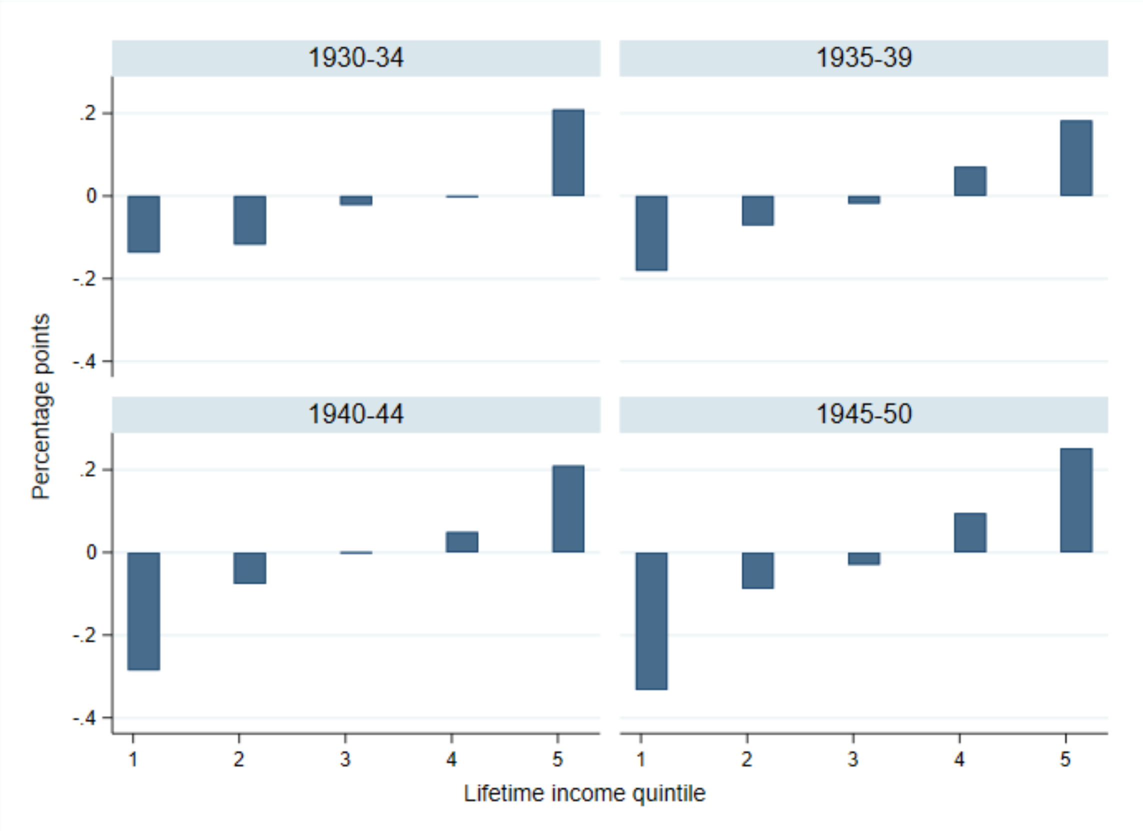
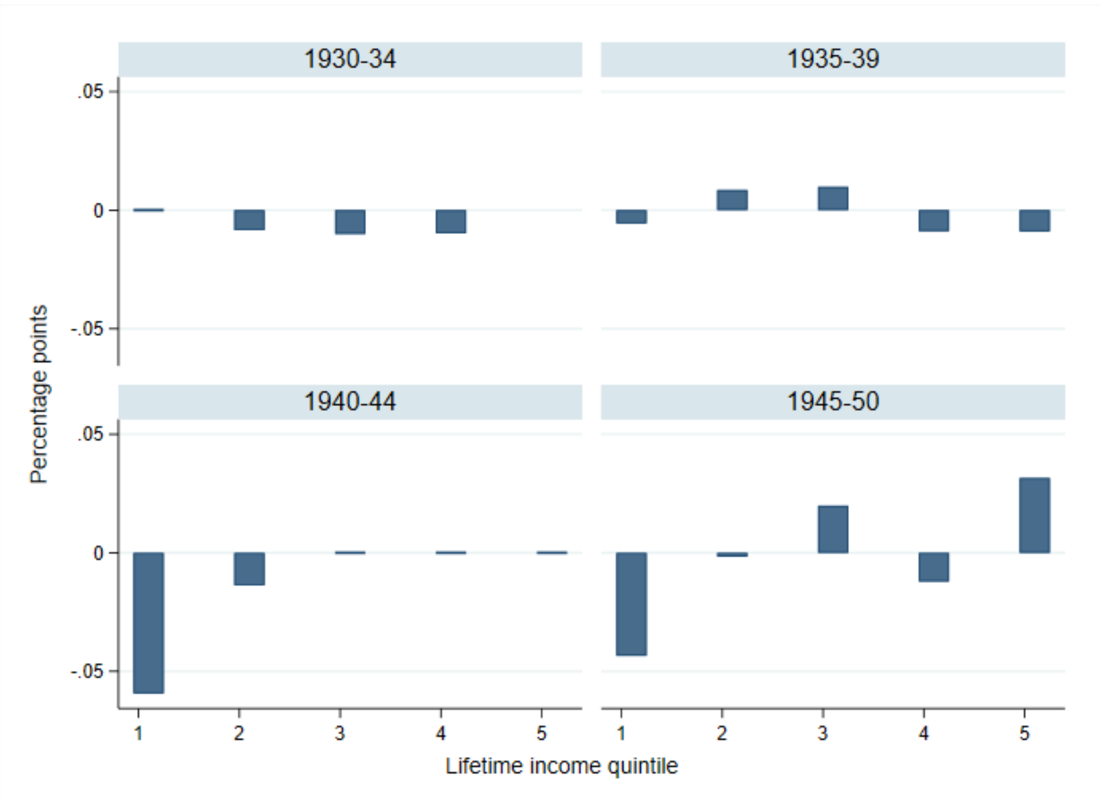


Figure 20: Difference in internal rate of returns with and w/o heterogeneous mortality - Women



Appendix A

Estimation of Kannisto parameters

We estimate the Kannisto parameters α and β through maximum likelihood by assuming that deaths follow a Poisson distribution with $D_x \sim Poisson\ (E_x \cdot \mu_x(\alpha, \beta))$, where D_x and E_x denote, respectively, deaths and person years lived at age x. We derive the Kannisto parameters by maximizing the log-likelihood function:

$$\log L(\alpha, \beta) = \sum_{x=75}^{85} \{D_x \log[\mu_x(\alpha, \beta)] - E_x \mu_x(\alpha, \beta)\} + constant$$

μ_x denotes mortality rate at age *x*.

Appendix B

Reforming the Italian pension system: an overview

Since the mid-1970s, the Italian population has been ageing fast. Between 1950 and 2018, the percentage of individuals aged 65 or more has increased from 9.5% to 22.7% of the total population (World Bank, 2019). Initially, policymakers neglected the implications of the ongoing demographic shift for the financial sustainability of the pay-as-you-go pension system. Indeed, the growth of working age population, which followed the baby boom of the early 1960s, and high employment levels ensured enough revenues for covering welfare outlays. As the first signals of rapidly rising pension expenditure began to appear at the beginning of the 1990s, policymakers inaugurated a long series of pension reforms aimed at extending the length of working life and reducing pension disbursements. In 1992, the Amato reform (Law n. 503/1992), while maintaining defined benefit pension rules, introduced three major changes (i) it increased progressively legal retirement age, up to 60 for women and 65 for men; (ii) it increased the number of years over which pensionable earnings were to be computed; (iii) it modified the indexation mechanism linking the growth of pension benefits to price inflation *in lieu* of real earnings growth. In 1995, the Dini reform (Law n. 335/1995) determined the transition from DB to NDC pension rules, with the aim of tightening the link between pension benefits and contributions.[17] The phase-in period was set to be very gradual. Workers with at

[17] Under the defined benefit pension regime, pension benefits are determined multiplying pensionable earnings by the number of working years and by an accrual rate. Under the NDC regime, contributions are (fictitiously) accumulated in an individual fund, and are revaluated in line with a moving average of GDP growth. Pension benefits are then computed by multiplying the

least 18 years of contributions as of December 1995 were fully unaffected by the reform. Instead, those with a shorter contributory record were to be affected on a *pro rata* basis, the weight of DB depending on the ratio between pre-1995 to the overall contribution period upon retirement. In addition, the 1995 reform tightened age requirement for accessing seniority pension benefits. Further tightening of age requirements for claiming seniority pension benefits was also at the core of the Maroni Reform in 2004 and the Prodi reform in 2007. In 2011, the Fornero reform (Law Decree n. 201/2011) accelerated the transition to full NDC rules, introducing a *pro rata* contribution for all workers starting from January 1, 2012. This means that all pensions awarded from this date onward have an NDC component, regardless of the 18-year contribution period mentioned above. The Fornero Reform provided also for (i) the abolition of seniority pension, which was replaced by the so-called "anticipated" pension, (ii) the gradual convergence towards a unique longevity-indexed retirement age, independent of gender and occupational profile, set to reach 67 on January 1, 2019, and (ii) the automatic update of minimum retirement age, and related conversion factors, every two years from 2019 onward.[18] After the Fornero reform, major changes gave way to experimental and temporary measures which aimed at providing more flexibility in the retirement timing.[19]

revaluated contributions by a coefficient which depends on remaining life expectancy at retirement. Such coefficients are neutral with respect to gender and other relevant socio-economic characteristics, but they are periodically updated to account for changes in official life expectancy projections.

[18] Law Decree No. 4/2019 has temporarily frozen such automatic update until December 31, 2026.

[19] For instance, Law n. 232/2016 introduced the possibility for individuals aged 63 or more to claim a specific social allowance until the attainment of legal retirement age/fulfillment of requirements for claiming anticipated pension benefits. Law Decree No. 4/2019 introduced an anticipated retirement option, valid for the 2019-2021 triennium, for workers aged 62 with 38 years of contributions (so-called *quota 100*).

Supplementary Tables

Table S1: Test of Proportionality of Hazards Assumption – Men (macro-occupational groups)

Variable	ρ	$\chi 2$	df	Prob> $\chi 2$
Clerical support workers	.	.	1	.
Managers	-0.00185	0.05	1	0.8237
Professionals	0.00348	0.17	1	0.6795
Technicians	-0.00600	0.52	1	0.4708
Service and sales workers	0.00369	0.20	1	0.6583
Craft and related trade workers, skilled agricultural, forestry and fishery workers	-0.00393	0.22	1	0.6357
Plant and machine operators, assemblers	-0.00653	0.62	1	0.4319
Elementary occupations	-0.01208	2.12	1	0.1456
Widow	0.00664	0.64	1	0.4240
Separated/Divorced	0.00120	0.02	1	0.8853
Never married	0.01152	1.96	1	0.1611
Abroad	-0.01087	1.69	1	0.1938
Islands	0.00218	0.07	1	0.7941
North-East	-0.01661	3.97	1	0.0464
North-West	-0.00944	1.29	1	0.2564
South	0.00519	0.39	1	0.5346
Social disability pension	-0.06081	69.19	1	0.0000
Disability pension	-0.01984	6.06	1	0.0138
Secondary education	0.01522	3.38	1	0.0662
Tertiary education	0.00679	0.65	1	0.4206
Global test		99.17	19	0.0000

Table S2: Test of Proportionality of Hazards Assumption – Women (macro-occupational groups)

Variable	ρ	$\chi 2$	df	Prob> $\chi 2$
Managers	0.00207	0.02	1	0.8843
Professionals	0.01618	1.29	1	0.2562
Technicians	0.00986	0.49	1	0.4843
Service and sales workers	0.02281	2.67	1	0.1023
Craft and related trade workers, skilled agricultural, forestry and fishery workers	0.00683	0.24	1	0.6260
Plant and machine operators, assemblers	0.02370	2.80	1	0.0945
Elementary occupations	-0.00115	0.01	1	0.9353
Widow	-0.01494	1.14	1	0.2858
Separated/Divorced	0.02016	2.14	1	0.1437
Never married	0.02055	2.28	1	0.1314
Abroad	-0.02862	4.01	1	0.0453
Islands	0.03470	5.95	1	0.0147
North-East	-0.00239	0.03	1	0.8672
North-West	-0.00685	0.24	1	0.6267
South	0.02274	2.62	1	0.1058
Social disability pension	-0.12164	110.78	1	0.0000
Disability pension	-0.01641	1.45	1	0.2288
Secondary education	0.01154	0.66	1	0.4163
Tertiary education	0.00650	0.20	1	0.6508
Global test		139.04	19	0.0000

Table S3: Test of Proportionality of Hazards Assumption - Men (micro-occupational groups)

Variable	ρ	$\chi 2$	df	Prob> $\chi 2$
Legislators and senior officials	-0.00332	0.16	1	0.6883
Managing directors and chief executives	0.00008	0.00	1	0.9924
Professional services managers	-0.01163	1.99	1	0.1584
Science professionals (mathematics, computer science, chemistry, physics, biology)	-0.00295	0.12	1	0.7243
Engineers, architects and similar professions	-0.00309	0.14	1	0.7113
Life science professionals	0.01221	2.11	1	0.1460
Health professionals	-0.00707	0.71	1	0.4004
Legal, social and cultural professionals	0.00877	1.10	1	0.2947
Teaching and research professionals	-0.00580	0.48	1	0.4898
Science and engineering technicians	-0.01044	1.57	1	0.2105
Life science technicians	-0.01065	1.64	1	0.2009
Business and administration technicians	0.00592	0.50	1	0.4775
Public service technicians	-0.01247	2.25	1	0.1339
General and keyboard clerks	.	.	1	.
Customer service clerks	0.00699	0.71	1	0.4004
Other clerifcal support workers	-0.00709	0.73	1	0.3916
Numerical and material recording clerks	-0.00956	1.34	1	0.2476
Sales workers	-0.01693	4.12	1	0.0423
Personal service workers	0.01120	1.82	1	0.1773
Personal care workers	0.01159	1.93	1	0.1645
Protective service workers	0.00929	1.24	1	0.2652
Mining, building and related trade workers	-0.00189	0.05	1	0.8199
Electrical and electronic trades workers	0.00249	0.09	1	0.7640
Handicraft and printing workers	0.00261	0.10	1	0.7546
Skilled agricultural, forestry and fishery workers	-0.00842	1.02	1	0.3125
Food processing, wood working, garment and other craft and related trades workers	-0.00960	1.34	1	0.2470
Stationary plant operators	-0.01121	1.81	1	0.1788
Assemblers	-0.01008	1.47	1	0.2256
Machine operators in agricultural/food industry, drivers & mobile plant operators	-0.00087	0.01	1	0.9168
Unskilled sales workers, cleaners and helpers	-0.00788	0.90	1	0.3425
Unskilled agricultural, forestry and fishery workers	-0.00274	0.11	1	0.7425
Labourers in mining, construction, manufacturing	-0.01314	2.49	1	0.1143
Widow	0.00626	0.57	1	0.4509
Separated/Divorced	0.00084	0.01	1	0.9189
Never married	0.01164	2.01	1	0.1562
Abroad	-0.01122	1.80	1	0.1797
Islands	0.00250	0.09	1	0.7647
North-East	-0.01595	3.66	1	0.0556
North-West	-0.00867	1.09	1	0.2969
South	0.00664	0.63	1	0.4270
Social disability pension	-0.06133	70.56	1	0.0000
Disability pension	-0.01991	6.15	1	0.0132
Secondary education	0.01513	3.34	1	0.0678
Tertiary education	0.00968	1.31	1	0.2517
Global test		132.17	43	0.0000

