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Abstract

Research on social stratification has mostly focused on working-age populations. With rapidly aging populations increasing across the rich world, inequalities at older ages are an increasingly relevant part of how contemporary societies are stratified. Here, we highlight an aspect of inequality that has been largely unexamined—the inequality of lifetime accumulated pensions. In contrast to most previous research on old-age inequality comparing social groups, we focused on total-population-level inequality. Using Swedish register data covering the retired population born from 1918–1939, we examined how the total pension income accumulated over an entire lifetime is distributed in Sweden. We found that the lifetime pension is much more unequal than pre-retirement earnings and yearly pension payments. Decomposition analyses show that lifespan inequality is the most important factor in lifetime pension inequality and is more important than differences in prior earnings. The decline in lifetime pension inequality across cohorts is mostly attributable to the decline in lifespan inequality, particularly for men. We also show that potential changes in pension policies and mortality patterns can affect the inequality in lifetime pensions but are limited in magnitude unless they directly affect the number of years of receiving the pension.

Keywords: Social stratification, aging, retirement, Sweden, mortality inequality, decomposition

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Introduction

Most research on social stratification in contemporary populations has focused on working ages. With rapidly aging populations increasing across the rich world, inequality at retirement ages are becoming a more relevant component of how societies are stratified. Focusing on the retired population, prior research has examined inequality in retirees' consumption and disposable income (e.g., Deaton and Paxson 1994). In the current study, we took a different and broader approach by examining how the total pension income over an entire lifetime is distributed in a population. We investigated how much of the total pensions received over an individual's life course (typically through transfers from younger generations in government-funded pension schemes) is determined by how long they live as well as their prior income, education, occupation, and other pre-retirement characteristics.

Here, a lifetime pension is defined as the accumulated pension payments from all parts of the pensions system (*all pillars*) from the typical retirement age of 65 to death. We had three aims. First, we determined the extent to which lifetime pensions are unequally distributed in Sweden. We compared lifetime pension inequality with inequality in prior labor earnings and in yearly pension income, the latter of which has been more commonly studied. By focusing on older ages, we were able to examine an aspect of inequality that has often been overlooked in the social stratification literature. Second, we used several different approaches (including standardizations and Gini decompositions) to examine different factors that contribute to lifetime pension inequality, finding that an important mechanism is that many individuals accumulate more pension income from pension systems simply because they live longer. Our results show that as the dispersion of lifespan distributions have changed across cohorts, lifetime pension inequality has also changed. Third, using counterfactual analyses, we explored the observed lifetime pension inequality's sensitivity to changes in pension policies and mortality.

A clear distinction and contribution of this study compared to most prior studies on inequality at older ages is that we used a *population-level* approach, whereas many others have used a *group-level* approach. A group-level approach examines the gap in the average lifetime pension between pre-defined social groups. In contrast, population-level approaches examine differences across all individuals within an entire population, conventionally using measures such as the Gini coefficient to capture the overall inequality. As we will show later in the results, although socioeconomic differences in the average lifetime pension are large, they only capture a limited proportion of the overall population-level inequality.

We used several decades of Swedish taxation data together with death registers and censuses covering the entire country to provide a holistic perspective on how much lifetime pension income differs between individuals. We documented the trends in lifetime pension inequality (measured by the Gini coefficient) over 22 birth cohorts. We show how socioeconomic and demographic factors jointly contribute to this inequality through a Gini decomposition. We decomposed the Gini coefficient for the lifetime pension and its change across cohorts into various sources, such as changes in lifespan and prior labor earnings.

Background

Previous Research on Old-Age Inequality

Social scientists have examined social inequality and social stratification since the 19th century. The majority of research has taken a cross-sectional approach, focusing on inequality in earnings or disposable income of the current working-age population. It has been less common to examine inequality among all members of society (Solt 2020). Population aging in recent decades has made it increasingly important for inequality researchers to examine inequality in the older population. Before the 1960s, the retired population was a relatively small part of the total population in high-income countries. In 1960, 8.3% of the total population of the OECD countries was older than 65, and this had increased to 17.5% as of 2020 (OECD 2022), an increase that will continue. Given the increasing share of the older population in high-income countries today, empirical evidence on income distributions of older individuals is surprisingly scarce. A large literature has focused on the prevalence and causes of old-age poverty specifically (e.g., Barrientos et al. 2003; McLaughlin and Jensen 1993), but here we are referring to studies examining inequality at the population level.

Prior studies have compared how different pension systems in different countries affect inequality among older adults. It has been consistently found that public pensions, which are often designed progressively, reduce inequality at old ages, whereas private pensions increase pre-existing inequalities (Been et al. 2017; van Vliet et al. 2012). Countries with more generous pension systems have less old-age poverty (Jacques et al. 2021).

An important line of prior research on old-age social stratification has examined inequality in current (pension) income among the retired population, often with a comparison with inequality at younger ages. As pension income replaces labor income as the primary source of income after retirement, there may be changes in income inequality after retirement. Will inequality become smaller, larger, or remain stable when a cohort enters retirement? The *cumulative advantage/disadvantage hypothesis* predicts that income inequality increases with age (Ferraro and Shippee 2009). This is because when individuals age, early advantages/disadvantages in health, education, income, and other aspects of social life carry over to later life, contributing to an increased income gap at older ages. Conversely, the *redistribution hypothesis* predicts that income inequality narrows after retirement, as public pension systems tend to redistribute money from the rich to the poor (O'Rand and Henretta 1999). This hypothesis is of particular relevance to countries characterized by generous and progressive pension systems (Brown and Prus 2006). Finally, a combination of the aforementioned two mechanisms leads to the third hypothesis—the *status maintenance hypothesis*, which predicts that income inequality may be relatively stable before and after retirement (Henretta and Campbell 1976).

Empirical evidence is mixed. Earlier cross-sectional research found higher inequality among Americans aged 75+ than among younger Americans (Crystal and Shea 1990). Using a cohort approach, researchers have also found support for an increasing income gap as people age (Crystal and Waehrer 1996; Crystal et al. 2017), in the context of rising overall income inequality over time. In the more redistributive Canadian system, Prus (2000) found that inequality declined in older age, suggesting that the pension system reduced inequality. Using individual-level longitudinal data from the United States, Hungerford (2020) found that cohort-specific income inequality is roughly stable as the cohort ages and starts to receive pensions. However, such stability was only found for Gini-type measures, and Hungerford (2020) showed that inequality differed for other measures giving different weight to the bottom and top range of the income distribution.

An important issue that has not been considered in previous research is the attrition due to death. Even if income change little as people age, income inequality may narrow simply because survivors to older ages are an increasingly positively selected and increasingly homogeneous group in terms of both health and income. Therefore, the role of mortality selection is important for studies on inequality among retirees. A broader lifetime perspective that accounts for differences in mortality is needed.

A different relevant line of research on old-age inequality has focused on the *net pension wealth* of individuals at different ages (Johnson et al. 1999; Bönke et al. 2019; Kuhn 2020; Olivera 2019). Net pension wealth is the current value of expected future pension flow (given that the pension system will honor their obligations), including (returns to) individually funded pension funds and benefits from governmental, collective agreement, or employer-linked pension plans (either defined benefits or defined notional contribution plans), as well as individual savings and funded pension plans. This line of research provides a good forecasted picture of inequality in old-age pensions from the perspective of currently working individuals, given that individuals' trajectories of future pension income are mostly based on their pension plans and prior income histories. As such, measuring the inequality in net pension wealth at different ages is informative to gauge (future) pension inequality, absent the effect of within-cohort inequality in mortality.

This study differs from most previous research on pension inequality. The lifetime pension is the sum of the product of the years lived and the yearly (rather stable) pension payments over those years. As such, it is the *retrospective*, observed total pension individuals actually obtain rather than the *prospective* total pension (i.e., net pension wealth). Also, unlike what is observed in a cross-sectional approach, the lifetime pension is not directly related to yearly consumption or poverty levels, and thus it relates to different research questions. The lifetime pension is more related to savings and wealth than to consumption. It is an absolute sum paid over an entire life course. Therefore, lifetime pension inequality shows the *actual monetary distribution* of pension systems. This makes our study more relevant for addressing questions of fairness and financing of pension systems.

Our approach is in some ways similar to estimating the amount of savings an individual would in practice need in a system without any actuarial or pension-like function to cover their de-facto consumption at older ages. Pension systems work to annuitize such payments, thereby protecting consumption from being impacted by lifespan variations. The lifetime pension directly corresponds to the actual observable amounts of cash an individual receives from a pension system. As such, it represents a value that can serve as a benchmark for how much an individual would need to de-facto save through means such as wealth and housing to meet their consumption needs in retirement, hypothetically in the absence of a (generous) pension system.

Our focus on lifetime-accumulated pensions is related to but distinct from the study of wealth inequality. Net pension wealth is an important part of older adults' total wealth, but it is usually not included in studies on wealth inequality, as net pension wealth is hard for individuals to gauge (Ekerdt and Hackney 2002; Sierminska et al. 2006). In a society without pensions or annuities, such as pre-industrial or contemporary low-income societies, individuals must save for consumption in old age, and such savings are an important component of wealth. In many high-income societies, wealth sources such as housing are also often important for the living standards of older individuals. Wealth is extremely unequally distributed (with the Gini coefficient ranging between 0.5 and 0.9) in many countries (Pfeffer and Waitkus 2021). At older ages, wealth is no doubt an important dimension of inequality, perhaps more so than at working ages. Similar to the United States, Sweden has one of the most unequal wealth distributions in the world (Pfeffer and Waitkus 2021). The extremely high concentration of wealth may also explain why pension income is relevant for most individuals, as large shares of the population have very modest savings and wealth and depend on pension income. Relatedly, researchers have shown that wealth inequality is smaller in countries without generous public pensions, as a large amount of wealth is then accumulated across a broader section of society (Domeiji and Klein 2002). Our study is valuable as a complementary perspective on common forms of savings for retirement, such as properties or cash, that represent a fixed amount of wealth (i.e., that are not connected to how long the person lives). In theory, these forms of savings can be annuitized into annual payments, but this is rare.

Another related approach is to study the inequality in end-of-life assets; i.e., how much wealth was left at the time of death (Poterba et al. 2017). Such an approach is more relevant to understanding intergenerational transfers of wealth. Unlike our approach, such research does not focus on the age at death or the accumulation of resources during retirement.

The Lifetime Pension and Fairness of Pension Systems

Besides providing an alternative perspective on the social stratification among older adults, this study also contributes to recent scholarly discussions on the fairness of pension systems. A major goal of pension systems is to protect individuals from uncertainty and randomness in lifespan and to make sure that individuals have adequate resources no matter how long they live (Ayuso et al. 2017; Shi and Kolk 2022). By contributing to pension systems at working ages, individuals can expect to have a stable income in retirement. This is particularly important for people with low prior incomes because those with high prior incomes usually have other means, such as private savings, to support their retirement lives (GAO 2019). Pensions thus act as insurance against living for a long time. Through them, resources are redistributed from the short-lived to the long-lived. Consequently, lifetime pension inequality is likely to be larger than the inequality in pre-retirement yearly earnings because those who had lower earnings tend to have shorter lifespans. Redistribution through unequal lifespans is in some aspects a desirable and intended goal of pension systems, but it is simultaneously an important source of inequality.

Pension systems also have other functions, the most important of which is to redistribute incomes from working life to retired life over individual life courses (i.e., intra-personal redistribution) (Ebbinghaus 2021). Intra-personal redistribution ensures that we experience similar inequality before and after retirement, although the extent of this similarity differs between pension systems. In Sweden, the link between earnings and the pension is comparatively large (OECD 2011). This means the pension system redistributes resources to a lesser extent. To achieve the goal of old-age poverty alleviation, public pension systems in most cases also distribute from high-income earners to low-income earners (i.e., inter-personal redistribution). Inter-personal redistribution itself constitutes one of the major functions of pension systems as a part of a larger welfare state (Ebbinghaus 2021).

Decomposing the sources of inequality in lifetime pensions as we have done in this paper (using Sweden as an example) will help researchers and policymakers understand how pension systems de-facto balance the different (contradicting) goals of pension systems. Intended levels of progressiveness of pensions systems and redistribution between the rich and the poor may not be realized due to the regressive effects of mortality inequality (Tan and Koedel 2019). A recent growing line of research has therefore shown how mortality inequality increases lifetime pension inequality between socioeconomic groups, and various researchers have argued that the role of mortality should be carefully examined when considering the progressivity of pension systems (e.g., Brown 2003, 2007; Goldman and Orszag 2014; NASEM 2015; OECD 2017; Shi and Kolk 2022; Sánchez-Romero et al. 2020).

Previous studies on mortality and pension inequality have examined the impact of pension reforms as they have moved from (often unsustainable) defined benefits systems to systems that better account for population aging, such as notional defined contribution systems and funded systems (Barr and Diamond 2009; Lee and Sánchez-Romero 2019; Mazzaferro et al. 2012). Researchers have also used a simulation approach to examine how different pension systems may impact pension inequality due to differential mortality (Lee and Sánchez-Romero

2019). The cohorts we examined were generally exposed to a stable defined-benefits pension environment before major reforms to the system were made for later cohorts (Palme 2005). In our study, we also conducted counterfactual analyses to explore how sensitive the observed lifetime pension inequality is in response to changes in pension policies, such as changes in retirement ages or the level of the guarantee pension.

Group- Versus Population-Level Approaches

Most previously mentioned studies on lifetime pension inequality used a group-level approach, examining differences in average lifetime pensions across socioeconomic groups. Such a group-level approach does not account for the potentially large heterogeneity within socioeconomic groups. Pre-retirement earnings are often operationalized by equally sized percentile groups (e.g., Bishnu et al. 2019; NASEM 2015). It is reasonable to assume that the explanatory power of socioeconomic variables (e.g., educational attainment and earnings quantiles) for total lifetime pension variation is limited at the group level, and that much inequality is found within rather than across groups.

Alternatively, measuring population-level lifetime pension inequality, as we did in this study, is complementary to previous group-based studies. It illustrates how much societal income redistribution through public pension systems is influenced by variations in mortality (and not only differences in mortality across groups), and thus contributes to the debate on the fairness of pension systems. A population-level approach gives a broader overview of the total variations in lifetime pensions across an entire approach.

It has recently been shown that in Sweden, mortality explains around one-quarter of the total differences in average lifetime pensions between socioeconomic groups, and the rest is mostly attributable to inequality in pre-retirement earnings (Shi and Kolk 2022). However, it is not known how much of the total lifetime pension inequality at the population level can be explained by within-group differences in average lifetime pensions. Furthermore, while previous group-level research has shown that pre-retirement earnings and yearly pension levels are more important than mortality, it is unclear if this also applies to population-level lifetime pension inequality. We will later show that for individual-level inequality, mortality is more important than pre-retirement earnings for explaining population-level inequality in total pensions.

Determinants of Lifetime Pensions

Figure 1 presents a theoretical model of how different factors are linked with a lifetime pension. A lifetime pension is predominantly a direct function of yearly pension income and the retirement lifespan, although to some extent other factors, such as spousal death, may also directly affect the lifetime pension through widowhood pensions. Accordingly, inequality in lifetime pensions comes from the variations in lifespan and yearly pension income. From a life-course perspective, yearly pension income is shaped by life-cycle events before retirement. Previous studies have examined how education, marital history, employment and occupational trajectory, and retirement pattern are associated with later-life inequality in (pension) income (Crystal et al. 1992; Fasang 2012; Fasang et al. 2013; Halpern-Manners et al. 2015; Riekhoff and Järnefelt 2018). Undoubtedly, these are important factors. Yet the most direct determinants of yearly pension income are arguably levels and trajectories of pre-retirement earnings. This is because second-pillar pension incomes are calculated based on earnings-based contributions. Thus, we hypothesized that once pre-retirement earnings are accounted for, other working-age sociodemographic factors have a limited effect on lifetime pension inequality.

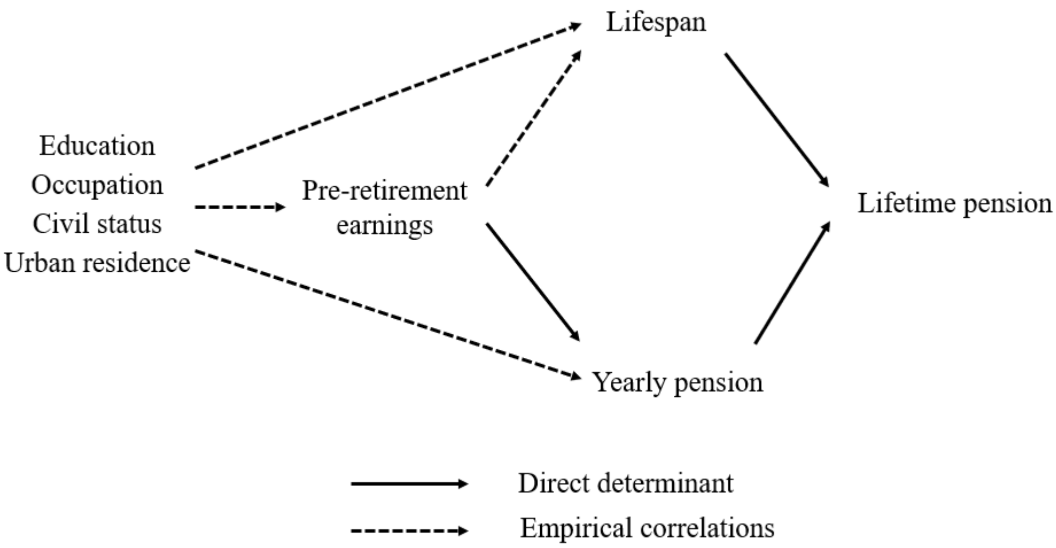

Figure 1. A theoretical model of a lifetime pension. *Source*: Authors' own.

Apart from earnings, the second key determinant of a lifetime pension is lifespan. If everyone were to die at the same age, lifetime pension inequality would be the same as yearly pension inequality. If those with lower yearly pension incomes tended to have longer lifespans, then lifetime pension inequality would be smaller than yearly pension inequality. This is unlikely to be the case, as in reality, people with lower incomes tend to have shorter lifespans (Fors et al. 2021; Shi et al. 2022). At least as importantly, lifespan variation is in itself a source of inequality and will independently contribute to variations in lifetime pensions. Hence, we expected lifetime pension inequality to be larger than yearly pension inequality. An interesting and unexplored question is therefore: What matters more for lifetime pension inequality—lifespan or pre-retirement earnings (where the latter will determine annual pension payments)?

For our cohorts, as we show later, earnings inequality among men at older working ages (50–59) was rather stable with a modest U-shaped function. There have been declines in earnings inequality among women due to rising female labor force participation over time, and as a consequence, income has become increasingly less concentrated among a small group of full-time working women (Shi and Kolk 2022). Reduced earnings inequality will likely lead to a decline in lifetime pension inequality across cohorts for women. Likewise, if lifespan variation has declined over cohorts, lifetime pension inequality may have become smaller. A recent study comprised of 195 countries showed that lifespan inequality at ages above 65 has generally increased over time, in contrast to the decline in the inequality in the total adult lifespan (Permanyer and Scholl 2019). It is worth pointing out that this study, like most previous studies on lifespan variation (Engelman et al. 2010; Myers and Manton 1984), was based on period life tables; i.e., a hypothetical period perspective rather than real cohorts (as in our study). Due to data limitations, less is known about how the lifespan variation in old age has changed across cohorts. If the period trends also hold for cohorts, lifetime pension inequality will increase, given the fact that longer lifespans are concentrated among people with higher yearly pension incomes.

Research Gaps and Our Contributions

Most of the aforementioned studies examined older adults at a certain point in their lives (implicitly then also conditioning upon their survival to the examined age). This is a natural approach, as it documents the levels of absolute and relative poverty among older populations, and can be compared directly to inequality studies on working-age populations. Such a cross-sectional approach, focused on inequality among currently alive older individuals, is appropriate if understanding inequality in consumption ability and living standards is of primary interest. However, this perspective will not account for the role of mortality, which results in some individuals in practice receiving less in pension payments over their lifetime than longer-lived individuals. This relates to the well-documented differential mortality by social status, which affects lifetime pensions in a systematically regressive way (Goldman and Orszag 2014), but also relates to differences in mortality across individuals that are unrelated to socioeconomic status.

Prior studies on the pension wealth of the retired or working-age population have focused on individuals currently alive. In their approaches, future pension payments were estimated according to actuarial calculations, and future inequality in old age was estimated with some forecasting among individuals at earlier life-course stages. However, these calculations were implicitly or explicitly based on mortality forecasts that by nature are population averages. Sophisticated approaches using such designs can take account of between-group differences in mortality, but they have not accounted for within-group differences in mortality. In this study, we took a cohort life-course approach, following individuals from retirement onset to death. We examined how much of the total pensions that the individuals accumulated over their life courses were unequally distributed across members of the same cohort, and we show the role of mortality in such inequalities.

One purpose of a pension system is to act as longevity insurance, and pension wealth measures the stake in such insurance. In this study, we explored the important but neglected research question: How much do different individuals de-facto receive in pension payments? Importantly, we measured inequality across all individuals in a population, unlike many previous studies that focused on differences in average lifetime pensions between social groups (e.g., high- versus low-income earners, men versus women, less- versus more-educated individuals).

As we also decomposed sources of inequality in total pension payments, we provide novel insights into explaining why certain individuals receive more (or less) in pensions and how this is explained by factors such as mortality and prior earnings. We also give a comparative account to compare inequality in cross-sectional pension payments at a given age, lifespan inequality, working-age earnings inequality, and lifetime pension inequality. Relatedly, prior work has examined equity in pension systems (Sánchez-Romero et al. 2020), but such analyses typically compared pre-defined social groups rather than cross-individual inequalities. Therefore, we contribute to knowledge on the extent to which pension systems work as longevity insurance and how much working-age income inequality is reinforced through such systems in old age from a life-course perspective.