Table S4: Test of Proportionality of Hazards Assumption - Women (micro-occupational groups)

Variable	ρ	$\chi 2$	df	Prob> $\chi 2$
Legislators and senior officials	0.00463	0.10	1	0.7473
Managers	0.00187	0.02	1	0.8957
Science, engineers, architects, life science, health professionals	0.01954	1.94	1	0.1632
Legal, social and cultural professionals	0.01657	1.36	1	0.2440
Teaching and research professionals	0.01175	0.67	1	0.4131
Science, engineering, life science technicians	0.00279	0.04	1	0.8418
Business and administration technicians	0.01342	0.90	1	0.3427
Public service technicians	0.01442	1.03	1	0.3109
Customer service clerks	-0.00648	0.22	1	0.6367
Other clerical support workers	0.02212	2.43	1	0.1193
Sales workers	0.02230	2.53	1	0.1119
Personal service workers	0.01767	1.56	1	0.2119
Personal care workers	0.02191	2.43	1	0.1187
Protective service workers	-0.00202	0.02	1	0.8864
Mining, building and related trade workers	0.01745	1.60	1	0.2066
Other craft and related trade workers	-0.00354	0.06	1	0.8040
Plant and machine operators	0.01385	0.92	1	0.3364
Assemblers	0.02131	2.28	1	0.1312
Unskilled sales workers	-0.00652	0.21	1	0.6445
Cleaners and helpers	-0.00889	0.40	1	0.5253
Unskilled workers in agriculture, forestry, fishery, mining, construction, manufacturing	0.02279	2.54	1	0.1112
Widow	-0.01479	1.12	1	0.2900
Separated/Divorced	0.01987	2.08	1	0.1492
Never married	0.02174	2.57	1	0.1089
Abroad	-0.02412	2.90	1	0.0887
Islands	0.03409	5.74	1	0.0166
North-East	-0.00284	0.04	1	0.8425
North-West	-0.00737	0.27	1	0.6005
South	0.02288	2.63	1	0.1050
Social disability pension	-0.12261	112.83	1	0.0000
Disability pension	-0.01605	1.38	1	0.2406
Secondary education	0.00862	0.37	1	0.5434
Tertiary education	0.00377	0.07	1	0.7942
Global test		151.22	33	0.0000

Table S5: Partial life expectancy at 65-74 – Men (macro-occupational groups)

Occupational class	ex_{65}	CI_{low}	CI_{up}
Managers and senior officials	8.69	8.65	8.72
Professionals	8.65	8.63	8.67
Technicians	8.56	8.54	8.59
Clerical support workers	8.47	8.44	8.50
Service and sales workers	8.44	8.39	8.49
Craft & related trade workers/skilled agricultural, forestry & fishery workers	8.41	8.37	8.44
Plant and machine operators, assemblers	8.38	8.34	8.42
Elementary occupations	8.38	8.35	8.41

Table S6: Life expectancy at 65 – Men (macro-occupational groups)

Occupational class	ex_{65}	CI_{low}	CI_{up}
Managers and senior officials	20.27	20.20	20.34
Professionals	19.14	19.10	19.19
Technicians	18.53	18.38	18.67
Clerical support workers	16.84	16.68	17.01
Service and sales workers	16.90	16.70	17.09
Craft & related trade workers/skilled agricultural, forestry & fishery workers	16.89	16.75	17.02
Plant and machine operators, assemblers	16.82	16.55	17.10
Elementary occupations	16.87	16.79	16.95

Table S7: Partial life expectancy at 65-74 – Men (micro-occupational groups)

Occupational class	e_{65-74}	CI_{low}	CI_{up}
Legislators and senior officials	8.70	8.65	8.74
Managing directors and chief executives	8.68	8.63	8.73
Professional services managers	8.64	8.47	8.75
Science professionals (mathematics, computer science, chemistry, physics, biology)	8.65	8.52	8,74
Engineers, architects and similar professions	8,73	8.62	8.81
Life science professionals	8.66	8.52	8.75
Health professionals	8.68	8.63	8.72
Legal. social and cultural professionals	8.60	8.57	8.64
Teaching and research professionals	8.68	8.65	8.71
Science and engineering technicians	8.56	8.51	8.60
Life science technicians	8.55	8.49	8.60
Business and administration technicians	8.57	8.53	8.60
Public service technicians	8.56	8.48	8.64
General and keyboard clerks	8.48	8.44	8.51
Customer service clerks	8.47	8.38	8.55
Other clerifcal support workers	8.47	8.33	8.58
Numerical and material recording clerks	8.32	8.15	8.46
Sales workers	8.45	8.37	8.52
Personal service workers	8.36	8.24	8.47
Personal care workers	8.46	8.25	8.61
Protective service workers	8.46	8.37	8.54
Mining. building and related trade workers	8.45	8.40	8.49
Electrical and electronic trades workers	8.36	8.30	8.42
Handicraft and printing workers	8.43	8.25	8.57
Skilled agricultural, forestry and fishery workers	8.40	8.28	8.50
Food processing, wood working, garment and other craft and related trades workers	8.37	8.27	8.46
Stationary plant operators	8.45	8.35	8.53
Assemblers	8.33	8.24	8.41
Machine operators in agricultural/food industry, drivers & mobile plant operators	8.38	8.33	8.43
Unskilled sales workers, cleaners and helpers	8.37	8.32	8.41
Unskilled agricultural. forestry and fishery workers	8.48	8.40	8.56
Labourers in mining, construction, manufacturing	8.35	8.26	8,42

Table S8: Life expectancy at 65 – Men (micro-occupational groups)

Occupational class	e_{65-74}	CI_{low}	CI_{up}
Legislators and senior officials	20.36	20.30	20.44
Managing directors and chief executives	20.23	20.46	19.97
Professional services managers	19.64	20.48	18.63
Science professionals (mathematics, computer science, chemistry, physics, biology)	19.79	20.90	18.57
Engineers, architects and similar professions	20.75	21.10	20.30
Life science professionals	16.78	16.29	17.40
Health professionals	19.83	19.87	19.78
Legal. social and cultural professionals	18.40	18.51	18.27
Teaching and research professionals	19.50	19.50	19.51
Science and engineering technicians	18.82	19.19	18.43
Life science technicians	18.69	19.02	18.33
Business and administration technicians	18.16	18.34	17.98
Public service technicians	19.11	19.20	19.00
General and keyboard clerks	16.92	17.09	16.75
Customer service clerks	16.40	16.83	15.93
Other clerifcal support workers	16.59	17.61	15.51
Numerical and material recording clerks	16.26	17.45	15.02
Sales workers	18.16	18.58	17.70
Personal service workers	16.25	16.50	15.95
Personal care workers	17.62	18.12	16.97
Protective service workers	15.73	15.97	15.46
Mining. building and related trade workers	17.16	17.22	17.08
Electrical and electronic trades workers	16.18	16.57	15.78
Handicraft and printing workers	17.38	18.55	16.11
Skilled agricultural, forestry and fishery workers	17.82	18.10	17.50
Food processing, wood working, garment and other craft and related trades workers	16.67	17.00	16.30
Stationary plant operators	18.88	19.77	17.96
Assemblers	16.56	17.20	15.90
Machine operators in agricultural/food industry, drivers & mobile plant operators	16.38	16.66	16.09
Unskilled sales workers, cleaners and helpers	16.76	16.88	16.63
Unskilled agricultural. forestry and fishery workers	17.60	17.51	17.71
Labourers in mining, construction, manufacturing	16.45	16.72	16.15

Table S9: Partial life expectancy at 65-74 – Women (macro-occupational groups)

Occupational class	ex_{65}	CI_{low}	CI_{up}
Managers and senior officials	8.74	8.67	8.80
Professionals	8.78	8.76	8.79
Technicians	8.75	8.73	8.77
Clerical support workers	8.71	8.68	8.74
Service and sales workers	8.72	8.69	8.76
Craft & related trade workers/skilled agricultural, forestry & fishery workers	8.73	8.67	8.77
Plant and machine operators, assemblers	8.66	8.53	8.75
Elementary occupations	8.72	8.69	8.74

Table S10: Life expectancy at 65 – Women (macro-occupational groups)

Occupational class	ex_{65}	CI_{low}	CI_{up}
Managers and senior officials	21.83	21.19	22.41
Professionals	21.67	21.47	21.87
Technicians	21.37	21.20	21.53
Clerical support workers	20.95	20.53	21.37
Service and sales workers	20.29	19.94	20.63
Craft & related trade workers/skilled agricultural, forestry & fishery workers	21.48	20.62	22.30
Plant and machine operators, assemblers	19.39	17.37	21.47
Elementary occupations	21.39	21.23	21.53

Table S11: Partial life expectancy at 65-75 – Women (micro-occupational groups)

Occupational class	ex_{65-74}	CI_{low}	CI_{up}
Legislators and senior officials	8.77	8.68	8.83
Managers	8.68	8.53	8.78
Science, engineers, architects, life science, health professionals	8.78	8.69	8.85
Legal, social and cultural professionals	8.73	8.70	8.77
Teaching and research professionals	8.79	8.77	8.81
Science, engineering, life science technicians	8.72	8.67	8.76
Business and administration technicians	8.73	8.69	8.77
Public service technicians	8.78	8.75	8.81
General and keyboard clerks	8.72	8.69	8.75
Customer service clerks	8.70	8.59	8.78
Other clerical support workers	8.63	8.46	8.75
Sales workers	8.68	8.59	8.76
Personal service workers	8.73	8.65	8.79
Personal care workers	8.72	8.57	8.81
Protective service workers	8.75	8.68	8.80
Mining, building and related trade workers	8.71	8.64	8.78
Other craft and related trade workers	8.75	8.67	8.81
Plant and machine operators	8.68	8.37	8.83
Assemblers	8.66	8.50	8.76
Unskilled sales workers	8.69	8.65	8.73
Cleaners and helpers	8.76	8.69	8.81
Unskilled workers in agriculture, forestry, fishery, mining, construction, manufacturing	8.75	8.69	8.80

Table S12: Full life expectancy at 65 – Women (micro-occupational groups)

Occupational class	ex_{65-74}	CI_{low}	CI_{up}
Legislators and senior officials	22.17	21.53	22.72
Managers	20.81	19.40	22.06
Science, engineers, architects, life science, health professionals	21.28	19.89	22.57
Legal, social and cultural professionals	20.46	20.06	20.83
Teaching and research professionals	22.11	21.88	22.34
Science, engineering, life science technicians	20.90	20.26	21.52
Business and administration technicians	21.32	20.92	21.70
Public service technicians	21.03	21.17	20.91
General and keyboard clerks	21.32	20.87	21.75
Customer service clerks	19.30	17.81	20.73
Other clerical support workers	18.49	16.26	20.70
Sales workers	19.04	18.06	19.96
Personal service workers	20.56	19.88	21.18
Personal care workers	18.57	16.97	20.02
Protective service workers	21.66	21.39	21.89
Mining, building and related trade workers	21.19	20.38	21.93
Other craft and related trade workers	22.80	20.99	24.58
Plant and machine operators	19.99	16.26	23.66
Assemblers	19.29	16.98	21.68
Unskilled sales workers	21.21	20.88	21.51
Cleaners and helpers	21.99	21.56	22.36
Unskilled workers in agriculture, forestry, fishery, mining, construction, manufacturing	21.71	21.73	21.69

Table S13: *Dichiarazioni Uniemens* sample
Observations by sex and prevalent occupation position

Sex	Blue-collar	White-collar	Managers	Total
Women	1,281,863	709,035	15,316	2,006,214
Men	3,321,301	1,243,378	157,306	4,721,985
Total	4,603,164	1,952,413	172,622	6,728,199

Table S14: *Dichiarazioni Uniemens* sample
N. of individuals by year of birth and prevalent occupation - Men

Year of birth	Blue-collar	White-collar	Managers	Total
1930	147407	32777	3116	183300
1931	141972	32998	3343	178313
1932	136486	33438	3564	173488
1933	138791	35064	3845	177700
1934	134759	35868	4176	174803
1935	131979	3831	4442	174731
1936	121986	37823	4516	164325
1937	123278	40028	5289	168595
1938	124128	44002	5911	174041
1939	118874	43633	5806	168313
1940	116921	44367	6478	167766
1941	101482	41563	6634	149679
1942	94447	40247	6405	141099
1943	91963	41226	6619	139808
1944	94543	42444	5900	142887
1945	88952	41042	5669	135663
1946	112945	56155	7644	176744
1947	113023	56167	7313	176503
1948	115732	57020	6979	179731
1949	112985	52923	7420	173328
1950	113083	50354	7001	170438
1951	109944	50710	6772	167426
1952	110746	49493	6514	166753
1953	113959	48309	6283	168551
1954	121697	48104	4905	174706
1955	125401	48531	4876	178808
1956	129292	50167	4881	184340
1957	134539	50623	4986	190148
Total	3,321,301	1,243,378	157,306	4,721,985

Table S15: *Dichiarazioni Uniemens* sample
N. of individuals by year of birth and prevalent occupation - Women