Prior work has often examined the impact of population-aging processes on intergenerational fairness in pension systems; in other words, if some cohorts have been "winners" or "losers" in the relative balance between contributing to the system and receiving pensions (Bravo et al. 2021). We did not examine this aspect but focused on within-cohort inequality. We used longitudinal data for a total of 22 cohorts to present trends in how inequality within cohorts have changed over time, thus focusing on differences in inequalities in outcomes across the cohorts, and not the relative difference between what they have paid and gained from the system.

Finally, through examining the inequality in lifetime pension incomes, we provide insights into understanding the social stratification system at large—especially inequalities at older ages and how they may relate to the intergenerational reproduction of inequality. The longer lifespans of people with a higher socioeconomic status mean that they accumulate more pension income over their entire life course. This implies that their children are likely to receive more bequests, thus reinforcing inequality in future generations, although these bequests will also take place later in life. In many contexts, savings and wealth are important for within-life-course transfers (transferring money within families from working to older family members), although this is less the case in Sweden and other Northern European countries (Lee and Mason 2011).

The Swedish Context

Our study was based in Sweden, a social-democratic welfare state with a generous pension system, and where much of within-life-course transferal is done through public transfers (Esping-Andersen 1990). Sweden had a comparably generous pension system during our study period (Korpi 1995), and for our cohorts, income inequality was among the lowest in the world (Atkinson 2003). During the period, Sweden also had among the lowest levels of old-age poverty in the world (Korpi 1995). Intergenerational residence was very uncommon, and few older individuals received financial transfers from their children (Lee and Mason 2011). Female labor force participation and wages were substantially lower than those of men for our earlier cohorts, but increased rapidly for the later cohorts we studied (Bygren et al. 2021).

The retirement age was around 65 for our cohorts born from 1918–1939, with some minor occupational variation, although it was common to receive retirement benefits earlier than that (Hagen 2013). Sweden had an individualized pension system and individual taxation during the period, although the guarantee pension was based on civil status. The cohorts were mostly covered by the combination of a guarantee pension, a state, defined-benefits, and income-related pension (the Allmän Tillägspension, or ATP, with payments on 60% of the qualifying salary, based on the 15 highest years of earnings over a 30-year qualification period), and occupational pension plans obtained through collective agreements in addition (covering on average between 15% and 30% of the total pension, differing by occupation, sex, and cohort, which covered most of the labor force). Replacement rates were often over 80% of the final salary after combining all pillars (Hagen 2013). The system was strongly earnings-related and also covered quite high incomes; consequently, the link between income and pension was stronger than in many other pension systems, and thus did not progressively redistribute income within cohorts as much as many other systems in OECD countries (OECD 2011). Our pension variable included all those pensions as well as other pensions, such as the guarantee pension, the widow pension, and private pension insurance (which is very uncommon), but it did not include various sickness and disability pension schemes covering ages before the statutory retirement age.

For our earliest cohorts, Sweden had among the highest life expectancies in the world. Although Sweden has become less exceptional over time in this regard, it still has exceptionally low mortality rates in working ages; however, it also has relatively high mortality among the oldest old (Drefahl et al. 2014). Sex differences in life expectancy are among the smallest in the world.

Methodology

Data

Our dataset covers the full population of Swedish-born persons born between 1918 and 1939. The dataset was constructed by linking multiple registers provided by Statistics Sweden using unique personal identification numbers. The *total population registers* provide basic demographic information, including sex, birth year, and country of birth. The *migration registers* contain information on in- and out-migration. The *death registers* provide the date of death for deceased persons. The yearly *taxation registers* provide information on labor earnings and pension income from 1968 onward, based on the end-of-year tax filings of all individuals. The 1970–1990 *censuses* contain information on occupational status, civil status, and urban/rural residence. We restricted our sample to individuals who had never migrated after age 50 and survived to age 65. This resulted in a total of 1,694,060 individuals. The registers are recorded yearly, with the last year of observation being 2018, whereas the censuses are conducted every five years (e.g., 1970, 1975, 1980, …). Figure A1 in the Appendix presents the ages, periods, and cohorts we covered in a Lexis diagram. We followed cohorts born between 1918 and 1939, and the last year we observed was 2018. For some cohorts and ages (above age 79 for our earliest cohort), we forecasted their remaining years of life and pension flows, as explained in the following section and Appendix 1.

Variables

Our outcome variable *lifetime pension income* is defined by the accumulated total taxable pension incomes from age 65 to death, which includes state pensions, occupational pension plans, and private pensions (private pensions account for a very small share of total pensions). It was derived from yearly taxation records of all sources of income. We did not have access to source data on different kinds of pensions. For individuals who survived to 2019, future annual pension incomes were assumed to equal the average annual pension of the last three years observed (2016–2018). This was applicable to ages above 80 for our first cohort. This was a reasonable approximation, as our data show that inflation-adjusted pension incomes are very stable after age 70, and assuming constant future annual pension payments is very reasonable.[1]

Lifespan is defined as the remaining years of life at age 65; i.e., age at death minus 65. As our data ran up to the year 2018, we included complete life spans and also used a simulation approach (based on the Gompertz age-mortality relationship with earnings as an additional predictor) to forecast lifespans for individuals who survived to 2019 (see the details of the forecasting method in Appendix 1). In total, 30.3% of the individuals survived to 2019. The forecasted person-years constituted 12.0% of the total person-years. For our earliest cohorts, we used virtually only observed mortality data, whereas the share of imputed person-years became larger for our latest cohorts. When aggregated, our forecasted mortality estimates

[1] The youngest cohort was aged 79 in the last year of observation, 2018. Therefore, the youngest age for imputed annual pension income was 80. In Table A1, we show that pension income was very stable from age 80 using observed pension data for the 1925 cohort. Specifically, compared to pension income at age 80, the average percentage changes (either increases or decreases) in pension incomes at ages 81, 85, and 90 were less than 2%.

completely matched the official life expectancy forecasted by Statistics Sweden (2020) at the national level.

Labor earnings are defined as the average annual pre-tax labor earnings from ages 50–59 that were obtained from tax registers, including income from work but not capital gains and similar income sources. Both labor earnings and pension income are presented with the unit of 1,000 Swedish krona (SEK, corresponding to around 125 USD), and were adjusted for inflation using 2018 as the base year. The exchange rate of SEK to USD varied over the period, with an average of approximately 8 SEK to 1 USD.

We included a set of control variables in the regression models that were later used for our decompositions. *Education* is a categorical variable with four categories: primary (64.6%), secondary (24.6%), tertiary (8.3%), and missing (2.5%). *Occupation* was operationalized using the Erikson-Goldthorpe-Portocarero (EGP) occupational class schema (Erikson et al. 1979) consisting of nine categories, including one for those out of employment and missing (17.6%). *Civil status* has four categories: married/cohabiting (77.7%), divorced/separated (10.0%), widowed (3.4%), and never married (9.8%). *Metropolitan county* is a dummy variable set as 1 for persons residing in metropolitan counties (Stockholm, Gothenburg, and Malmö; 34.0%) during working ages. Occupation, civil status, and metropolitan county were derived from six waves of census data from 1970–1990, when the age of the individual was 50–54. In the Appendix, we present the descriptive statistics of the variables in Table A2.

Standardization

An approach to account for different determinants of lifetime pension inequality is to conduct counterfactual analyses using standardization. By standardizing or reweighting the age groups of one population to match the age structure of a benchmark population, it is possible to obtain the "standardized" income and wealth inequality value that can be seen as the counterfactual inequality level when the differences in age structures are "removed" (e.g., Lee 1994), similar to common standardization approaches in demography.

We conducted similar counterfactual analyses to examine the roles of lifespan and pre-retirement earnings in cohort differences in lifetime pension inequality. Specifically, we first chose a set of benchmark years (1918, 1921, 1924, etc.) and then applied individual weights to later cohorts so that the lifespan (or pre-retirement earnings) distributions of the later cohorts became identical to the benchmark cohort. These weights are presented as ratios between the density of the benchmark population and the later cohort at each age (income) position.

The standardization approach has two shortcomings. First, it considers only the *compositional differences* in the determinants of lifetime pensions and does not take into account changes in the effects of the determinants on lifetime pensions. For instance, the association between pre-retirement earnings and the lifetime pension may have changed over time. Second, this approach cannot control for other variables, and thus can only be used to examine one or a few variables, as standardization based on more variables is infeasible.

Gini Decomposition

Our main analysis consisted of decomposing the Gini of the lifetime pension into different explaining variables. The Gini coefficient is a standard inequality measure in the inequality literature. One way to calculate the Gini coefficient (*G*) is:

$$G = \frac{2}{n\mu}\sum_{i=1}^{n} y_i R_i - 1 \quad (1)$$

where y_i is the lifetime income for individual i, R_i is the rank of the lifetime pension for that individual, μ is the mean of the lifetime pension of the population, and n is the number of individuals.

To identify the contributions of lifespan and pre-retirement earnings to the Gini of the lifetime pension, we applied the regression-based decomposition method proposed by Wagstaff et al. (2003). An advantage of this method is the feasibility of decomposing the total inequality into multiple contributing factors simultaneously. To calculate the concentration index, R_i in Eq. (1) represents the rank of a socioeconomic variable for the individual. When the ranking variable is the outcome variable itself, the concentration index becomes identical to the Gini coefficient. This decomposition method has been used by economists to decompose income inequality (e.g., Zhong 2011). Suppose that we have the following linear regression model with k independent variables:

$$y_i = \alpha + \sum_k \beta_k x_{ki} + \epsilon_i \quad (2)$$

we can substitute Eq. (2) into Eq. (1) and then rearrange the new equation as:

$$G = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu}\right) C_k + \frac{GC\epsilon}{\mu} \quad (3)$$

where $\bar{x}_k$ is the mean of variable k, C_k is the concentration index of variable k (using the lifetime pension as the ranking variable), and $GC\epsilon$ is the generalized concentration index for ϵ_i, which is analogous to the Gini coefficient (Shorrocks 1983). Therefore, Eq. (3) shows that the Gini coefficient of the lifetime pension of a given time can be partitioned into two parts. The first is the deterministic component. The second is the residual component, which shows the inequality in the lifetime pension that cannot be explained by the independent variables.

We calculated the Gini coefficient by cohort and sex, and decomposed the Gini for each of them. To evaluate the contributions of the independent variables to the changes in the Gini between two cohorts, we took the difference between the two cohorts. Additionally, to test the robustness of our results from the Gini decomposition approach, we used two additional R^2 (variance) based approaches, partial R^2 and R^2 decomposition, to disentangle the total variance in the lifetime pension into contributing factors. These results are presented in the Appendix and discussed briefly in the Results section.

Counterfactuals

As a final step, we conducted several counterfactual analyses to examine how changes in pension policies and mortality may impact the inequality of lifetime pensions. Specifically, three pension policies were examined. First, we increased the minimum pension, examined by raising yearly pension incomes to a level whereby the total yearly pension income of the entire cohort was raised by 10%. Second, we added a progressive tax scheme, which reduced the total yearly pension income of a cohort by 10%. Figure A2 in the Appendix shows the tax rate across levels of gross annual pension income for the 1928 cohort. Third, we raised retirement ages by one to four years, which was examined by shifting the yearly pension income variable to older ages. Additionally, we examined hypothetical changes in mortality whereby everyone lived one to three years fewer or more. The pension of the additional years was assumed to be the same as that of the last observable year.

Results

Summary Statistics

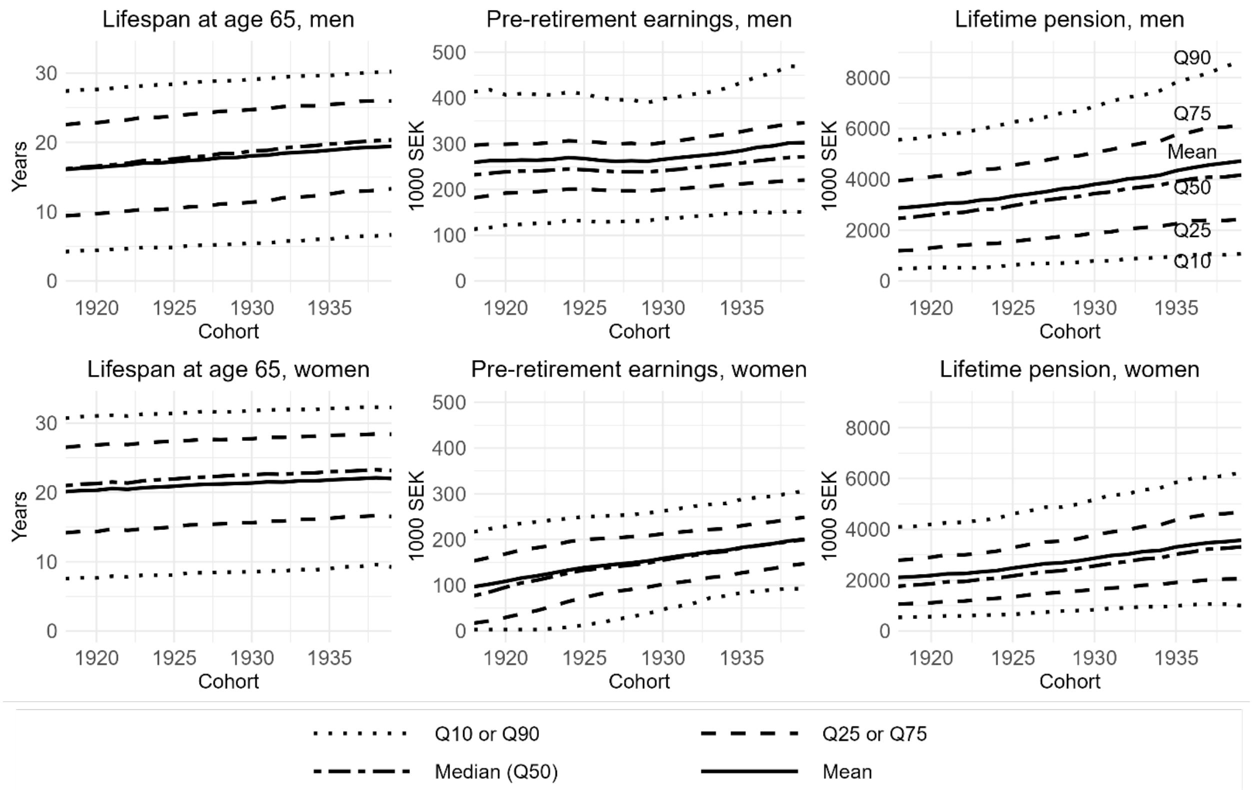

Figure 2. Summary statistics for the main variables. *Source*: Authors' calculations based on Swedish register data. *Notes*: The solid lines show cohort-specific means for the variables, two-dashed lines show the medians, dashed lines show the 25th and 75th quantiles, and the dotted lines show the 10th and 90th quantiles. Calculations for lifespans were based on forecasted mortality and pensions after the year 2018.

We begin by showing several summary measures of the three key variables—lifetime pension, pre-retirement earnings, and mortality—in Figure 2 over our study period. The average remaining years of life at age 65 (i.e., life expectancy at age 65, denoted as e_{65}) increased steadily over time. From the 1918 cohort to the 1939 cohort, the male e_{65} increased from 16.1 to 19.4 years, and the female e_{65} increased from 20.1 to 22.0 years. Average annual earnings over ages 50–59 increased from 259,000 to 303,000 SEK for men, and from 97,000 to 201,000 SEK for women (1 USD ≈ 8 SEK). Lifetime pensions increased from 2,881,000 to 4,898,000 SEK for men, and from 2,115,000 to 3,706,000 SEK for women. In general, the socioeconomic variables (education, pre-retirement earnings, pension at age 70, lifetime pension) are moderately or strongly correlated with each other (Pearson's r: 0.3–0.8), whereas lifespan is only weakly correlated with socioeconomic variables (Pearson's r ≈ 0.1) except for lifetime pension (see Pearson correlation coefficients in Tables A3–A5). The Pearson correlation between pension at age 70 and pre-retirement earnings is around 0.8 for both men and women. Lifetime pensions are strongly correlated with pension at age 70 (men: 0.77; women: 0.75), lifespan (men: 0.70: women: 0.65) and pre-retirement earnings (men: 0.6; women: 0.63), and yearly pension at age 70, and moderately correlated with years of education (men: 0.36; women: 0.39).

A commonly used measure in the literature of income inequality is the ratio between the 90th and the 10th percentiles (P90/P10 ratio), which shows relative inequality. Over time, the P90/P10 ratio for lifetime pensions declined from 11.36 to 8.36 for men, and from 7.43 to 6.43 for women (see quantile-based inequality measures in Tables A6 and A7). Contrastingly, the P90/P50 ratio declined to a lesser extent (from 2.25 to 2.07 for men; from 2.33 to 1.88 for women). The trends in P90/P10 and P90/P50 together that the poorest relatively benefited the mostly over time. Figure A3 in the Appendix presents how life expectancy, pre-retirement earnings, and lifetime pensions have evolved over time with respect to the first cohort born in 1918. Figure A4 shows that the sex gap (absolute difference) in the average lifetime pension increased across cohorts, but the relative inequality (ratio) between men and women decreased.

Prior research on inequality in lifetime pensions has mostly used a group-level approach, quantifying group differences in the average lifetime pension. We show that mean differences across socioeconomic groups only contribute a minor share to the overall variance in lifetime pensions across the whole population (Figure A5). We conducted variance decomposition so that the total variance in lifetime pensions was split into two components: a between-group component (i.e., variance explained by between-group differences in average lifetime pensions) and a within-group component. The results show that differences in the average lifetime pension across earnings quintiles (a division often used in prior research)—i.e., the between-group component—explain less than 35% of the total variance in lifetime pensions across individuals; for education, the between-group component is less than 15% (Figure A5). This means that the vast majority of the population-level total variance in lifetime pensions has been overlooked in prior group-level analyses, and it is not explained by *mean* differences in lifespan and yearly pension levels across pre-defined social groups. We further explored this aspect through our decompositions.

Descriptive Accounts of Old-Age Inequality in Sweden

The left panels in Figure 3 show the Lorenz curves of four key variables for men and women born in 1918. The Lorenz curve plots the cumulative share of the variable against the cumulative percentile. The Gini coefficient is defined as twice the area between the Lorenz curve and the 45° line. For men, the Gini coefficient was 0.23 for the annual pension at age 70, 0.29 for pre-retirement earnings, 0.30 for lifespan, and 0.41 for the lifetime pension (top-left panel). The fact that the lifetime pension is the most unequal among the four variables is also reflected in the top-right panel, which shows the relative value of the outcome for each percentile. The differences are particularly marked in the bottom half of the distribution, where lifespan and the lifetime pension income are very unequally distributed, whereas the distributions of pensions and earnings are equal. Earnings and yearly pensions become very unequal only at the very top of the distribution.

The results for women are different. Pre-retirement earnings had the highest Gini (0.50), whereas lifespan had the lowest Gini (0.24). The high level of earnings inequality resulted from a significant proportion of women having earnings close to zero: 15.2% of women had pre-retirement earnings below 3,000 SEK. The lifetime pension Gini for women (0.38) was slightly higher than for men. The bottom-right panel shows the large share of women having no earnings at all, and also shows the impact of a minimum pension, in that virtually everyone in the 1918 cohort had at least 55% of the mean pension (the couple-level guarantee pension), and a different group had around 62% (the single guarantee level). For later cohorts, the Lorenz curves for women much more closely resemble those for men, with a Gini in earnings of around 0.2 to 0.3.