Year of birth	Blue-collar	White-collar	Managers	Total
1930	45675	13192	131	58998
1931	44858	13326	139	58323
1932	44764	13465	161	58390
1933	45163	14078	172	59413
1934	46193	14524	181	60898
1935	46717	15554	208	62479
1936	44042	15769	203	60014
1937	44952	16817	263	62032
1938	44975	18301	345	63621
1939	43027	18562	302	61891
1940	43820	20014	355	64189
1941	39141	19690	333	59164
1942	35448	18473	366	54287
1943	36364	19429	477	56270
1944	38104	20864	417	59385
1945	35560	20393	435	56388
1946	46184	28408	634	75226
1947	44771	29450	592	74813
1948	46723	31530	630	78883
1949	44794	31663	910	77367
1950	45754	31941	1083	78778
1951	45035	32493	1152	78680
1952	46691	34156	1404	82251
1953	49569	36643	1493	87705
1954	53925	40120	714	94759
1955	57005	43324	696	101025
1956	59611	46745	723	107079
1957	63108	50002	831	113941
Total	1,281,863	709,035	15,316	2,006,214

Table S16: Life expectancy at 50 by lifetime income quintile and year of birth with 95% CIs - Men

Year of birth	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1930	27.30 [25.40; 30.31]	27.30 [25.47; 29.62]	29.51 [29.08; 29.93]	28.00 [25.90; 30.87]	31.40 [30.92; 31.87]
1931	28.44 [26.23; 31.04]	29.17 [28.78; 29.53]	27.79 [25.75; 30.48]	30.30 [29.80; 30.79]	31.51 [31.02; 31.98]
1932	30.22 [29.97; 30.47]	29.51 [29.22; 29.79]	29.81 [29.34; 30.26]	30.20 [29.75; 30.64]	31.95 [31.61; 32.29]
1933	30.30 [30.16; 30.43]	29.71 [29.56; 29.85]	30.27 [30.08; 30.45]	30.81 [30.61; 31.00]	32.37 [32.16; 32.57]
1934	30.37 [30.16; 30.58]	30.13 [29.98; 30.29]	30.68 [30.46; 30.89]	31.33 [31.17; 31.48]	32.84 [32.63; 33.04]
1935	30.55 [30.34; 30.76]	30.59 [30.38; 30.79]	30.91 [30.69; 31.13]	32.05 [31.81; 32.28]	33.25 [33.03; 33.47]
1936	30.40 [30.18; 30.62]	30.70 [30.47; 30.93]	31.25 [30.98; 31.51]	32.08 [31.87; 32.28]	33.74 [33.58; 33.89]
1937	30.51 [30.29; 30.73]	31.04 [30.77; 31.30]	31.74 [31.51; 31.96]	32.51 [32.26; 32.76]	34.04 [33.80; 34.27]
1938	30.49 [30.27; 30.70]	31.43 [31.16; 31.70]	31.83 [31.58; 32.06]	32.88 [32.59; 33.16]	34.33 [34.04; 34.61]
1939	30.72 [30.49; 30.95]	31.56 [31.33; 31.79]	32.27 [32.04; 32.50]	32.90 [32.54; 33.23]	34.40 [34.13; 34.66]
1940	30.83 [30.63; 31.04]	31.57 [31.30; 31.83]	32.20 [31.92; 32.46]	33.14 [32.85; 33.42]	34.72 [34.48; 34.95]
1941	30.62 [30.36; 30.87]	31.58 [31.33; 31.82]	32.41 [32.08; 32.72]	33.23 [32.86; 33.59]	35.00 [34.70; 35.27]
1942	30.61 [30.36; 30.85]	31.52 [31.24; 31.79]	32.62 [32.32; 32.91]	33.17 [32.86; 33.47]	35.03 [34.72; 35.32]
1943	30.30 [30.11; 30.48]	31.32 [31.06; 31.56]	32.68 [32.37; 32.98]	33.27 [32.69; 33.81]	34.92 [34.65; 35.17]
1944	30.40 [30.08; 30.72]	31.99 [31.54; 32.41]	33.01 [32.65; 33.35]	33.87 [33.49; 34.23]	35.11 [34.72; 35.47]
1945	30.73 [30.46; 30.99]	31.98 [31.57; 32.37]	33.21 [32.69; 33.70]	34.05 [33.68; 34.39]	35.33 [34.90; 35.72]
1946	30.83 [30.52; 31.14]	32.25 [31.91; 32.58]	32.84 [32.41; 33.25]	34.47 [34.08; 34.85]	35.61 [35.34; 35.88]
1947	30.97 [30.54; 31.38]	32.55 [32.08; 33.00]	33.26 [32.77; 33.74]	34.54 [34.00; 35.04]	35.89 [35.36; 36.38]
1948	31.19 [30.87; 31.50]	32.66 [32.26; 33.04]	33.48 [32.58; 34.32]	34.85 [34.27; 35.38]	36.65 [36.31; 36.96]
1949	31.37 [30.85; 31.88]	32.79 [32.21; 33.34]	34.15 [33.53; 34.74]	35.02 [34.42; 35.57]	36.55 [36.01; 37.05]
1950	31.46 [31.04; 31.87]	32.28 [31.51; 33.03]	33.31 [32.69; 33.92]	35.07 [34.53; 35.58]	36.92 [36.40; 37.40]
1951	31.36 [31.03; 31.68]	33.63 [32.93; 34.30]	34.05 [33.29; 34.77]	35.33 [34.53; 36.07]	36.12 [35.27; 36.89]
1952	31.32 [30.80; 31.84]	33.37 [32.73; 33.98]	33.74 [33.09; 34.37]	34.89 [34.11; 35.62]	37.14 [36.26; 37.91]
1953	31.51 [30.76; 32.23]	33.15 [32.53; 33.74]	33.67 [32.76; 34.53]	35.23 [34.26; 36.11]	37.38 [36.63; 38.06]
1954	31.04 [29.93; 32.12]	31.52 [30.17; 32.84]	33.73 [32.48; 34.88]	35.05 [33.92; 36.08]	36.52 [35.47; 37.44]
1955	31.68 [30.74; 32.58]	33.46 [32.32; 34.51]	32.48 [31.11; 33.78]	35.29 [33.65; 36.69]	36.92 [35.84; 37.86]
1956	31.93 [30.86; 32.95]	33.04 [32.06; 33.97]	33.17 [31.03; 35.11]	35.32 [33.91; 36.56]	35.12 [33.11; 36.88]
1957	33.13 [32.28; 33.92]	31.94 [30.45; 33.37]	32.92 [30.52; 35.14]	33.19 [30.90; 35.34]	37.82 [36.66; 38.79]

Table S17: Life expectancy at 50 by lifetime income quintile and year of birth with 95% CIs - Women

Year of birth	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1930	36.58 [35.77; 37.31]	34.97 [32.60; 36.99]	35.88 [34.70; 36.91]	36.15 [35.35; 36.86]	36.21 [35.63; 36.74]
1931	35.29 [33.53; 36.85]	36.82 [36.26; 37.33]	35.91 [34.91; 36.80]	36.53 [35.88; 37.10]	36.05 [35.04; 36.93]
1932	36.83 [36.25; 37.35]	36.41 [35.87; 36.90]	36.58 [35.51; 37.47]	36.27 [35.69; 36.80]	36.56 [35.80; 37.22]
1933	37.06 [36.62; 37.47]	37.07 [36.72; 37.39]	36.47 [36.01; 36.89]	36.25 [35.58; 36.87]	36.90 [36.27; 37.45]
1934	36.91 [36.49; 37.29]	36.76 [36.41; 37.09]	37.48 [37.07; 37.84]	36.83 [36.27; 37.32]	36.85 [36.24; 37.39]
1935	37.24 [36.95; 37.52]	37.65 [37.32; 37.95]	37.66 [37.28; 38.00]	37.33 [36.73; 37.86]	37.28 [36.88; 37.64]
1936	37.55 [37.17; 37.89]	37.54 [37.16; 37.90]	37.75 [37.28; 38.17]	37.60 [37.26; 37.90]	37.15 [36.71; 37.54]
1937	37.42 [36.96; 37.83]	38.17 [37.87; 38.44]	38.09 [37.83; 38.32]	37.37 [36.81; 37.86]	37.54 [37.18; 37.86]
1938	37.78 [37.38; 38.13]	37.56 [37.25; 37.84]	37.97 [37.61; 38.29]	37.68 [37.23; 38.08]	37.79 [37.49; 38.06]
1939	37.56 [37.21; 37.89]	37.84 [37.36; 38.27]	37.94 [37.58; 38.27]	37.66 [37.04; 38.21]	37.81 [37.39; 38.18]
1940	37.17 [36.72; 37.59]	37.94 [37.60; 38.25]	38.17 [37.77; 38.53]	37.79 [37.31; 38.21]	37.66 [37.09; 38.16]
1941	36.99 [36.50; 37.43]	37.80 [37.15; 38.35]	38.15 [37.69; 38.56]	37.87 [37.40; 38.29]	37.62 [37.19; 38.01]
1942	37.05 [36.62; 37.46]	37.91 [37.63; 38.18]	38.04 [37.48; 38.54]	37.86 [37.36; 38.30]	38.16 [37.70; 38.58]
1943	37.33 [36.84; 37.77]	37.46 [36.70; 38.12]	38.33 [37.82; 38.78]	38.08 [37.59; 38.51]	37.58 [37.08; 38.03]
1944	37.16 [36.31; 37.89]	38.44 [38.08; 38.78]	38.38 [37.86; 38.85]	37.63 [37.15; 38.05]	38.26 [37.82; 38.66]
1945	37.75 [37.12; 38.30]	37.80 [37.19; 38.34]	38.02 [37.61; 38.40]	37.73 [36.89; 38.45]	38.34 [37.72; 38.88]
1946	37.43 [36.68; 38.09]	38.70 [38.16; 39.18]	38.57 [37.89; 39.15]	38.72 [38.40; 39.02]	38.50 [38.12; 38.84]
1947	37.70 [37.28; 38.10]	38.48 [37.80; 39.06]	38.84 [38.24; 39.36]	38.58 [38.00; 39.09]	39.61 [38.93; 40.16]
1948	38.06 [37.47; 38.59]	38.79 [38.26; 39.25]	39.13 [38.25; 39.85]	38.45 [37.79; 39.03]	39.38 [38.82; 39.86]
1949	37.89 [37.00; 38.65]	38.73 [38.17; 39.24]	38.79 [38.08; 39.41]	38.28 [37.32; 39.10]	39.20 [38.15; 40.04]
1950	37.67 [36.85; 38.41]	38.12 [37.22; 38.91]	38.63 [37.58; 39.51]	37.58 [36.75; 38.33]	39.63 [38.75; 40.34]
1951	37.46 [36.59; 38.24]	39.63 [38.56; 40.46]	38.70 [36.96; 40.00]	37.40 [36.17; 38.46]	39.86 [39.03; 40.52]
1952	38.28 [37.54; 38.92]	38.65 [37.55; 39.56]	37.27 [35.53; 38.71]	39.33 [38.08; 40.30]	39.49 [38.63; 40.19]
1953	38.06 [37.05; 38.93]	38.86 [37.59; 39.87]	38.50 [36.89; 39.76]	38.88 [37.90; 39.70]	40.24 [39.31; 40.97]
1954	37.67 [36.39; 38.74]	37.99 [36.30; 39.32]	40.05 [38.95; 40.88]	39.03 [37.51; 40.20]	39.99 [38.58; 41.01]
1955	38.91 [37.91; 39.73]	38.26 [36.51; 39.61]	40.12 [38.33; 41.32]	37.79 [35.77; 39.36]	39.94 [37.30; 41.51]
1956	36.48 [33.92; 38.50]	39.00 [37.79; 39.96]	39.80 [37.38; 41.32]	38.18 [35.78; 39.94]	39.17 [36.97; 40.71]
1957	37.09 [34.53; 39.06]	40.57 [39.68; 41.27]	37.27 [34.59; 39.32]	35.64 [32.54; 38.25]	39.27 [37.09; 40.80]

Table S18: Lifetable entropy at 50 by lifetime income quintile and year of birth with 95% CIs

Men

Year of birth	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1930	0,2804 [0,2260; 0,3264]	0,3246 [0,2688; 0,3519]	0,3441 [0,3415; 0,3453]	0,2956 [0,2358; 0,3255]	0,3035 [0,3023; 0,3037]
1931	0,3151 [0,2583; 0,3326]	0,3545 [0,3522; 0,3556]	0,3080 [0,2494; 0,3356]	0,3255 [0,323; 0,3262]	0,3031 [0,3021; 0,3033]
1932	0,3402 [0,3398; 0,3403]	0,3509 [0,3498; 0,3515]	0,3333 [0,3303; 0,3347]	0,3252 [0,3228; 0,3263]	0,2991 [0,2982; 0,2995]
1933	0,3442 [0,3440; 0,3443]	0,3516 [0,3513; 0,3518]	0,3346 [0,3342; 0,3347]	0,3203 [0,3199; 0,3204]	0,2934 [0,2927; 0,2940]
1934	0,3359 [0,3356; 0,3360]	0,3376 [0,3372; 0,3378]	0,3247 [0,3244; 0,3249]	0,3114 [0,3113; 0,3115]	0,2855 [0,2845; 0,2862]
1935	0,3317 [0,3315; 0,3318]	0,3290 [0,3288; 0,3291]	0,3162 [0,3158; 0,3164]	0,3011 [0,3003; 0,3016]	0,2816 [0,2802; 0,2828]
1936	0,3335 [0,3331; 0,3336]	0,3239 [0,3235; 0,3241]	0,3116 [0,3112; 0,3117]	0,2975 [0,2969; 0,2979]	0,2722 [0,2711; 0,2731]
1937	0,3279 [0,3274; 0,3281]	0,3176 [0,3172; 0,3177]	0,3063 [0,3057; 0,3067]	0,2901 [0,2891; 0,2907]	0,2647 [0,2631; 0,2662]
1938	0,3252 [0,3246; 0,3255]	0,3126 [0,3120; 0,3129]	0,3001 [0,2997; 0,3003]	0,2812 [0,2800; 0,2820]	0,2588 [0,2567; 0,2608]
1939	0,3250 [0,3247; 0,3252]	0,3098 [0,3092; 0,3100]	0,2925 [0,2918; 0,2929]	0,2815 [0,2799; 0,2825]	0,2564 [0,2545; 0,2582]
1940	0,3234 [0,3232; 0,3235]	0,3089 [0,3083; 0,3091]	0,2959 [0,2950; 0,2964]	0,2789 [0,2775; 0,2801]	0,2529 [0,2510; 0,2547]
1941	0,3253 [0,3247; 0,3254]	0,3064 [0,3059; 0,3065]	0,2912 [0,2900; 0,2919]	0,2743 [0,2726; 0,2756]	0,2466 [0,2441; 0,2488]
1942	0,3266 [0,3262; 0,3268]	0,3084 [0,3078; 0,3086]	0,2881 [0,2869; 0,2889]	0,2740 [0,2727; 0,2750]	0,2477 [0,2450; 0,2502]
1943	0,3310 [0,3307; 0,3312]	0,3099 [0,3094; 0,3101]	0,2869 [0,2854; 0,2880]	0,2736 [0,2703; 0,2756]	0,2482 [0,2458; 0,2503]
1944	0,3305 [0,3300; 0,3307]	0,3014 [0,2993; 0,3027]	0,2817 [0,2795; 0,2835]	0,2662 [0,2632; 0,2687]	0,2431 [0,2395; 0,2463]
1945	0,3253 [0,3245; 0,3258]	0,3005 [0,2984; 0,3019]	0,2795 [0,2756; 0,2826]	0,2630 [0,2599; 0,2657]	0,2419 [0,2375; 0,2461]
1946	0,3253 [0,3239; 0,3261]	0,2970 [0,2949; 0,2988]	0,2778 [0,2753; 0,2797]	0,2565 [0,2527; 0,2600]	0,2350 [0,2320; 0,2379]
1947	0,3199 [0,3179; 0,3212]	0,2922 [0,2887; 0,2951]	0,2747 [0,2708; 0,2779]	0,2550 [0,2497; 0,2599]	0,2294 [0,2235; 0,2351]
1948	0,3154 [0,3137; 0,3168]	0,2892 [0,2861; 0,2919]	0,2721 [0,2641; 0,2782]	0,2497 [0,2436; 0,2553]	0,2184 [0,2141; 0,2227]
1949	0,3161 [0,3124; 0,3190]	0,2859 [0,2811; 0,2899]	0,2629 [0,2564; 0,2687]	0,2456 [0,2391; 0,2517]	0,2181 [0,2113; 0,2247]
1950	0,3142 [0,3110; 0,3168]	0,2916 [0,2856; 0,2960]	0,2709 [0,2656; 0,2753]	0,2451 [0,2389; 0,2509]	0,2137 [0,2067; 0,2207]
1951	0,3120 [0,3098; 0,3140]	0,2750 [0,2673; 0,2817]	0,2596 [0,2519; 0,2661]	0,2384 [0,2291; 0,2469]	0,2223 [0,2122; 0,2318]
1952	0,3133 [0,3093; 0,3165]	0,2786 [0,2717; 0,2847]	0,2616 [0,2555; 0,2668]	0,2423 [0,2339; 0,2497]	0,2089 [0,1971; 0,2209]
1953	0,3112 [0,3047; 0,3162]	0,2784 [0,2721; 0,2837]	0,2638 [0,2547; 0,2711]	0,2382 [0,2270; 0,2481]	0,2033 [0,1929; 0,2139]
1954	0,3131 [0,3043; 0,3180]	0,2884 [0,2796; 0,2914]	0,2617 [0,2491; 0,2711]	0,2402 [0,2274; 0,2514]	0,2155 [0,2025; 0,2280]
1955	0,3067 [0,2978; 0,3133]	0,2744 [0,2617; 0,2849]	0,2730 [0,2623; 0,2784]	0,2377 [0,2184; 0,2542]	0,2077 [0,1940; 0,2211]
1956	0,3054 [0,2941; 0,3141]	0,2763 [0,2664; 0,2842]	0,2667 [0,2457; 0,2770]	0,2353 [0,2188; 0,2496]	0,2297 [0,2090; 0,2439]
1957	0,2918 [0,2808; 0,3019]	0,2872 [0,2746; 0,2938]	0,2671 [0,2444; 0,2759]	0,2552 [0,2353; 0,2620]	0,1949 [0,1792; 0,2118]

Table S19: Lifetable entropy at 50 by lifetime income quintile and year of birth (95%)
Women

Year of birth	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1930	0.2192 [0.2134; 0.2235]	0.2336 [0.2182; 0.2343]	0.2308 [0.2231; 0.2343]	0.2334 [0.2273; 0.2383]	0.2321 [0.2276; 0.2359]
1931	0.2248 [0.2158; 0.2255]	0.2241 [0.2191; 0.2286]	0.2310 [0.2244; 0.2347]	0.2272 [0.2219; 0.2317]	0.2330 [0.2256; 0.2381]
1932	0.2191 [0.2145; 0.2232]	0.2277 [0.2235; 0.2314]	0.2284 [0.2194; 0.2357]	0.2286 [0.2244; 0.2322]	0.2297 [0.2231; 0.2354]
1933	0.2182 [0.2143; 0.2219]	0.2238 [0.2203; 0.2271]	0.2312 [0.2272; 0.2349]	0.2276 [0.2227; 0.2314]	0.2247 [0.2189; 0.2300]
1934	0.2207 [0.2171; 0.2241]	0.2290 [0.2256; 0.2322]	0.2191 [0.2148; 0.2235]	0.2266 [0.2214; 0.2314]	0.2258 [0.2202; 0.2310]
1935	0.2183 [0.2154; 0.2211]	0.2168 [0.2131; 0.2206]	0.2161 [0.2120; 0.2204]	0.2190 [0.2130; 0.2248]	0.2219 [0.2177; 0.2260]
1936	0.2136 [0.2098; 0.2174]	0.2161 [0.2120; 0.2202]	0.2138 [0.2088; 0.2190]	0.2149 [0.2114; 0.2185]	0.2232 [0.2188; 0.2276]
1937	0.2157 [0.2112; 0.2201]	0.2068 [0.2033; 0.2104]	0.2093 [0.2063; 0.2124]	0.2169 [0.2115; 0.2222]	0.2162 [0.2124; 0.2200]
1938	0.2110 [0.2068; 0.2152]	0.2149 [0.2117; 0.2180]	0.2108 [0.2067; 0.2150]	0.2132 [0.2085; 0.2179]	0.2133 [0.2100; 0.2167]
1939	0.2110 [0.2075; 0.2143]	0.2076 [0.2027; 0.2124]	0.2092 [0.2053; 0.2132]	0.2096 [0.2035; 0.2154]	0.2107 [0.2063; 0.2151]
1940	0.2139 [0.2100; 0.2176]	0.2085 [0.2048; 0.2123]	0.2040 [0.1996; 0.2085]	0.2105 [0.2055; 0.2155]	0.2125 [0.2066; 0.2182]
1941	0.2182 [0.2141; 0.2219]	0.2092 [0.2028; 0.2156]	0.2047 [0.1996; 0.2099]	0.2086 [0.2037; 0.2136]	0.2127 [0.2082; 0.2170]
1942	0.2183 [0.2144; 0.2220]	0.2104 [0.2072; 0.2136]	0.2048 [0.1989; 0.2107]	0.2100 [0.2047; 0.2153]	0.2059 [0.2007; 0.2113]
1943	0.2159 [0.2110; 0.2206]	0.2139 [0.2064; 0.2212]	0.2018 [0.1960; 0.2078]	0.2069 [0.2014; 0.2126]	0.2142 [0.2089; 0.2195]
1944	0.2180 [0.2097; 0.2258]	0.2024 [0.1978; 0.2072]	0.2020 [0.1957; 0.2086]	0.2132 [0.2080; 0.2184]	0.2045 [0.1992; 0.2100]
1945	0.2130 [0.2058; 0.2203]	0.2091 [0.2023; 0.2159]	0.2072 [0.2023; 0.2123]	0.2074 [0.1986; 0.2158]	0.2025 [0.1950; 0.2103]
1946	0.2152 [0.2070; 0.2232]	0.1971 [0.1902; 0.2045]	0.1976 [0.1894; 0.2063]	0.1971 [0.1929; 0.2015]	0.1997 [0.1949; 0.2047]
1947	0.2121 [0.2070; 0.2173]	0.2013 [0.1928; 0.2104]	0.1947 [0.1870; 0.2030]	0.1967 [0.1895; 0.2042]	0.1830 [0.1740; 0.1934]
1948	0.2079 [0.2004; 0.2155]	0.1958 [0.1888; 0.2032]	0.1895 [0.1783; 0.2019]	0.2008 [0.1923; 0.2096]	0.1858 [0.1781; 0.1941]
1949	0.2113 [0.2002; 0.2226]	0.1969 [0.1892; 0.2049]	0.1936 [0.1844; 0.2034]	0.2022 [0.1904; 0.2144]	0.1879 [0.1747; 0.2029]
1950	0.2127 [0.2025; 0.2229]	0.2038 [0.1926; 0.2152]	0.1969 [0.1836; 0.2112]	0.2096 [0.1999; 0.2188]	0.1805 [0.1689; 0.1939]
1951	0.2176 [0.2066; 0.2285]	0.1813 [0.1673; 0.1978]	0.1960 [0.1754; 0.2190]	0.2145 [0.2001; 0.2281]	0.1789 [0.1674; 0.1924]
1952	0.2053 [0.1953; 0.2158]	0.1983 [0.1838; 0.2141]	0.2128 [0.1938; 0.2294]	0.1858 [0.1697; 0.2043]	0.1835 [0.1717; 0.1967]
1953	0.2082 [0.1949; 0.2221]	0.1933 [0.1771; 0.2112]	0.1986 [0.1790; 0.2199]	0.1926 [0.1796; 0.2067]	0.1705 [0.1577; 0.1859]
1954	0.2144 [0.1982; 0.2310]	0.2075 [0.1870; 0.2287]	0.1743 [0.1596; 0.1922]	0.1883 [0.1696; 0.2091]	0.1737 [0.1561; 0.1955]
1955	0.1960 [0.1819; 0.2117]	0.2029 [0.1815; 0.2256]	0.1716 [0.1504; 0.1996]	0.2077 [0.1844; 0.2306]	0.1747 [0.1469; 0.2134]
1956	0.2317 [0.2029; 0.2564]	0.1925 [0.1763; 0.2109]	0.1776 [0.1508; 0.2140]	0.2023 [0.1749; 0.2308]	0.1862 [0.1608; 0.2164]
1957	0.2229 [0.1931; 0.2511]	0.1650 [0.1523; 0.1806]	0.2166 [0.1864; 0.2441]	0.2306 [0.2003; 0.2440]	0.1855 [0.1598; 0.2164]

Table S20: Number of observations per individual between ages 45-49 in the final *Dichiarazioni Uniemens* sample

Obs. per individual	Women	Men	Total
1	261,057	398,564	659,621
	12.4%	8.2%	9.5
2	187,852	295,593	782,808
	8.9%	6.1%	7.0
3	161,069	272,062	433,131
	7.5%	5.9%	6.4
4	174,332	341,581	515,913
	8.3%	7.1%	7.4
5	1,322,630	3,534,506	4,857,136
	62.8%	73.0%	69.9
Total	2,106,940	4,842,306	6,949,246
	100%	100%	100

Table S21: Life expectancy at 67 by pension income quintile and calendar year (95% CI) - Men

Calendar Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1995	14.17 [14.09;14.27]	14.55 [14.44;14.66]	14.23 [14.15;14.32]	14.16 [14.07;14.26]	15.25 [15.13;15.38]
1996	14.29 [14.19;14.38]	14.82 [14.71;14.94]	14.32 [14.23;14.40]	14.20 [14.11;14.30]	15.01 [14.90;15.12]
1997	14.09 [14.01;14.18]	14.61 [14.50;14.72]	14.39 [14.31;14.47]	14.30 [14.20;14.39]	15.01 [14.90;15.12]
1998	14.28 [14.20;14.36]	14.65 [14.55;14.76]	14.44 [14.36;14.52]	14.55 [14.46;14.64]	15.26 [15.16;15.37]
1999	14.51 [14.43;14.60]	14.81 [14.70;14.92]	14.69 [14.60;14.78]	14.71 [14.62;14.80]	15.34 [15.24;15.44]
2000	14.72 [14.63;14.82]	14.87 [14.78;14.97]	14.80 [14.71;14.88]	14.88 [14.80;14.97]	15.59 [15.49;15.68]
2001	14.60 [14.52;14.69]	15.17 [15.07;15.26]	15.19 [15.10;15.27]	15.05 [14.96;15.13]	16.01 [15.92;16.11]
2002	14.45 [14.37;14.54]	14.92 [14.82;15.01]	14.91 [14.82;14.99]	15.00 [14.92;15.09]	15.84 [15.75;15.92]
2003	15.05 [14.96;15.13]	15.35 [15.27;15.44]	15.37 [15.29;15.46]	15.58 [15.50;15.67]	16.60 [16.50;16.69]
2004	14.90 [14.81;14.98]	15.30 [15.22;15.39]	15.28 [15.19;15.36]	15.47 [15.39;15.55]	16.09 [16.01;16.18]
2005	15.42 [15.33;15.51]	15.63 [15.55;15.71]	15.61 [15.53;15.69]	15.88 [15.81;15.96]	16.49 [16.42;16.57]
2006	15.34 [15.26;15.42]	15.54 [15.45;15.62]	15.77 [15.68;15.85]	15.82 [15.74;15.91]	16.69 [16.61;16.77]
2007	15.40 [15.32;15.47]	15.67 [15.59;15.75]	15.66 [15.58;15.75]	15.93 [15.85;16.01]	16.87 [16.79;16.94]
2008	15.49 [15.42;15.57]	15.67 [15.59;15.75]	15.84 [15.76;15.92]	16.07 [15.99;16.15]	16.86 [16.79;16.94]
2009	15.61 [15.53;15.69]	15.84 [15.77;15.93]	15.98 [15.90;16.05]	16.23 [16.16;16.31]	17.03 [16.96;17.11]
2010	15.64 [15.56;15.72]	16.08 [15.99;16.16]	16.08 [16;16.16.00]	16.54 [16.46;16.62]	17.21 [17.13;17.28]
2011	15.42 [15.34;15.50]	15.85 [15.77;15.93]	16.18 [16.10;16.26]	16.54 [16.46;16.62]	17.16 [17.08;17.24]
2012	15.77 [15.68;15.85]	16.13 [16.05;16.22]	16.44 [16.36;16.52]	16.66 [16.58;16.74]	17.43 [17.34;17.50]
2013	15.94 [15.86;16.01]	16.37 [16.28;16.46]	16.56 [16.48;16.64]	16.99 [16.91;17.07]	17.69 [17.61;17.78]
2014	15.76 [15.68;15.84]	16.06 [15.98;16.15]	16.29 [16.21;16.37]	16.89 [16.81;16.97]	17.64 [17.56;17.72]
2015	16.13 [16.05;16.21]	16.43 [16.34;16.51]	16.69 [16.61;16.77]	17.27 [17.18;17.35]	18.08 [17.99;18.15]
2016	15.87 [15.80;15.95]	16.28 [16.20;16.36]	16.68 [16.60;16.76]	17.28 [17.20;17.35]	17.90 [17.82;17.98]
2017	16.38 [16.30;16.46]	16.66 [16.58;16.74]	17.07 [16.99;17.16]	17.53 [17.45;17.60]	18.34 [18.26;18.42]