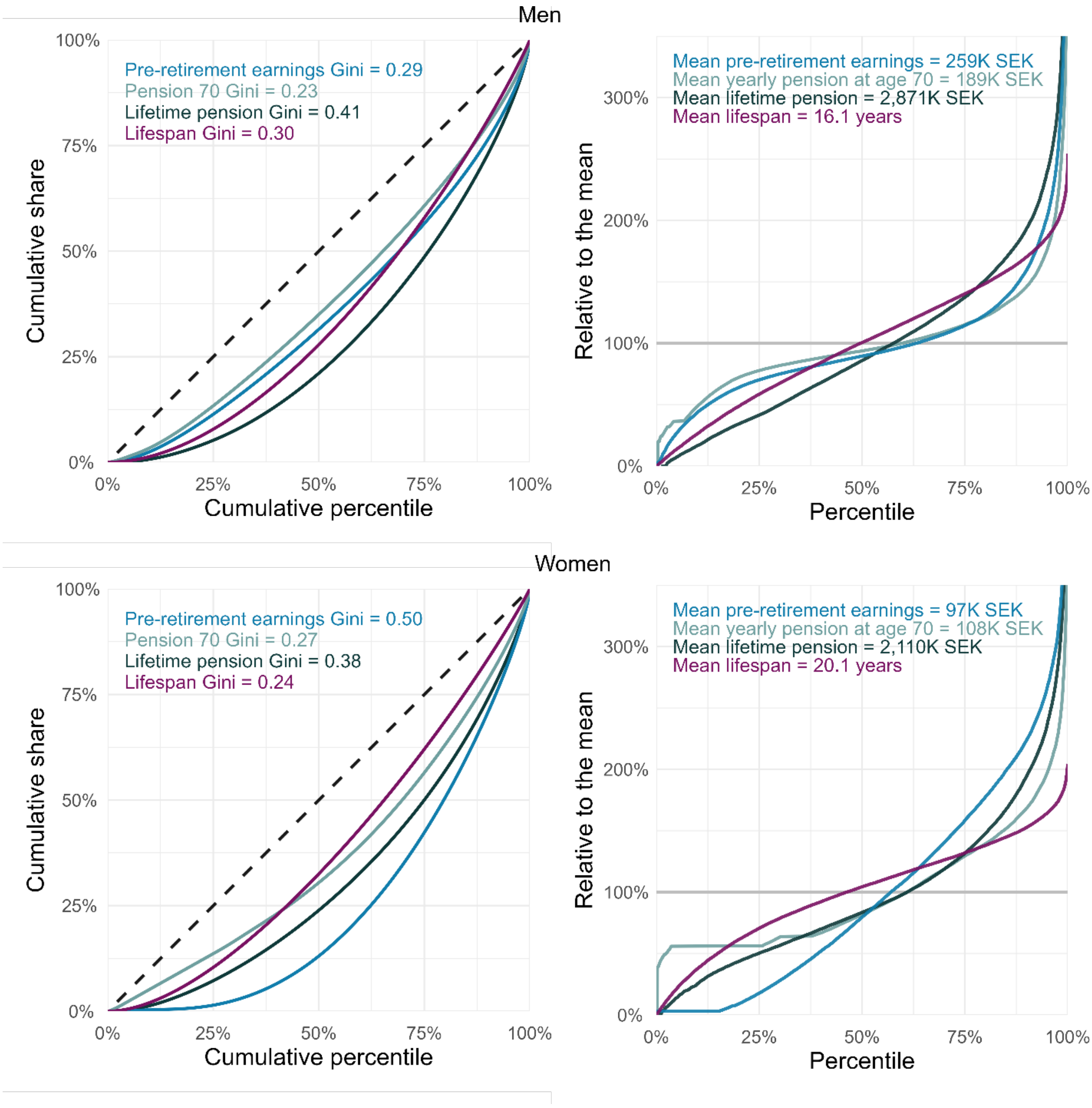

Figure 3. Inequality of the three economic outcomes for Swedish men (top) and women (bottom) born in 1918. The left panels show the Lorenz curves for pre-retirement earnings, the pension at age 70, and the lifetime pension. The right panels show relative levels of the four different outcomes (pre-retirement earnings, the pension at age 70, the lifetime pension, and lifespan), as compared to the mean value of that outcome. *Source*: Authors' calculations based on Swedish register data.

Cohort trends of the Gini coefficient for these variables are presented in Figure 4. For men, the ranking of the Gini coefficients among the variables was largely consistent across cohorts. The Gini coefficient for the lifetime pension declined from 0.41 to 0.38 from 1918 to 1939 for men. The level of the inequality in lifetime pension was much higher than that of the other variables over the whole period. The Gini coefficient for pre-retirement earnings declined from 0.29 in 1918 to 0.24 in 1930, and subsequently increased to 0.26 in 1939. The Gini coefficient for lifespan decreased consistently from 0.30 to 0.25 over the period.

Clearly, for earlier female cohorts, the ranking of the Gini coefficient for these variables is different from that of male cohorts. For females born in 1918, the highest Gini coefficient was pre-retirement earnings, followed by 0.38 for the lifetime pension, 0.27 for the annual pension at age 70, and 0.24 for lifespan. The Gini coefficient for pre-retirement earnings fell strongly to 0.25 in 1939 due to increasing female labor force participation over the period. Initially, earnings were strongly concentrated in the rather small group of full-time working women in the early cohorts, and as this group became much larger over time, earnings were also distributed more equally. The Gini coefficient for the lifetime pension declined to 0.34 for the 1939 female cohort, higher than that of the other variables. The Gini coefficient for lifespan declined slightly to 0.22 in 1939. The pension inequality at age 70 was rather constant, but decreased for cohorts after 1933 due to reforms in the guarantee pension in 1994 (Ministry of Health and Social Affairs 2009:46).

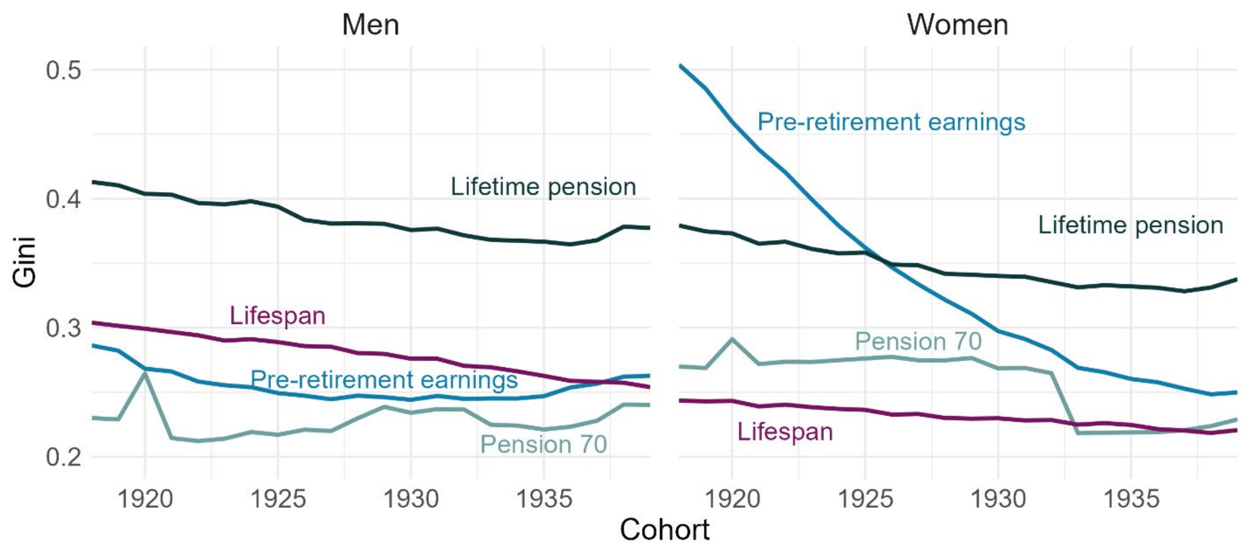

Figure 4. Gini coefficients for pre-retirement earnings, the pension at age 70, the lifetime pension, and lifespan. *Source*: Authors' calculations based on Swedish register data.

Explaining Changes in Inequality in the Total Pension

Figure 5 shows the counterfactual cohort trajectories (orange lines) of lifetime pension inequality using a standardization approach. In the upper panels, we held the distribution of lifespan constant using different benchmark cohorts (darker colors for earlier years). The results indicate that inequality in the lifetime pension would have been higher than what was observed if the lifespan distribution or pre-retirement earnings distribution had been constant from earlier years. There are noticeable differences. For men, the counterfactual lines in the constant-lifespan scenario are flatter than the lines in the constant-earnings scenario. The Gini coefficient for the lifetime pension would be 0.42 for the 1939 cohort if the lifespan distribution had been stable from the 1918 cohort, and would be 0.39 if the earnings distribution had been stable since the 1918 cohort.

The results for women are different. Holding the lifespan distribution constant to earlier levels, the Gini coefficient would still have declined, whereas holding the earnings distribution constant would have led to increases in the Gini coefficient. For instance, the Gini coefficient for the lifetime pension would be 0.35 for the 1939 cohort if the lifespan distribution had been unchanged from the 1918 cohort, and would be 0.48 if the earnings distribution had been stable since the 1918 cohort. This suggests that the decline in earnings inequality played a more important role than the decline in lifespan inequality. These sex differences are not surprising, as Figure 4 has shown that women experienced a greater decline in earnings inequality than men.

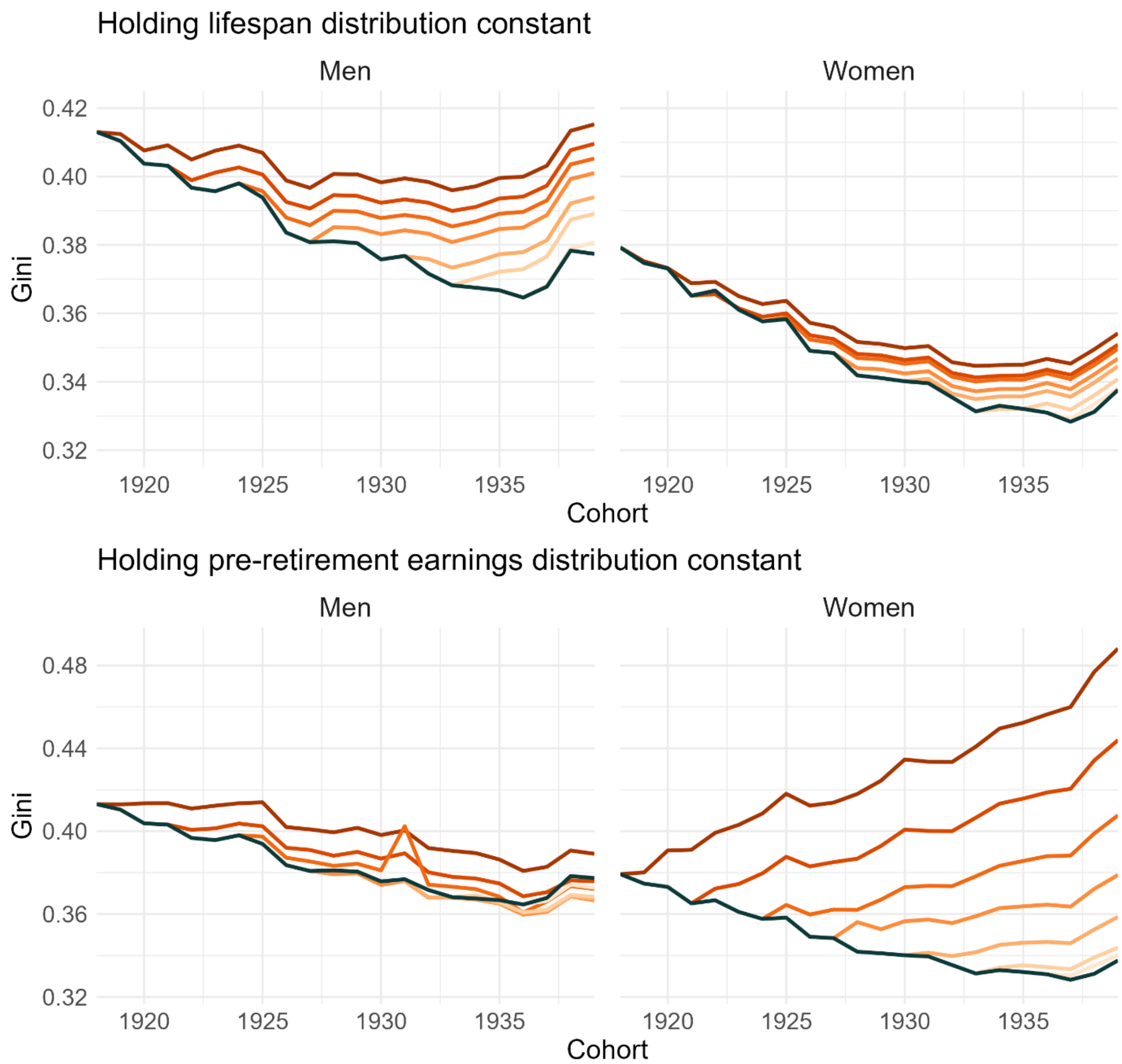

Figure 5. Observed and counterfactual Gini coefficients for the lifetime pension (1) holding the lifespan distribution constant (upper panels) and (2) holding the pre-retirement earnings distribution constant (lower panels). *Source*: Authors' calculations based on Swedish register data. *Notes*: The green line shows the observed Gini trend, and the orange lines show the counterfactual Gini trends. The benchmark years are 1918, 1921, 1924, 1927, 1930, 1933, and 1936. The lighter colors of the counterfactual trend lines denote more recent years.