Table S22: Life expectancy at 67 by pension income quintile and calendar year (95% CI) - Women

Calendar Year	Quntile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1995	18.70 [18,59;18,80]	18.77 [18,64;18,90]	18.61 [18,45;18,78]	18.34 [18,25;18,42]	18.41 [18,31;18,51]
1996	18.66 [18,56;18,76]	18.95 [18,83;19,06]	18.23 [18,08;18,40]	18.34 [18,26;18,43]	18.30 [18,20;18,40]
1997	18,65 [18,55;18,76]	18.73 [18,62;18,86]	18.41 [18,25;18,55]	18.41 [18,32;18,51]	18.33 [18,23;18,44]
1998	18.85 [18,75;18,95]	18.82 [18,72;18,92]	18.38 [18,23;18,52]	18.34 [18,26;18,42]	18.60 [18,50;18,69]
1999	19.00 [18,90;19,09]	19.00 [18,89;19,10]	18.40 [18,26;18,54]	18.55 [18,46;18,63]	18.47 [18,38;18,57]
2000	19.19 [19,09;19,28]	19.18 [19,07;19,29]	18.83 [18,68;18,97]	18.82 [18,75;18,91]	19.00 [18,91;19,10]
2001	19.43 [19,33;19,51]	19.33 [19,23;19,43]	19.18 [19,03;19,31]	19.09 [19,00;19,17]	18.92 [18,83;19,01]
2002	19.00 [18,92;19,09]	19.17 [19,07;19,26]	18.64 [18,51;18,77]	18.66 [18,58;18,74]	18.77 [18,68;18,86]
2003	19.77 [19,69;19,86]	20.03 [19,93;20,12]	19.42 [19,31;19,55]	19.40 [19,32;19,48]	19.89 [19,80;19,98]
2004	19.58 [19,50;19,66]	19.58 [19,50;19,67]	18.98 [18,87;19,08]	18.99 [18,92;19,07]	19.16 [19,08;19,25]
2005	19.82 [19,73;19,90]	20.17 [20,08;20,25]	19.54 [19,43;19,64]	19.57 [19,49;19,64]	19.42 [19,34;19,50]
2006	20.00 [19,91;20,08]	19.85 [19,77;19,94]	19.59 [19,49;19,69]	19.56 [19,48;19,64]	19.58 [19,50;19,66]
2007	19.96 [19,88;20,04]	19.97 [19,89;20,05]	19.53 [19,43;19,62]	19.55 [19,48;19,64]	19.43 [19,35;19,51]
2008	20.21 [20,13;20,28]	20.03 [19,95;20,11]	19.93 [19,83;20,02]	19.43 [19,36;19,51]	19.48 [19,40;19,56]
2009	20.13 [20,06;20,22]	20.47 [20,38;20,55]	20.01 [19,92;20,09]	19.75 [19,68;19,83]	20.02 [19,94;20,10]
2010	20.07 [19,98;20,15]	20.39 [20,30;20,47]	19.86 [19,78;19,94]	19.94 [19,85;20,01]	20.08 [20,00;20,16]
2011	20.34 [20,26;20,42]	20.13 [20,05;20,21]	19.95 [19,87;20,03]	19.62 [19,54;19,70]	19.85 [19,78;19,94]
2012	20.72 [20,64;20,80]	20.75 [20,68;20,83]	20.11 [20,03;20,20]	20.03 [19,95;20,11]	20.29 [20,21;20,37]
2013	20.84 [20,75;20,91]	20.81 [20,73;20,90]	20.27 [20,19;20,35]	20.37 [20,30;20,45]	20.19 [20,11;20,27]
2014	20.35 [20,26;20,43]	20.41 [20,33;20,49]	19.84 [19,76;19,91]	19.73 [19,64;19,81]	19.81 [19,73;19,88]
2015	20.66 [20,58;20,74]	20.68 [20,60;20,76]	20.14 [20,06;20,22]	20.24 [20,16;20,33]	20.26 [20,19;20,34]
2016	20.54 [20,46;20,61]	20.57 [20,49;20,65]	20.15 [20,07;20,23]	20.06 [19,97;20,13]	20.10 [20,02;20,18]
2017	20.93 [20,84;21,01]	20.80 [20,71;20,88]	20.45 [20,37;20,53]	20.26 [20,18;20,34]	20.42 [20,34;20,50]

Table S23: Lifetable entropy at 67 by pension income quintile and calendar year (95% CI) - Men

Calendar Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1995	0.5146 [0.5102;0.5186]	0.4856 [0.4806;0.4902]	0.4989 [0.4946;0.5030]	0.5069 [0.5026;0.5115]	0.5094 [0.5044;0.514]
1996	0.5099 [0.5055;0.5138]	0.4934 [0.4887;0.4978]	0.4978 [0.4937;0.5021]	0.5074 [0.5029;0.5115]	0.4838 [0.4795;0.4879]
1997	0.5125 [0.5081;0.5164]	0.4816 [0.4774;0.4854]	0.4951 [0.4913;0.4992]	0.5067 [0.5027;0.5112]	0.4710 [0.4667;0.4751]
1998	0.4921 [0.4882;0.4962]	0.4889 [0.4849;0.4929]	0.4913 [0.4874;0.4952]	0.5045 [0.5001;0.5083]	0.4789 [0.4748;0.4830]
1999	0.5009 [0.4969;0.5049]	0.4763 [0.4723;0.4804]	0.4821 [0.4781;0.4863]	0.4897 [0.4857;0.4936]	0.4612 [0.4574;0.4651]
2000	0.5081 [0.5038;0.5122]	0.4748 [0.4710;0.4786]	0.4816 [0.4778;0.4853]	0.4774 [0.4738;0.4809]	0.4545 [0.4508;0.4580]
2001	0.4999 [0.4959;0.5037]	0.4761 [0.4724;0.4800]	0.4907 [0.4870;0.4944]	0.4810 [0.4771;0.4849]	0.4619 [0.4585;0.4657]
2002	0.4869 [0.4833;0.4906]	0.4778 [0.4740;0.4815]	0.4737 [0.4700;0.4775]	0.4729 [0.4694;0.4764]	0.4535 [0.4498;0.4570]
2003	0.4868 [0.4831;0.4907]	0.4666 [0.4631;0.4703]	0.4710 [0.4672;0.4747]	0.4680 [0.4645;0.4719]	0.4559 [0.4523;0.4592]
2004	0.4849 [0.4813;0.4889]	0.4614 [0.4576;0.4648]	0.4527 [0.4491;0.4564]	0.4557 [0.4521;0.4592]	0.4261 [0.4225;0.4297]
2005	0.4866 [0.4830;0.4904]	0.4681 [0.4645;0.4719]	0.4560 [0.4525;0.4596]	0.4480 [0.4445;0.4515]	0.4195 [0.4160;0.4229]
2006	0.4744 [0.4703;0.4778]	0.4615 [0.4578;0.4653]	0.4519 [0.4482;0.4558]	0.4347 [0.4311;0.4383]	0.4124 [0.4088;0.4156]
2007	0.4717 [0.4682;0.4755]	0.4549 [0.4512;0.4586]	0.4379 [0.4342;0.4417]	0.4381 [0.4346;0.4415]	0.4080 [0.4046;0.4114]
2008	0.4684 [0.4645;0.4721]	0.4553 [0.4517;0.4590]	0.4453 [0.4413;0.4488]	0.4233 [0.4198;0.4268]	0.4057 [0.4022;0.4092]
2009	0.4545 [0.4507;0.4584]	0.4536 [0.4497;0.4576]	0.4282 [0.4247;0.4316]	0.4180 [0.4144;0.4216]	0.3944 [0.3910;0.3974]
2010	0.4620 [0.4580;0.4655]	0.4542 [0.4505;0.4582]	0.4286 [0.4252;0.4323]	0.4195 [0.4162;0.4231]	0.3906 [0.3873;0.3938]
2011	0.4547 [0.4511;0.4585]	0.4464 [0.4426;0.4499]	0.4286 [0.4250;0.4321]	0.4162 [0.4124;0.4198]	0.3942 [0.3908;0.3977]
2012	0.4491 [0.4452;0.4527]	0.4434 [0.4395;0.4473]	0.4288 [0.4251;0.4323]	0.4066 [0.4031;0.4103]	0.3914 [0.3881;0.3951]
2013	0.4414 [0.4379;0.4449]	0.4278 [0.4238;0.4314]	0.421 [0.4176;0.4245]	0.4081 [0.4044;0.4117]	0.3863 [0.3826;0.3897]
2014	0.4386 [0.4347;0.4424]	0.4377 [0.4338;0.4415]	0.4214 [0.4179;0.4251]	0.4028 [0.3992;0.4063]	0.3877 [0.3843;0.3912]
2015	0.4427 [0.4392;0.4463]	0.4268 [0.4230;0.4305]	0.4210 [0.4173;0.4245]	0.4055 [0.4018;0.4092]	0.3855 [0.3823;0.3889]
2016	0.4365 [0.4327;0.4403]	0.4272 [0.4237;0.4307]	0.4106 [0.4072;0.4140]	0.4058 [0.4025;0.4091]	0.3760 [0.3728;0.3794]
2017	0.4382 [0.4347;0.4417]	0.4279 [0.4242;0.4312]	0.4193 [0.4159;0.4228]	0.3976 [0.3944;0.4008]	0.3798 [0.3765;0.3830]

Table S24: Lifetable entropy at 67 by pension income quintile and calendar year (95% CI) - Women

Calendar Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1995	0.3812 [0.3771; 0.3852]	0.3700 [0.3653; 0.3742]	0.3828 [0.3764; 0.3887]	0.3786 [0.3753; 0.3821]	0.3759 [0.3722; 0.3800]
1996	0.3748 [0.3711; 0.3787]	0.3742 [0.3700; 0.3783]	0.3899 [0.3836; 0.3956]	0.3825 [0.3790; 0.3860]	0.3803 [0.3761; 0.3843]
1997	0.3632 [0.3594; 0.3672]	0.3680 [0.3636; 0.3721]	0.3803 [0.3749; 0.3860]	0.3809 [0.3772; 0.3844]	0.3756 [0.3717; 0.3793]
1998	0.3657 [0.3619; 0.3695]	0.3555 [0.3518; 0.3592]	0.3650 [0.3599; 0.3699]	0.3651 [0.3618; 0.3683]	0.3743 [0.3707; 0.3780]
1999	0.363 [0.3595; 0.3665]	0.3538 [0.3502; 0.3577]	0.3613 [0.3564; 0.3661]	0.3592 [0.3560; 0.3626]	0.3609 [0.3574; 0.3646]
2000	0.3605 [0.3571; 0.3639]	0.3560 [0.3521; 0.3596]	0.3713 [0.3665; 0.3759]	0.3634 [0.3600; 0.3665]	0.3679 [0.3645; 0.3715]
2001	0.3601 [0.3567; 0.3637]	0.3570 [0.3535; 0.3605]	0.3690 [0.3648; 0.3736]	0.3603 [0.3570; 0.3634]	0.3635 [0.3600; 0.3667]
2002	0.3526 [0.3492; 0.3557]	0.3485 [0.3453; 0.3516]	0.3609 [0.3567; 0.3651]	0.3481 [0.3448; 0.3513]	0.3665 [0.3631; 0.3698]
2003	0.3533 [0.3499; 0.3566]	0.3444 [0.3412; 0.3480]	0.3557 [0.3517; 0.3594]	0.3496 [0.3466; 0.3529]	0.3687 [0.3652; 0.3720]
2004	0.3512 [0.348; 0.3544]	0.3340 [0.3309; 0.3370]	0.3481 [0.3444; 0.3518]	0.3358 [0.3328; 0.3387]	0.3514 [0.3481; 0.3548]
2005	0.3389 [0.3358; 0.3419]	0.3376 [0.3344; 0.3407]	0.3474 [0.3439; 0.3510]	0.3457 [0.3425; 0.3489]	0.3469 [0.3438; 0.3502]
2006	0.3459 [0.3427; 0.3492]	0.3388 [0.3357; 0.3420]	0.3475 [0.3440; 0.3512]	0.3441 [0.3409; 0.3472]	0.3508 [0.3476; 0.3537]
2007	0.3422 [0.3393; 0.3452]	0.3388 [0.3358; 0.3418]	0.3482 [0.3449; 0.3516]	0.3496 [0.3462; 0.3526]	0.3396 [0.3366; 0.3427]
2008	0.3398 [0.337; 0.3428]	0.3378 [0.3346; 0.3408]	0.3463 [0.3431; 0.3496]	0.3376 [0.3345; 0.3405]	0.3408 [0.3376; 0.3438]
2009	0.3318 [0.3286; 0.3347]	0.3418 [0.3388; 0.3449]	0.3491 [0.3459; 0.3522]	0.3359 [0.3330; 0.3389]	0.3348 [0.3317; 0.3378]
2010	0.3348 [0.3317; 0.3379]	0.3346 [0.3316; 0.3378]	0.3383 [0.3353; 0.3414]	0.3449 [0.3421; 0.3482]	0.3377 [0.3346; 0.3408]
2011	0.3416 [0.3385; 0.3446]	0.3242 [0.3212; 0.3272]	0.3384 [0.3352; 0.3414]	0.3411 [0.3379; 0.3443]	0.3325 [0.3293; 0.3356]
2012	0.3307 [0.3278; 0.3338]	0.3373 [0.3341; 0.3403]	0.3380 [0.3348; 0.3413]	0.3374 [0.3343; 0.3408]	0.3349 [0.3317; 0.3382]
2013	0.3279 [0.3249; 0.3312]	0.3409 [0.3378; 0.3441]	0.3367 [0.3337; 0.3399]	0.3439 [0.3410; 0.3469]	0.3328 [0.3296; 0.3359]
2014	0.3293 [0.3261; 0.3325]	0.3349 [0.3318; 0.3382]	0.3336 [0.3305; 0.3366]	0.3386 [0.3354; 0.3419]	0.3321 [0.3289; 0.3353]
2015	0.3282 [0.325; 0.3312]	0.3317 [0.3288; 0.3349]	0.3348 [0.3313; 0.3380]	0.3363 [0.3329; 0.3395]	0.3327 [0.3296; 0.3358]
2016	0.3297 [0.3267; 0.3329]	0.3418 [0.3388; 0.3451]	0.3416 [0.3385; 0.3450]	0.3369 [0.3340; 0.3401]	0.3337 [0.3306; 0.3369]
2017	0.3224 [0.3193; 0.3257]	0.3371 [0.3337; 0.3402]	0.3293 [0.3262; 0.3326]	0.3373 [0.3343; 0.3403]	0.3337 [0.3306; 0.3369]

Table S25: Men’s post-retirement mortality and wives’ pension

	(1)
	Odds ratio
Men's pension quintile [Ref: 1st (bottom)]	.
2nd	0.955***
	(0.00688)
3rd	0.932***
	(0.00694)
4th	0.854***
	(0.00661)
5h (top)	0.720***
	(0.00600)
Wife's pension quintile [Ref: 1st (bottom)]	
2nd	0.985**
	(0.00708)
3rd	0.954***
	(0.00703)
4th	0.973***
	(0.00746)
5th (top)	1.027***
	(0.00857)
Constant	4.73e-05***
	(5.20e-05)
Observations	7,412,143

Notes. Results from logistic survival analysis based on male retirees from the FPLD fund, who retired between 1995 and 2017, whose wife was alive in 1995 and also retired between 1995 and 2017. The mortality follow-up extends from the year men turn 67 to the end of 2018 or the year of their death, if the latter occurs earlier. Dependent variable is a dummy taking value 1 if the woman dies by the end of the year, 0 otherwise. Pension quintiles are cohort-specific for both men and wives. Control variables: year of birth, age difference with respect to wife, widowhood status, macro-region of residence, macro-region of birth, and 23 duration dummies.

Table S26: Monthly pension minimum (Euro), Italy, 1995-2017

Year	Minimum	Year	Minimum
1995	382.4	2007	436.1
1996	382.4	2008	443.6
1997	382.4	2009	457.8
1998	382.4	2010	461.0
1999	382.4	2011	468.4
2000	382.4	2012	481.0
2001	382.4	2013	495.4
2002	392.7	2014	500.9
2003	402.1	2015	501.9
2004	412.2	2016	501.9
2005	420.4	2017	501.9
2006	427.6		

Source: INPS.

Supplementary Figures

Figure S1: Lexis diagram

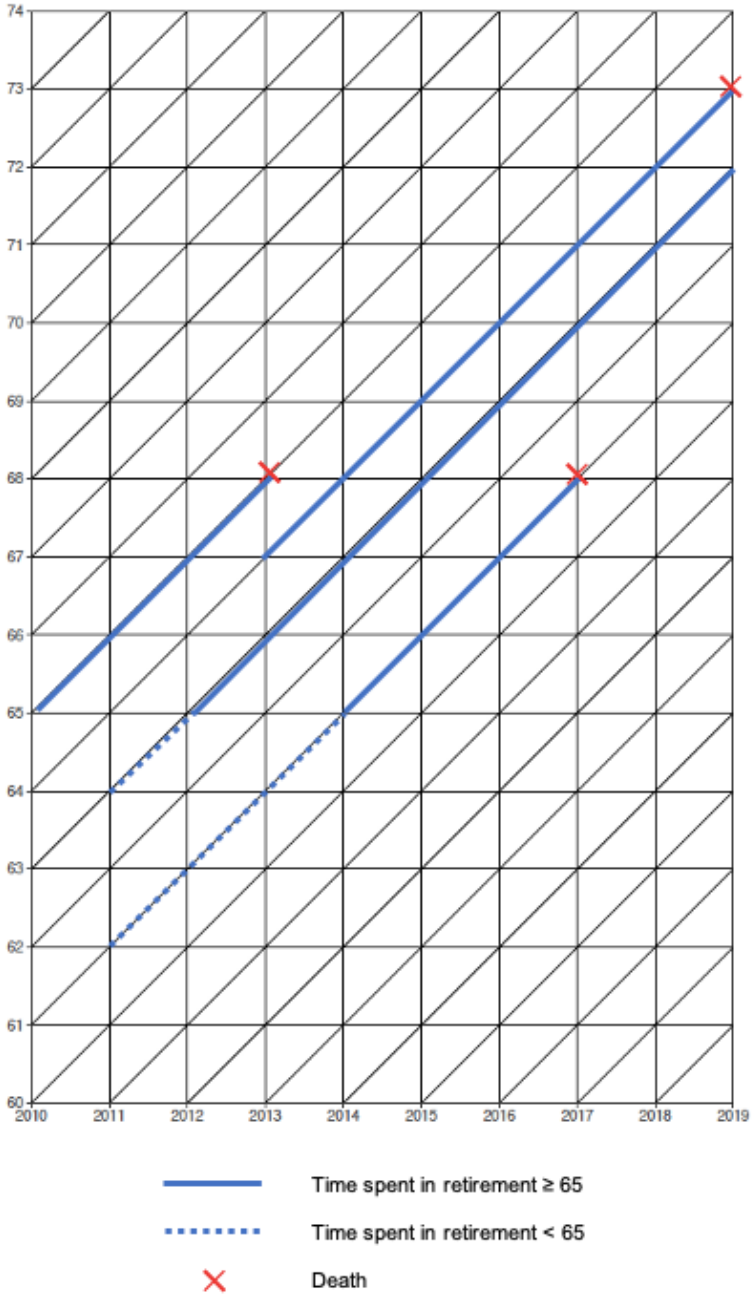
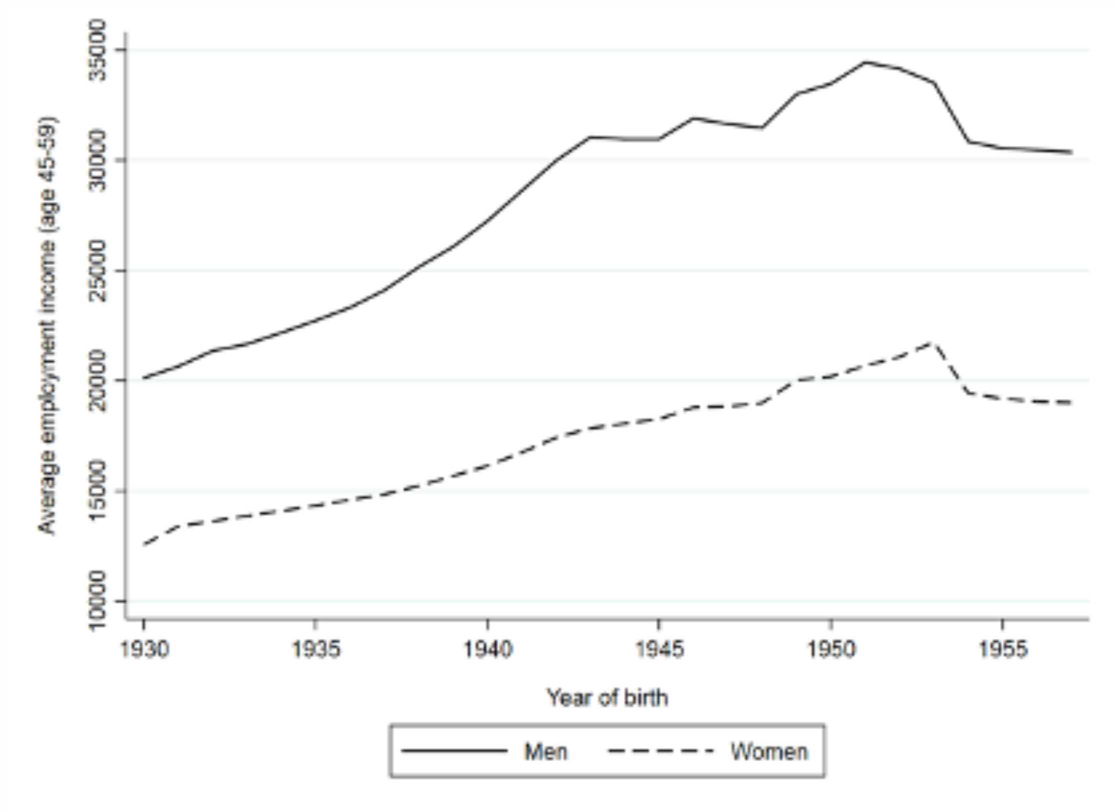
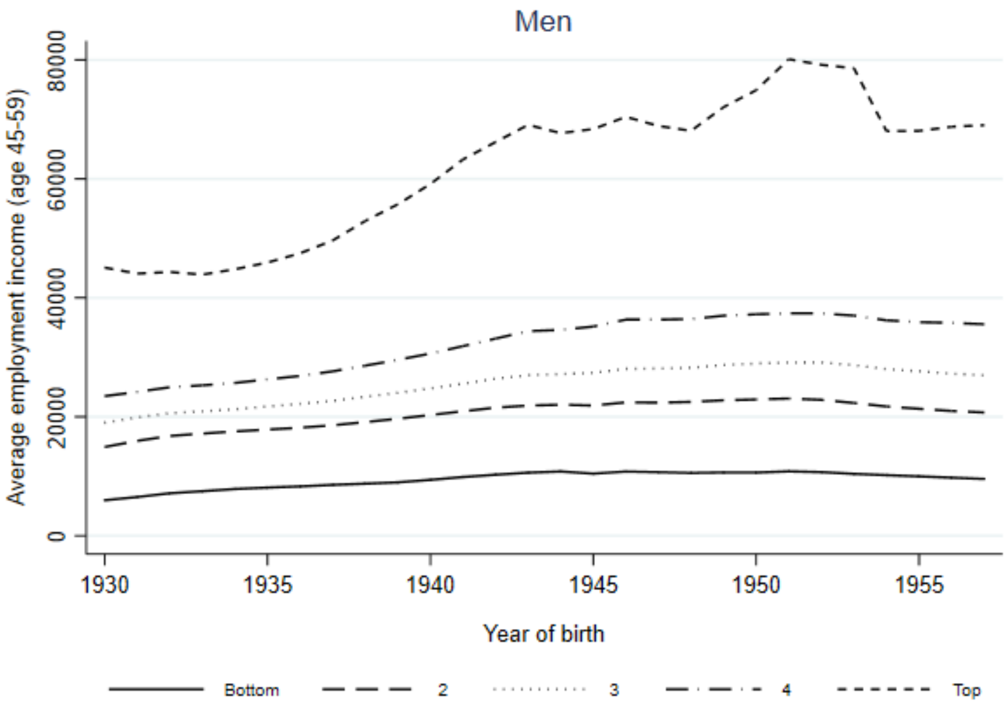


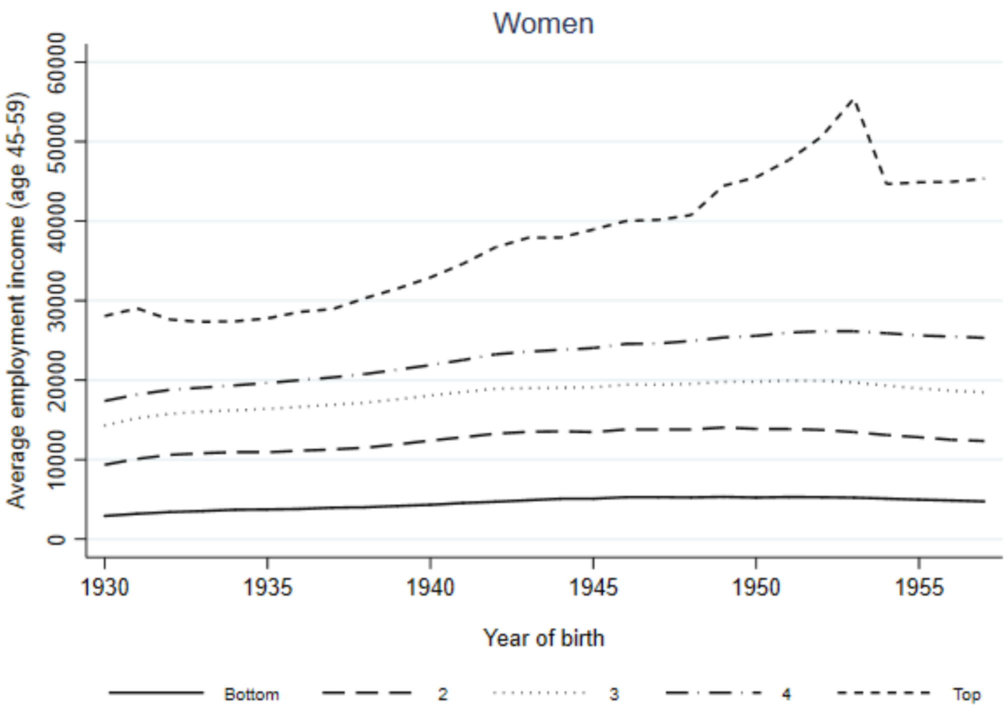
Figure S2: Average employment earnings at 45-49 by sex and birth cohort (Euro, 2019 real values) *Dichiarazioni Uniemens* sample



Notes. The graphs plot the evolution of inflation-adjusted average gross earnings at 45-49 by sex and year of birth. Earnings are expressed in Euro, 2019 real values. Own elaboration based on INPS data.