We present the results of decomposing the Gini coefficient of each cohort into different components attributable to the covariates in Figure 6 (the coefficients for lifespan and pre-retirement earnings from the regression models can be found in Figures A6 and A7). We found that lifespan is the most important source of lifetime pension inequality among all the variables. Across cohorts, the contribution of lifespan was between 0.17 and 0.20 for women, and between 0.21 and 0.27 for men. In general, earnings contributed more in both absolute and relative terms for women than for men. The contribution of earnings ranged between 0.08 and 0.13 for women, and between 0.06 and 0.11 for men.

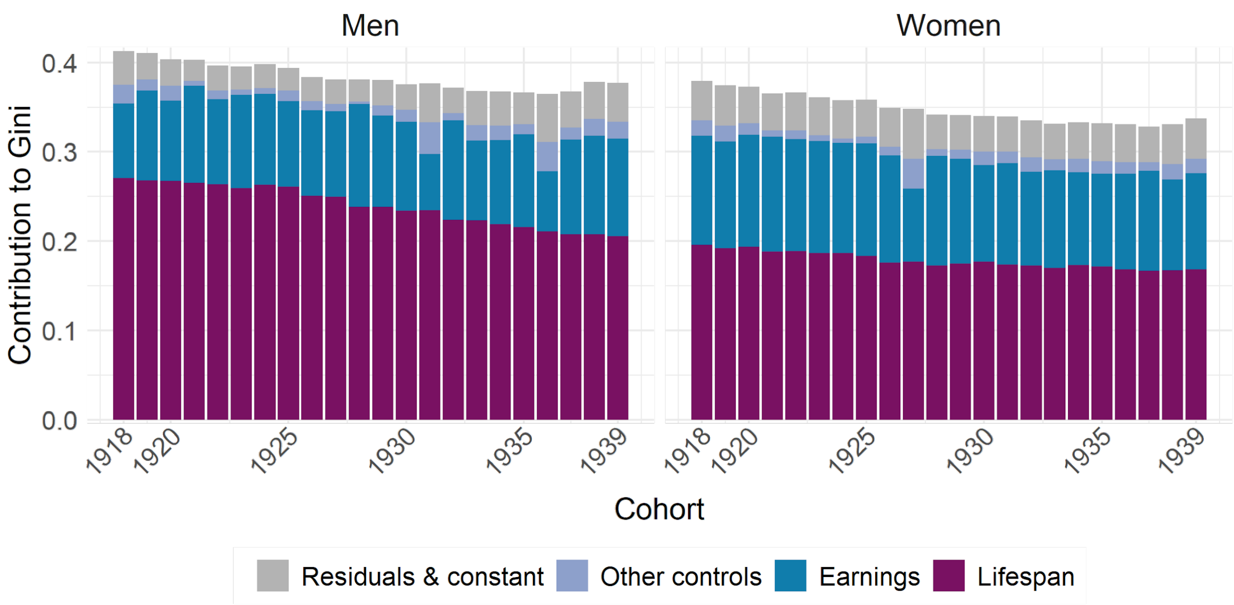

Figure 6. Decomposition of the lifetime pension Gini into contributing factors. *Source*: Authors' calculations based on Swedish register data. *Note*: For the decomposition, we used the method proposed by Wagstaff et al. (2003). Other controls were education, civil status, occupation (EGP schema), and metropolitan county. See Figures A6 and A7 for the coefficients of lifespan and pre-retirement earnings from the regression models.

Regarding the importance of the factors in determining the changes across cohorts, Table 1 shows their contributions to the total changes between the 1918 and 1939 cohorts. For women, the Gini coefficient declined by 0.050 between the two cohorts, of which 44.2% was attributed to lifespan, 49.5% to earnings, and 15.1% to occupation. Other variables played a relatively minor role. For men, the Gini coefficient decreased by 0.033, which was mostly driven by lifespan. Lifespan contributed a decline of 0.063, 191.9% of the total change. This means if lifespan changes had not occurred over time, lifetime pension inequality would have increased, consistent with findings in the standardization approach (upper-right panel in Figure 5). Earnings contributed -76.1% of the total change, meaning that by eliminating the effect of earnings, lifetime pension inequality would have declined even more, inconsistent with the standardization approach (lower-right panel in Figure 5). This is mainly because the standardization approach only takes into account the compositional effect of earnings. Although the earnings inequality declined between the two cohorts (compositional effect), the link between earnings and the lifetime pension increased (allocation effect), which drove the Gini coefficient up. The allocation effect can be seen in the regression coefficient for earnings, which increased over time for both men and women (Figure A3).

Table 1. Changes in the Gini of the total pension income between the 1918 and 1939 cohorts.

	Men		Women	
	Contribution	Percentage	Contribution	Percentage
Lifespan	-0.063	191.9%	-0.022	44.2%
Earnings	0.025	-76.1%	-0.025	49.5%
Education	0.003	-9.7%	0.002	-3.3%
Occupation	-0.009	27.3%	-0.008	15.1%
Civil status	0.000	0.8%	0.002	-4.7%
Metropolitan county	0.000	1.4%	-0.001	2.6%
Residual	0.012	-35.5%	0.002	-3.5%
Total	-0.033	100.0%	-0.050	100.0%

Source: Authors' calculations based on Swedish register data. *Note*: In all the calculations, inflation was adjusted to SEK in the year 2018.

To test the robustness of the Gini decomposition results, we conducted additional analyses using two R^2-based approaches: partial R^2 and decomposing R^2 (see results in Figures A8 and A9 and details of the methods in the Appendix). The two approaches can help explain how important each predicting variable is for the variance in the lifetime pension. The general patterns seen in the Gini decomposition remain. For example, lifespan explains more than 60% of the variance that cannot be explained by other covariates for both men and women. Earnings explains around 40% of the variance when controlling for other predictors.

Impacts of Changes in Policy and Mortality on Lifetime Pension Inequality

Figure 7 presents how pension policies and changes in cohort lifespans may impact the inequality of lifetime pensions. The impacts of different scenarios are consistent across cohorts.

For illustration purposes, we will discuss the results for the 1928 cohort (see details also in Table A8). The observed Gini was 0.39 for men and 0.35 for women. We first examined a policy that raised the guarantee pension by 118% (an increase from 61,300 to 133,400 SEK in 2018 inflation-adjusted terms) so that the total yearly pension payments to the entire cohort were increased by 10%. Such a policy reduced the Gini for both sexes but much more for women. The Gini for women would drop by 19.7%, but by only 3.6% for men, which is not surprising due to significant sex differences in pension incomes. Adding a progressive tax scheme (see Figure A2 in the Appendix for details on how this was calculated) where the total yearly pension payments were reduced by 10% would reduce inequality, but only modestly.

Postponing retirement ages uniformly for the whole population would increase the inequality in lifetime pensions: A one-year increase in retirement age would increase the Gini by 3.2% and 2.6% for men and women, respectively, whereas a four-year increase would increase the Gini by 11.5% and 9.0% for men and women, respectively. Changes to the retirement age and lifespan both affect the numbers of years individuals receive pensions, and thus they have a relatively strong impact on the Gini of lifetime pensions. Thus, lengthening this period with pension payments for everyone (through earlier retirement or longer lifespans) reduced inequality as it decreased the variance in the years of receiving pensions.

As a relative inequality measure, the Gini for lifetime pensions would remain constant if individuals at different lifetime pension distribution experienced the same proportional changes. In the case of universal increases in retirement ages, it increases the relative share of people with very short post-retirement lifespans, which tends to lead to more inequalities in lifespans and lifetime pensions. In addition, individuals who tend to die earlier tend to have a smaller lifetime pension, and they are more affected by such policies and lose a higher proportion of their lifetime pension. Hence, lifetime pension inequality increases with universal increases in retirement ages. We show in Figures A10–A11 in the Appendix how different scenarios would lead to proportional changes across people with different levels of observed lifetime pensions, which can help explain the direction of the changes in the Gini under different scenarios.

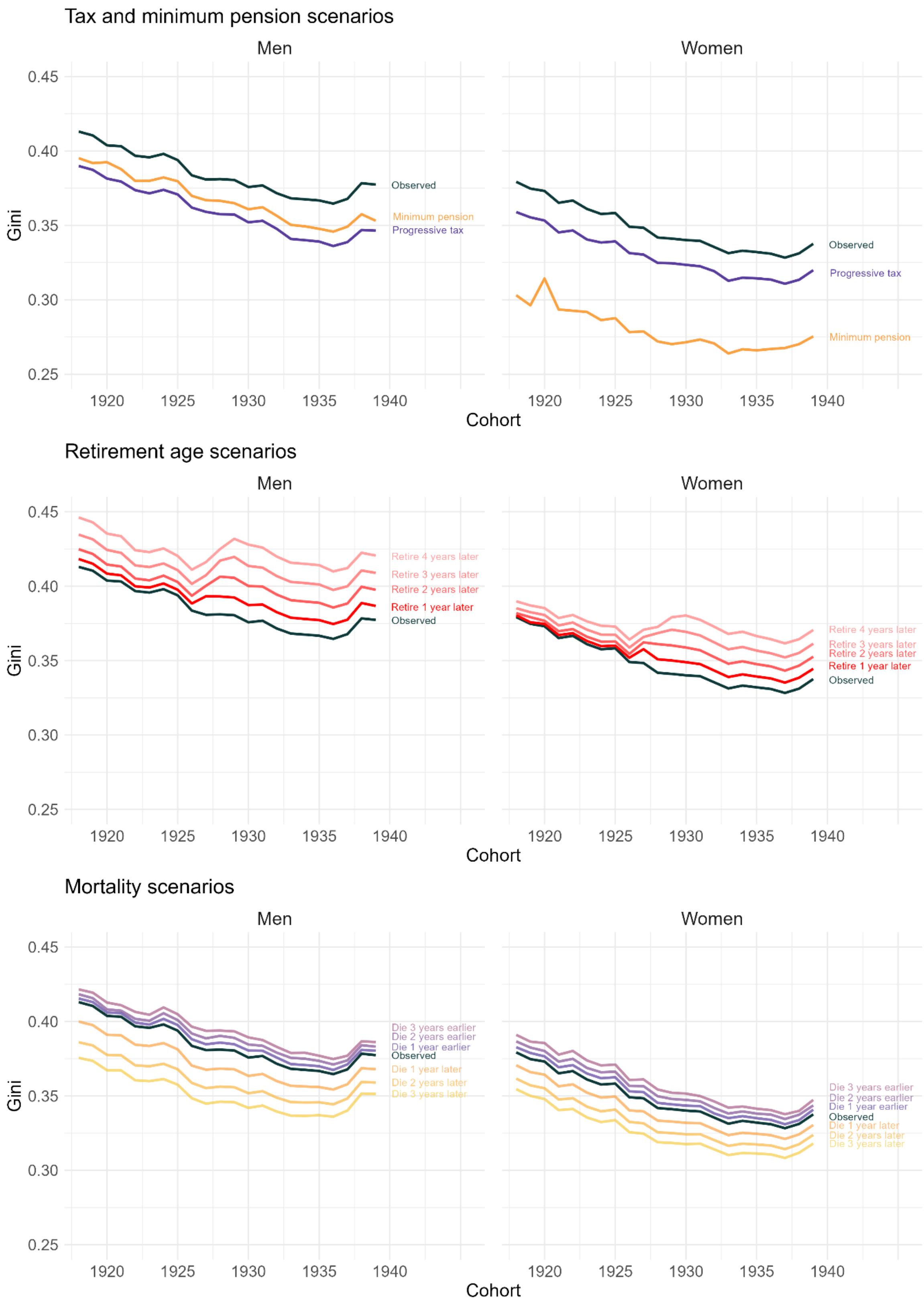

Figure 7. Decomposition of the lifetime pension Gini into contributing factors. *Source*: Authors' calculations based on Swedish register data.