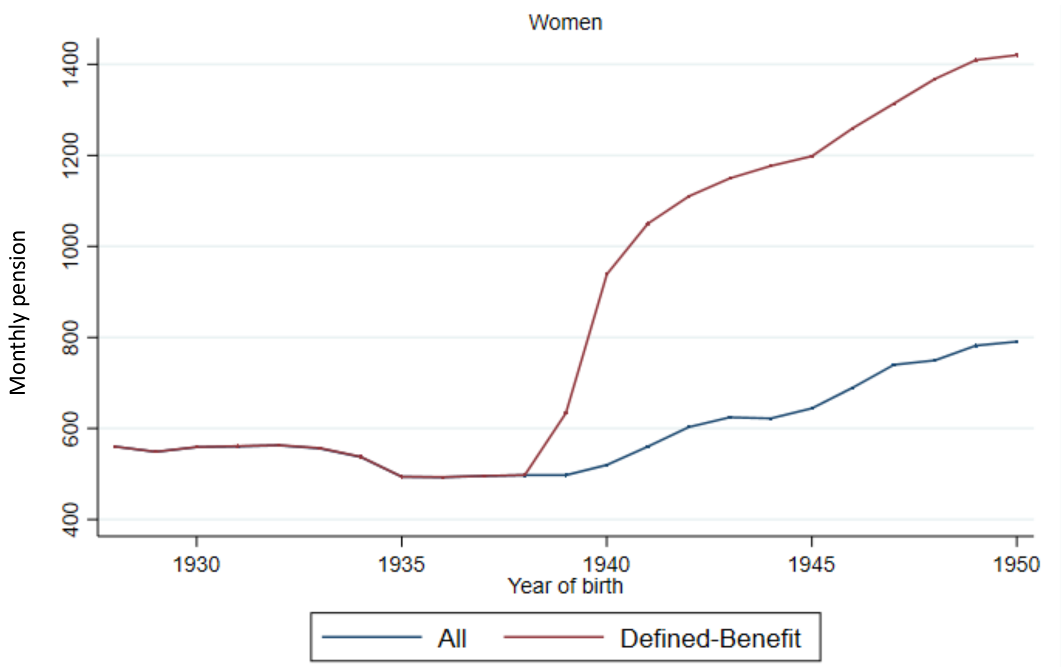
Figure S3: Average employment earnings at 45-49 by sex, cohort and quintile (Euro, 2019 real values)
Dichiarazioni Uniemens sample





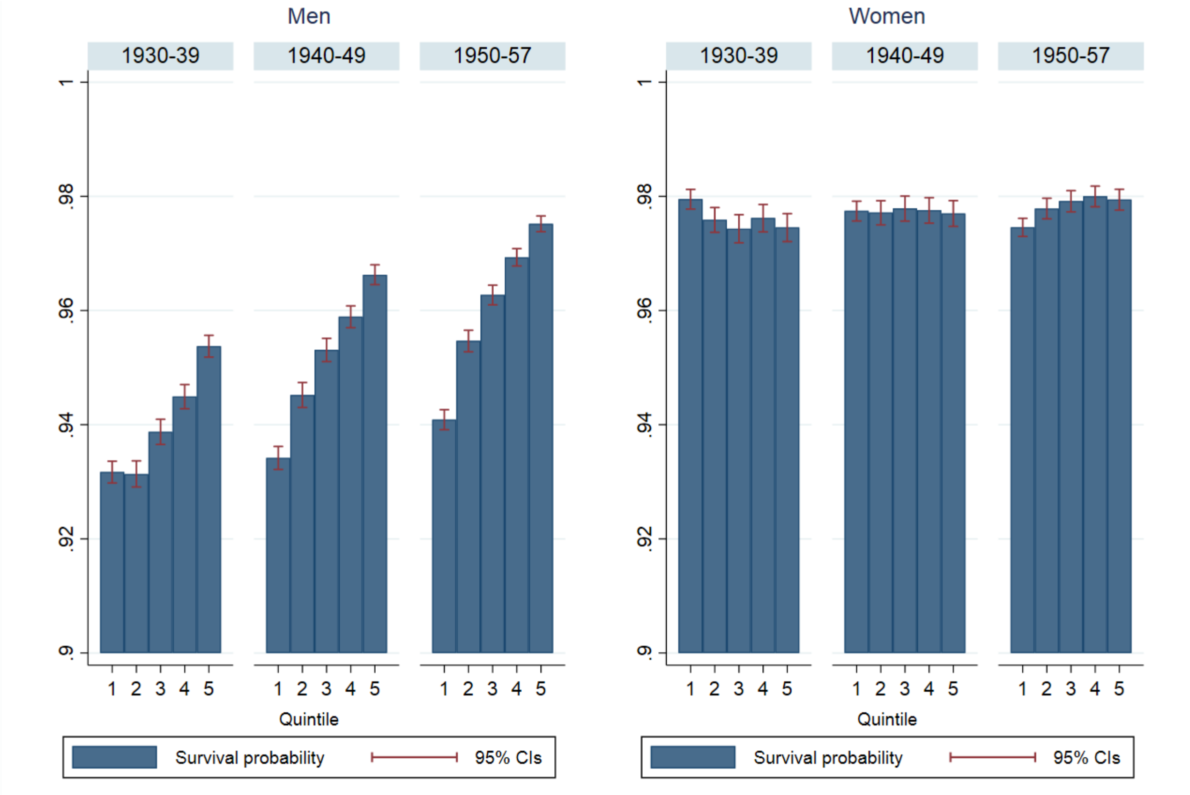
Notes. The graphs plot the evolution of inflation-adjusted average gross earnings at 45-49 by sex, year of birth and quintile. Earnings are expressed in Euro, 2019 real values. Own elaboration based on INPS data

Figure S4: Median monthly gross pension income (FPLD fund), by sex, cohort and retirement regime
Pensioni Casellario sample



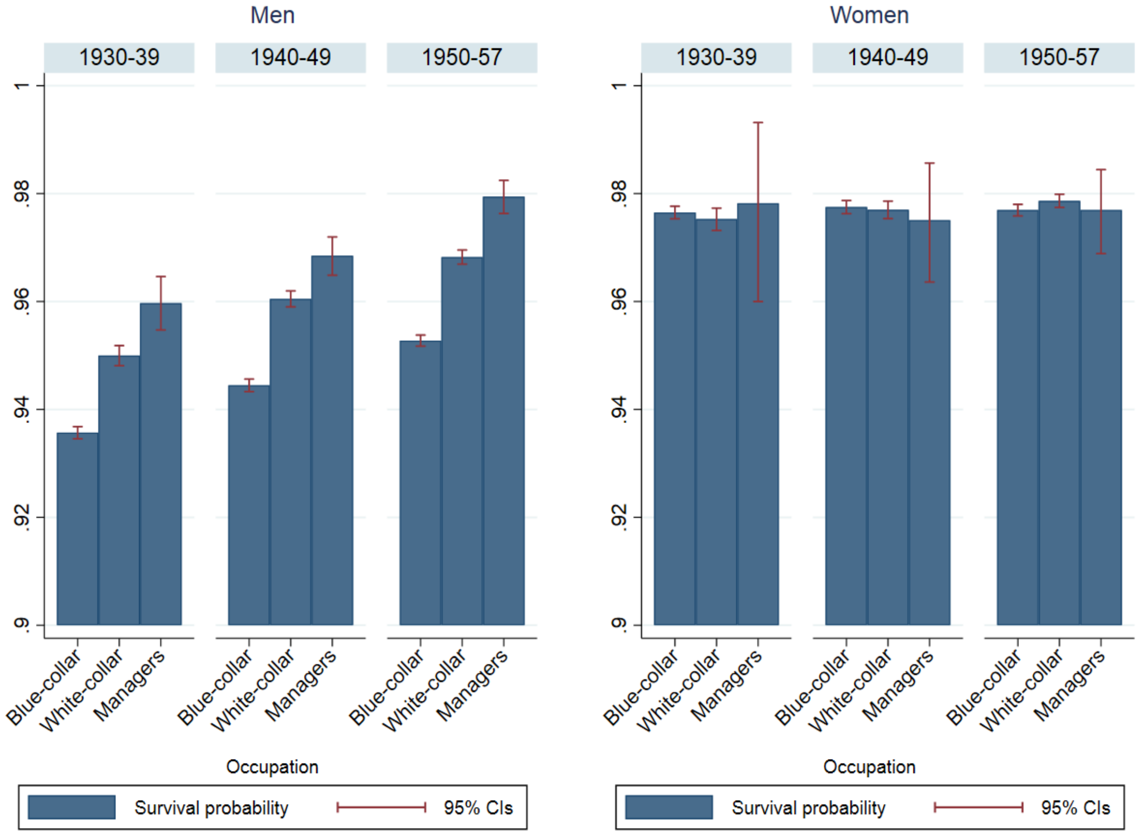
Notes. The graphs plot the evolution of inflation-adjusted median gross pension income at age 67 for pensioners from the private employees pension fund (FPLD). Income is expressed in Euro, 2019 real values. Own elaboration based on INPS data.

Figure S5: Probability of surviving to 61 at 50 by quintile of average earnings at 45-49
Dichiarazioni Uniemens sample



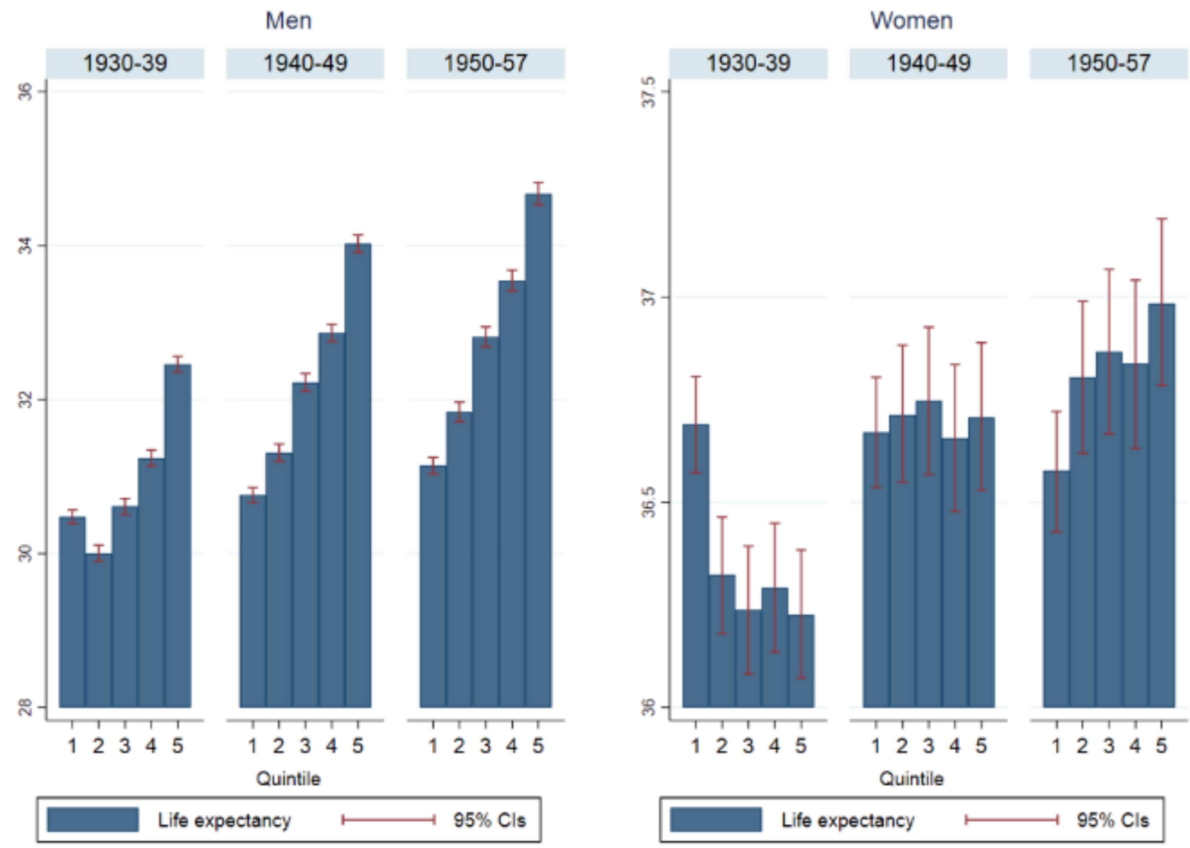
Notes. The graphs plot the evolution of the probability of surviving to 61 at 50, by quintile of average employment earnings at 45-59, sex and birth cohort, along with 95% confidence intervals. Life expectancy estimates are based on observed survival probabilities only. Own elaboration based on INPS data.

Figure S6: Probability of surviving to 61 at 50 by prevalent occupation at 45-49
Dichiarazioni Uniemens sample



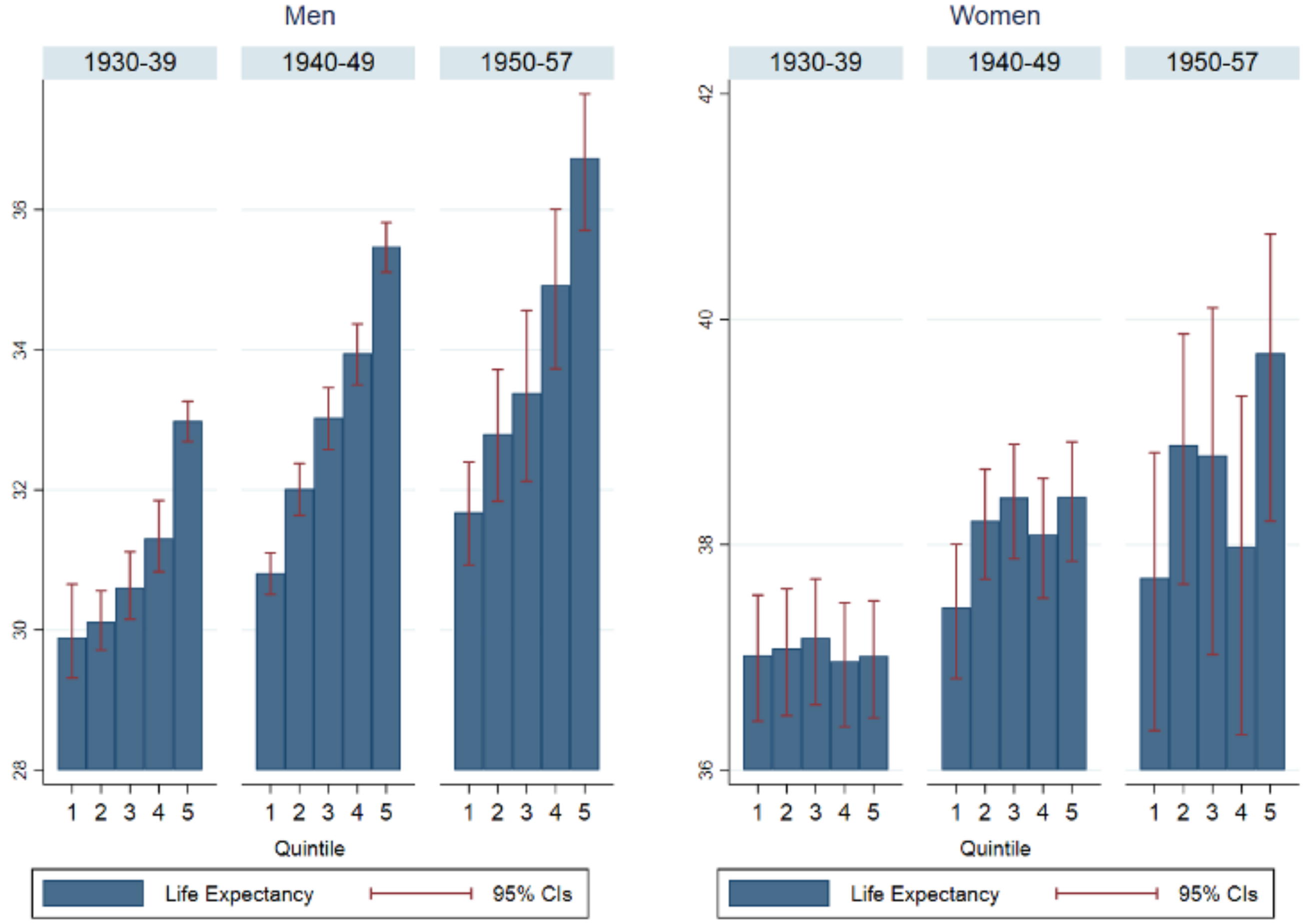
Notes. The graphs plot the evolution of the probability of surviving to 61 at 50, by prevalent occupation at 45-59, sex and birth cohort, along with 95% confidence intervals. Life expectancy estimates are based on observed survival probabilities only. Own elaboration based on INPS data.