Discussion

Inequality in old age has many dimensions. In the current study, we examined inequality in the total pension income over the life course and showed the relative importance of factors such as mortality and pre-retirement earnings for determining lifetime pension inequality. We highlight three important findings. First, lifetime pension payments are more unequally distributed than both pre-retirement earnings and yearly pension income. Second, lifetime pension inequality is mostly attributable to lifespan inequality, and to a lesser extent to inequality in pre-retirement earnings. The effects of other socio-demographic factors, such as education, occupation, and civil marital status, are negligible once lifespan and earnings are controlled for. Third, we found a declining trend in lifetime pension inequality across cohorts. For men, this is predominantly attributable to cohort declines in lifespan inequality. For women, the role of declining pre-retirement earnings inequality—largely driven by rising female labor force participation—is on par with declining lifespan inequality in explaining the downward trend of lifetime pension inequality. We also explored how different changes in pension systems, as well as different mortality and retirement scenarios, would affect lifetime pension inequality.

Our findings are relevant for ongoing debates on pension design in contemporary aging populations. Reducing old-age poverty and redistributing incomes from the rich to the poor is a goal for pension designers in many welfare states. Ensuring progressive replacement rates is a common strategy to achieve such redistributive goals. On a yearly basis, we did find less inequality in pension incomes than in pre-retirement earnings, thus supporting the redistribution hypothesis of the age pattern of income inequality (O'Rand and Henretta 1999). It is not surprising that the lifetime pension is more unequally distributed than the yearly pension, since longer lifespans tend to be concentrated among people with higher yearly pension incomes. Of even greater importance is that the lifetime pension is a product of inequalities in both lifespans and yearly pension levels, and thus shows very great variation across individuals. Our contrafactual analyses show that even rather large changes to the progressivity in how pensions are paid are relatively less important for total pensions when compared to changes in the timing of retirement or mortality changes that affect the number of years an individual receives a pension. This is in line with the overall importance of years lived for understanding lifetime pensions across all our results.

The regressive role of mortality has been confirmed by prior research on lifetime pension inequality between socioeconomic groups (e.g., NASEM 2015; Shi and Kolk 2022;

Tan and Koedel 2019). A recent study found that among those who were born in 1925, Swedish men with primary education accumulated on average three million SEK (around 375,000 USD) less than their counterparts with tertiary education, and mortality explained one quarter of the total differences (Shi and Kolk, 2022). Here we show that a large proportion of population-level inequality is overlooked by such group-based comparisons. The explanatory power of mortality in overall lifetime pension inequality is much bigger than in between-group differences in lifetime pensions. Hence, we highlight the importance of inequality in mortality (where most of the variance is within and not between social groups) as one of the most fundamental aspects of inequality in old age. More importantly, this is not only a concern for research on variations in lifespan; it also profoundly impacts the ways pension systems work. Lifespan variation is a very fundamental factor determining the size of total pension payments to individuals. We argue that such a population-level perspective is useful for future work on mortality inequality and pension fairness, as well as helping researchers and policy makers understanding how pension systems work and redistribute money.

Pension systems have several goals. Many of them counteract each other. In particular, in this study, we highlight one dimension of pension systems: the insurance function. This ensures an adequate yearly stream of income regardless of how long individuals live (i.e., resources are redistributed from the short-lived to the long-lived), and it has a crucial impact on inequality in the total pension income. As this is one of the explicit goals of pension systems, it is both “a feature and a bug” of pension systems. Nevertheless, it deserves to be highlighted and quantified, as it is of critical importance, and it is important to understand the social role of pensions. We argue that it is impossible to think about fairness and inequality in old age without taking account of both demographic and socioeconomic differences, as well as how they interplay. Our decomposition analyses also showed that most of the regressive effect of mortality takes place at the individual level rather than at the group level (e.g., education, sex), which has been the topic of most research on unequal distributional aspects of pension systems. Thus, the individual “mortality lottery” is the most important determinant of how much of a cumulative pension men and women in Sweden actually receive.

The pension amount a person receives is likely a reasonable approximation of their consumption needs over their lifespan. Our calculations of total pensions are useful as a benchmark for how large an amount of resources (through savings, inherited wealth, within-family transfers, or capital stocks, such as housing) an individual need to save to cover their consumption needs in retirement in the absence of a pension system. We show that there is marked variation and inequality across individuals regarding this amount, and consequently, relying on fixed savings that are not annuitized (e.g., housing, savings, or retirement money paid in a lump sum at retirement) is highly risky as an individual strategy. Thus, our approach illustrates the social utility of pension systems as a form of longevity insurance. It also shows just how substantive a role a modern high-income country's pension system has in transferring resources from the short-lived to the long-lived (and the important inequalities that may arise from such transfers).

This study also provides new perspectives on the social stratification literature. First, our study can help elucidate research on wealth inequality. Comparative studies have shown that the magnitude of wealth inequality varies considerably across countries, with Sweden (with its Gini over 0.85) being one of the most unequal (Pfeffer and Waitkus 2021). Such cross-country variation can be partly explained by differences in welfare systems. In a country like Sweden with a generous (and non-optional) welfare and pension system, those with average and lower socioeconomic statuses have less incentive to accumulate wealth over the courses of their lives, as the welfare system protects them against contingencies such as old age and disability (Domeiji and Klein 2002). Rankings of countries in studies on wealth inequality typically do not include the present value of pensions, which may result in differences in how countries are ranked (Pfeffer and Waitkus 2021). Different measures (i.e., wealth as operationalized in previous studies, total wealth with the inclusion of net pension wealth, net pension wealth, lifetime-accumulated pensions) are conceptually different. In future work, it would be interesting to explore how inequality levels vary across different outcomes and interplay with total pensions.

Second, our study highlights an important subpopulation, the retirees, who deserve more attention from social stratification scholars. Because of population aging, pension systems and inequality at post-retirement ages are an increasingly important component of the social stratification system. In Sweden, yearly pension income is largely predictable based on the prior- earnings trajectory. The higher the previous earnings, the higher the pension income. This implies a life-course pattern of status maintenance or cumulative advantage/disadvantage. Systematic mortality differentials according to socio-demographic characteristics make it necessary to incorporate mortality into the analysis of pension inequality. Examining lifetime pension inequality therefore provides a broader perspective on old-age inequality. Moreover, lifetime pension inequality may be translated into inequalities in end-of-life assets and bequests whereby economic inequality is reproduced across generations. Intergenerational social immobility may therefore be partly explained by lifetime pension inequality in which mortality differentials play a crucial role. This intergenerational aspect could be more thoroughly examined in future work.

Another important perspective, highlighted by the major importance the variance in time of death across individuals plays in terms of lifetime pensions, is that the process of changing lifespan distribution alone reduces lifetime pension inequality. Previous research using period data has shown an increasing trend of lifespan inequality among older people in developed countries (Engelman et al. 2010; Permanyer and Scholl 2019), in contrast to overall lifespan at birth, where the variance is decreasing and the shapes of survivorship curves are becoming more “rectangularized” (Myers and Manton 1984). Using cohort data, Engelman et al. (2010) showed that in Sweden, the variation in remaining years of life at ages 50 and 75, measured using standard deviation, plateaued for women and slightly increased for men between 1900 and 1916. To the best of our knowledge, no study has shown cohort trends of lifespan variation at older ages measured by the Gini coefficient. In contrast to previous findings, by using a combination of observed and forecasted mortality rates based on the official mortality forecasts for Sweden, we have shown that lifespan variation at age 65 declined across Swedish men and women born between 1918 and 1939. This decline reflects a process that demographers call as the rectanguarization of the survival curve, or mortality compression.

In our results, the declining lifespan variation among retirees contributed significantly to the decline in lifetime pension inequality. Future work may examine whether cohort trends in lifespan inequality at older ages in other countries are consistent with our findings. If so, lifetime pension inequality in those countries may also decline accordingly. If lifespan variation has indeed widened in other countries, it may lead to negative consequences for inequality at old ages, as the population-level variation in age at death is such an important determinant of total pensions. Consequently, the trends in lifetime pension inequality in other countries would probably be the opposite of what was observed in our study. In other words, we may see greatly exacerbated rather than reduced lifetime pension inequality in other countries over time. This is an important topic for future research. In light of the importance of lifespan inequality, we want to stress that it is noteworthy that the lifetime pension inequality in all contexts is persistently larger than other types of inequality (except wealth). It seems likely that mortality trends thus will impact pension inequality in very substantial but also non-obvious ways, which may override the importance of other changes in pension design and income inequality. The important role lifespan inequality plays in affecting differences across both cohorts and social groups in terms of inequalities in how much total pension is paid is likely not known among governments and policy makers when they design pension policies, and this may give rise to unintended consequences.

In the context of rising life expectancy, like many other OECD countries, Sweden introduced a notional defined contribution (NDC) system in the 1990s to ensure intergenerational fairness and pension sustainability (Palme 2005). It is not known how this will impact redistribution and lifetime pension inequality. The cohorts in our study were largely exposed to earlier, relatively uniform defined-benefits pension systems. Hence, our study could not assess the impacts of different pension systems. Future work may extend our research to incorporate more recent cohorts (i.e., cohorts born after the mid-1950s) who have been affected by the new systems. Our study used a joint variable with all kinds of pension payments, which was both a strength and a weakness. It is plausible that different components of pension systems play different roles in generating inequalities in total pensions. Another weakness is that our results for the latest cohorts were partially based on forecasted rather than observed rates and pensions. For mortality, this means our results are only as reliable as our forecasts, and we may have also somewhat underestimated mortality differences across individuals, whereas in contrast, we likely modeled the forecasted pension quite well. Future research should examine how different aspects of a pension system, such as the guarantee pension, second-tier income replacements, personal pension savings, and collective agreement pensions, differently shape the interactions between working-age earnings, lifespan, and lifetime pension, and how this varies across contexts and pension systems.