Figure S7: Life exp. at 50 by quintile of average employment earnings at 45-49 based on observed mortality rates - *Dichiarazioni Uniemens* sample



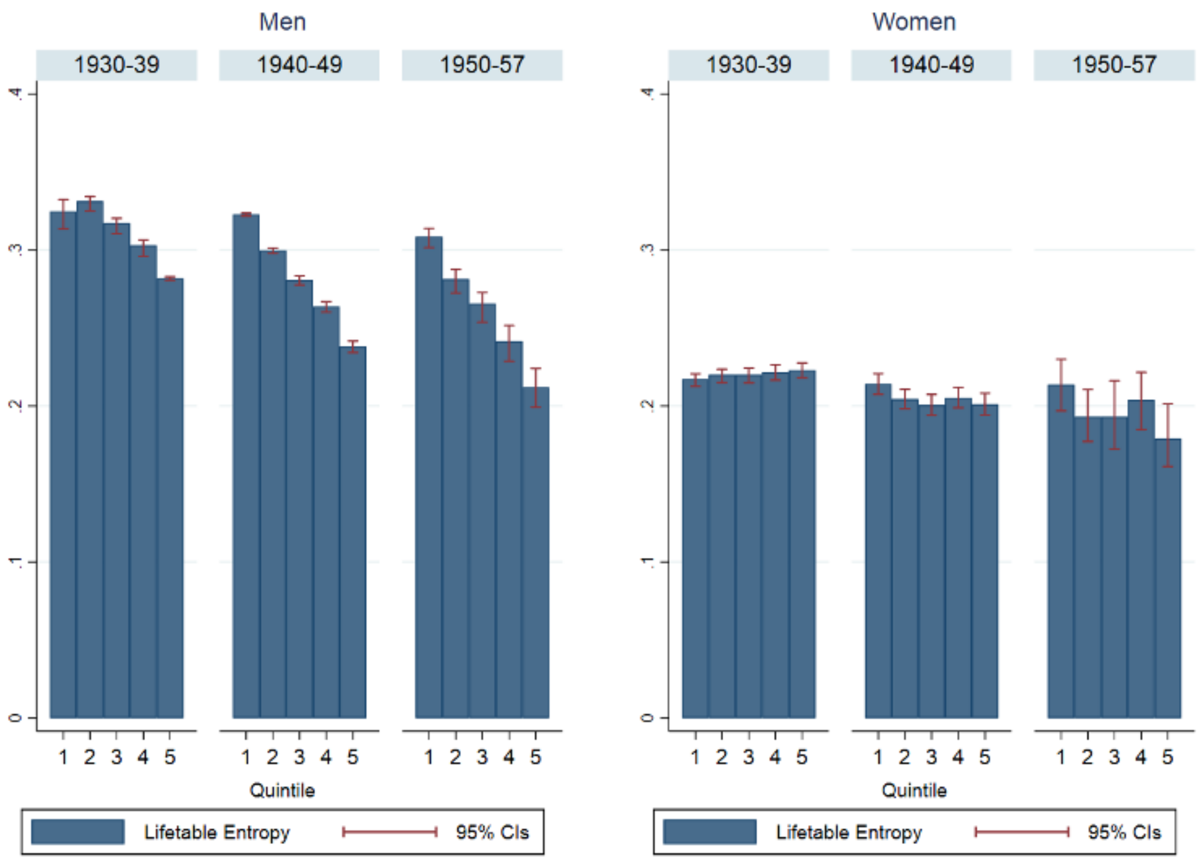
Notes. The graphs plot the evolution of life expectancy at 50 by quintile of average employment earnings at 45-59, sex and birth cohort, along with 95% confidence intervals. Life expectancy estimates are based on observed survival probabilities only. For later cohorts, survival probabilities of earlier cohorts were employed. Own elaboration based on INPS data.

Figure S8: Life exp. at 50 by quintile of average employment earnings at 45-49 based on individuals with at least 4 years of observations between 45-49 - *Dichiarazioni Uniemens* sample



Notes. The graph plots the evolution of life expectancy at 50 by quintile of average employment earnings at 45-49, sex and birth cohort, along with 95% confidence intervals. Estimates are constructed starting from a sample which includes only individuals who are observed for at least 4 years between ages 45-49 in the *Dichiarazioni Uniemens* archive. Own elaboration based on INPS data.

Figure S9: Lifetable entropy at 50 by quintile of average employment earnings at 45-49 based on individuals with at least 4 years of observations between 45-49 - *Dichiarazioni Uniemens* sample

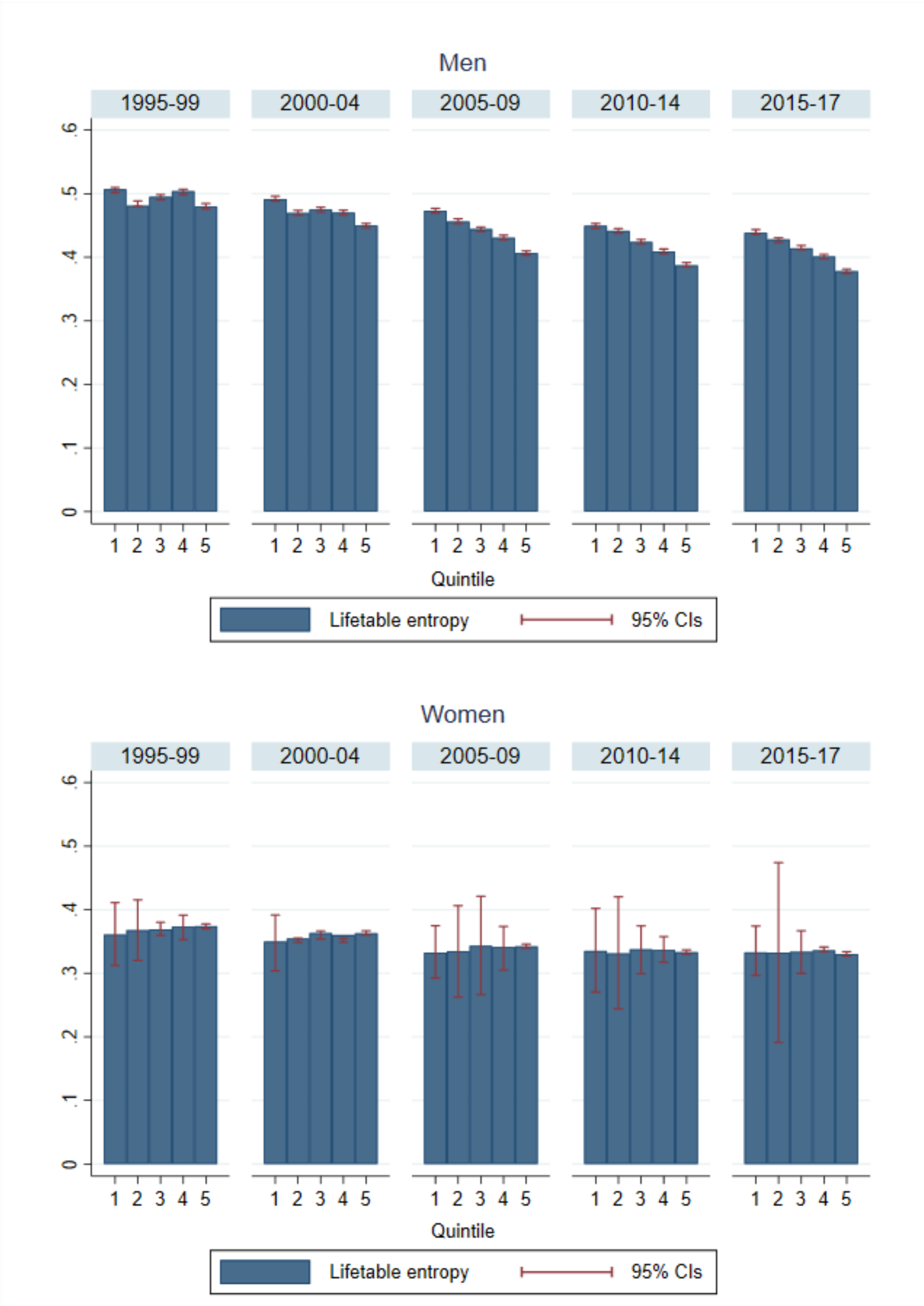


Notes. The graph plots the evolution of lifetable entropy at 50 by quintile of average employment earnings at 45-49, sex and birth cohort, along with 95% confidence intervals. Estimates are constructed starting from a sample which includes only individuals who are observed for at least 4 years between ages 45-49 in the *Dichiarazioni Uniemens* archive. Own elaboration based on INPS data.

Figure S10: Life expectancy at 67 by quintile of pension income (individuals with pension above the minimum) – *Pensioni Casellario* sample

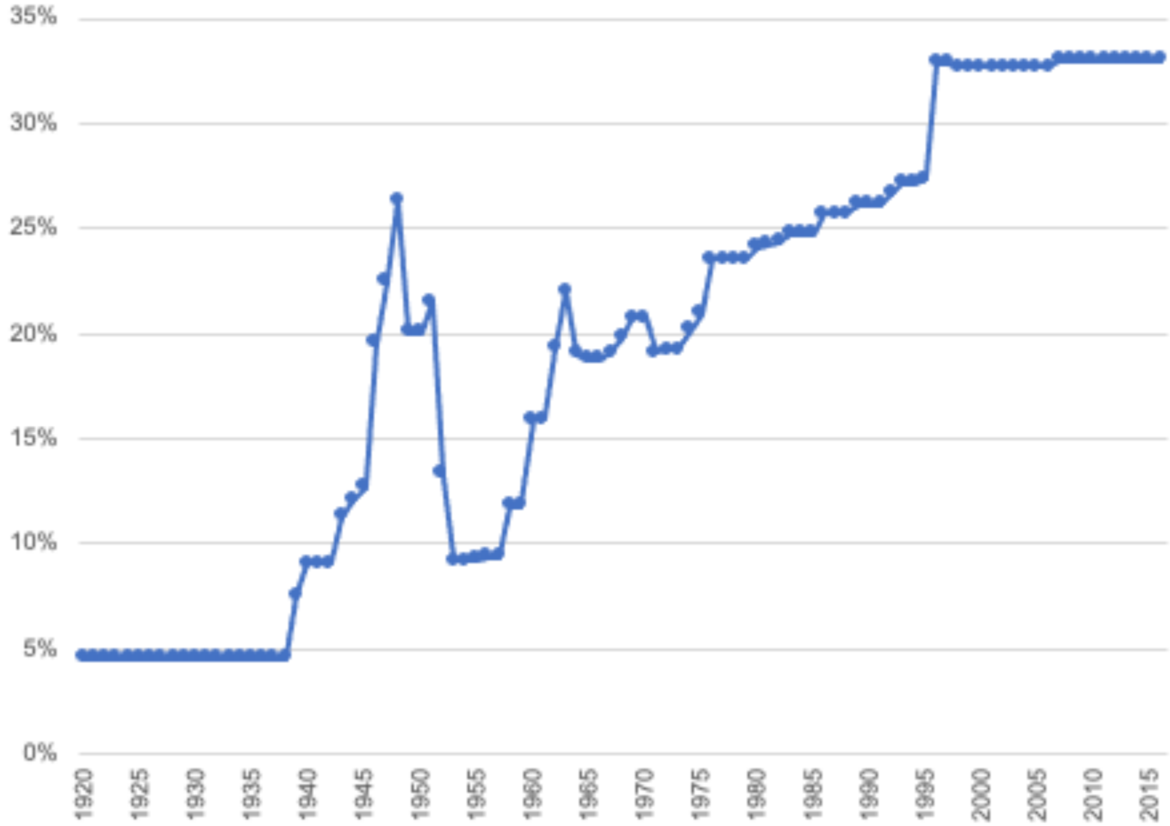
Notes. The graph plots the evolution of life expectancy at 67 by pension quintile and sex, along with 95% confidence intervals. Estimates are constructed starting from a sample which includes only individuals with pension income above the minimum in each calendar year. Own elaboration based on INPS data.

Figure S11: Lifetable entropy at 67 by quintile of pension income (individuals with pension above the minimum) – *Pensioni Casellario* sample



Notes. The graph plots the evolution of lifetable entropy at 67 by pension quintile and sex, along with 95% confidence intervals. Estimates are constructed starting from a sample which includes only individuals with pension income above the minimum in each calendar year. Own elaboration based on INPS data.

Figure S12: Yearly average contribution rate – *Fondo Pensione Lavoratori Dipendenti*



Source: INPS.