Acknowledgments

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Online Appendix

Appendix 1.

A1.1 Forecasting the ages at death of individuals survived to 2019

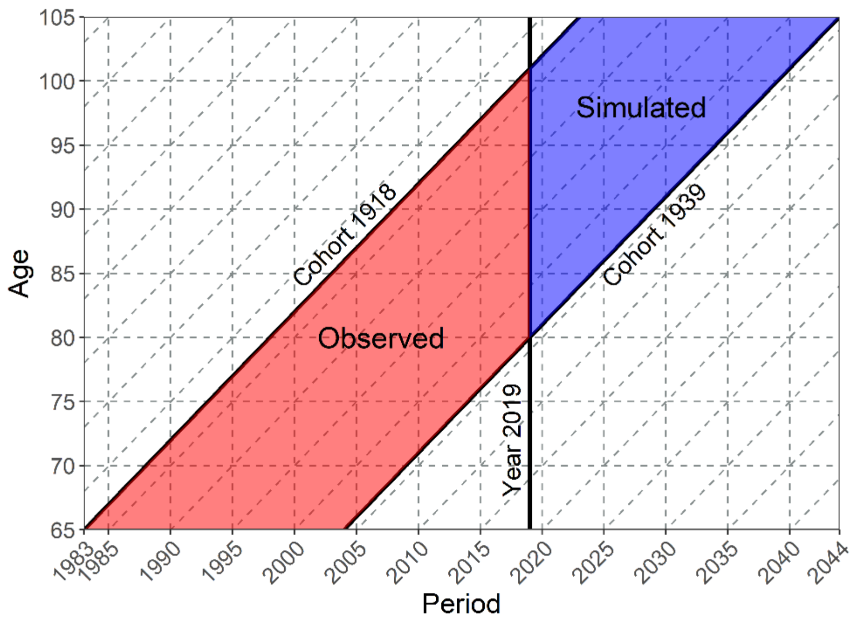

Figure A1. Lexis diagram for the data structure. *Source*: Authors' own.

We assume a Gompertz relationship for mortality rates at ages 65, 66, 67, …, 104,105+. That is: $log\left(m(a)\right) = \alpha + \beta a$. We allowed both the intercept (α) and the slope (β) to vary across earnings and cohorts. Specifically, our imputation consisted of four steps summarized as follows:

Step 1. We fitted the linear models with the logarithm of mortality rates as the outcome variable, age (continuous), earnings quintile (ordinal, five levels), birth year (continuous), the interaction of age and earnings quintile, and the interaction of age and birth year as predictors. The models were estimated using the observed data and the ordinary least square method, separately for men and women.

Step 2. We predicted mortality rates for years of 2019 and onwards using the estimated coefficients from *Step 1*.

Step 3. We adjusted the estimated mortality rates from *Step 2* using mortality forecasts provided by Statistics Sweden (2020). This involved a proportional transformation for age-earnings-quintile-specific mortality rates so that the total mortality matched the official forecasts and the sizes of age-earnings quintiles were kept the same as empirically observed.

Step 4. We generated random numbers to simulate age at death for individuals who survived to 2019 using the adjusted mortality rates from Step 3.

Figure A1 illustrates the structure of the dataset used for subsequent analysis. The main results were highly robust when this procedure was repeated, or when education instead of earnings quintile was used as one of the predictors in *Step 1*.

A1.2 The Partial R^2

The regression-based partial R^2 approach has also been used in the income and earnings inequality literature to disentangle the effects of different covariates on the variance of the outcome variable (e.g., Kim and Sakamoto 2008; Meng et al. 2013; Xie and Zhou 2014). The income variable is first regressed on a set of predictors. Then, a variable of interest is excluded from the regression model and the reduced model is re-estimated. The partial R^2 is calculated as:

$$Partial\ R^2 = \frac{R^2 - R^2_{-K}}{1 - R^2_{-K}}$$

where R^2 is the variance explained by all covariates in the full model and R^2_{-K} is variance explained by all covariates in the model where variable K is removed. This way, the partial R^2 can be interpreted as the proportion of the remaining variance that cannot be explained by other covariates but can be explained by variable K.

While this approach can show the relative importance of different variables in determining the total variance of the outcome variable, it has several limitations. First, it only shows the relative role of the determinants without accounting for the absolute level of inequality. Policy interventions are more concerned about the actual magnitude of inequality that is caused by certain sources. Second, partial R^2 may drift in either direction on some occasions when the covariate actually leads to an increase in the total inequality (see discussions in Zhou 2014). Third, variance as a measure of distributional dispersion is much less used in the income inequality literature, making results difficult to be compared across studies.

Appendix 2. Figures

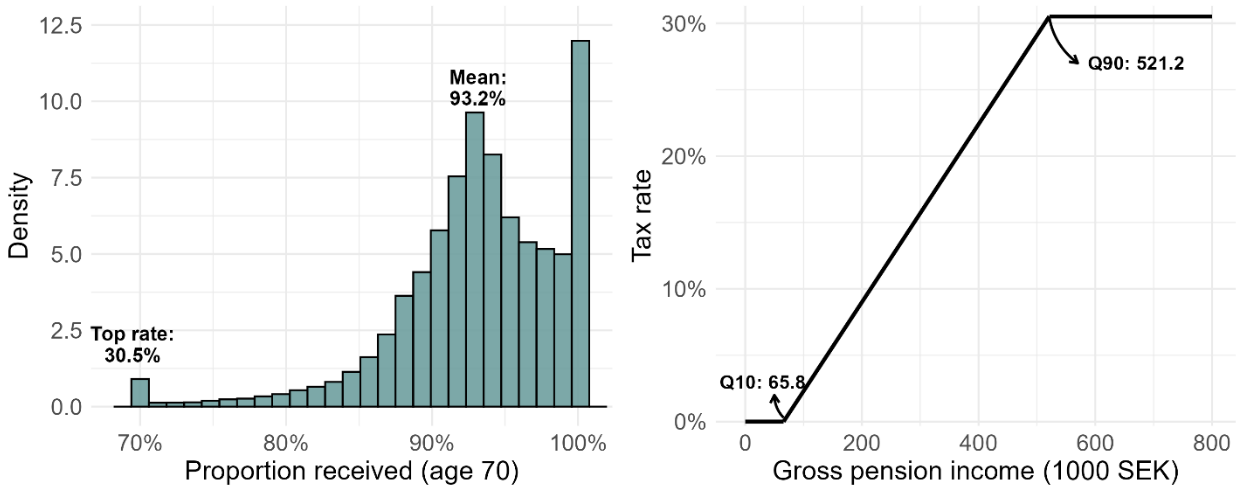

Figure A2. Figure describing progressive taxation scenario used for hypothetical pension calculations, 1928 cohort. Left: proportion of income received after tax. Right: tax rate by gross annual pension income. *Source*: Authors' calculations based on Swedish register data.

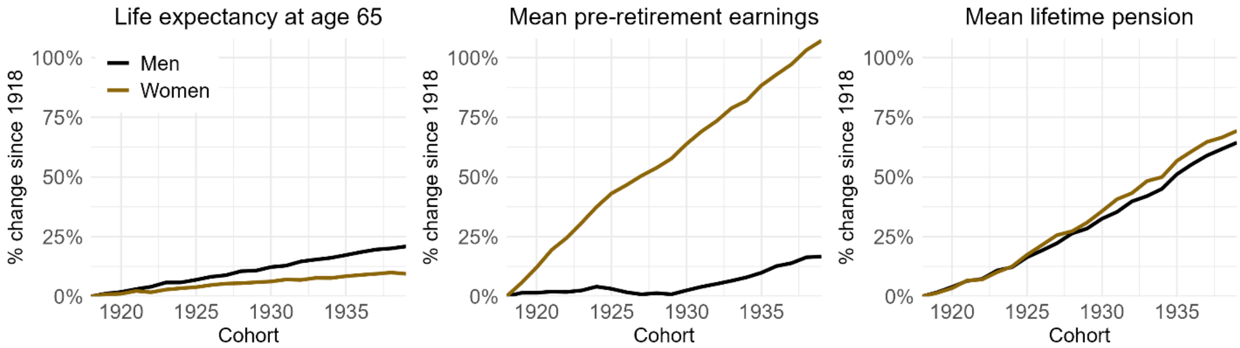

Figure A3. Proportional change in the mean of three main variables as compared to 1918 by sex. Left: Life expectancy. Middle: Pre-retirement earnings (over ages 50–59). Right: Lifetime pension. *Source*: Authors' calculations based on Swedish register data.

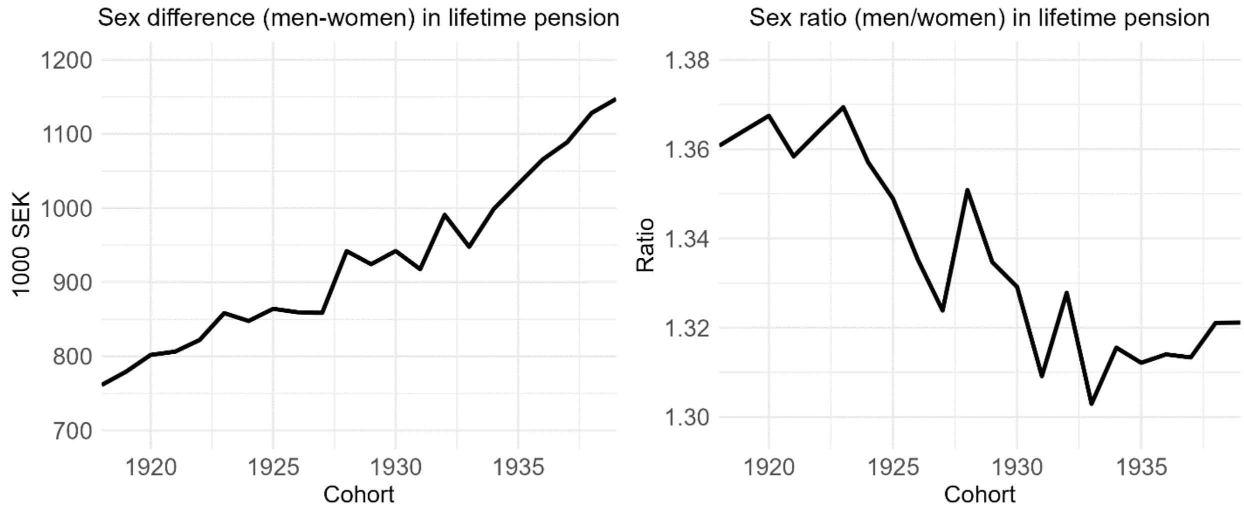

Figure A4. Cohort trends of sex differences in lifetime pension. Left: Sex difference (men – women). Right: Sex ratio (men/women). *Source*: Authors' calculations based on Swedish register data.

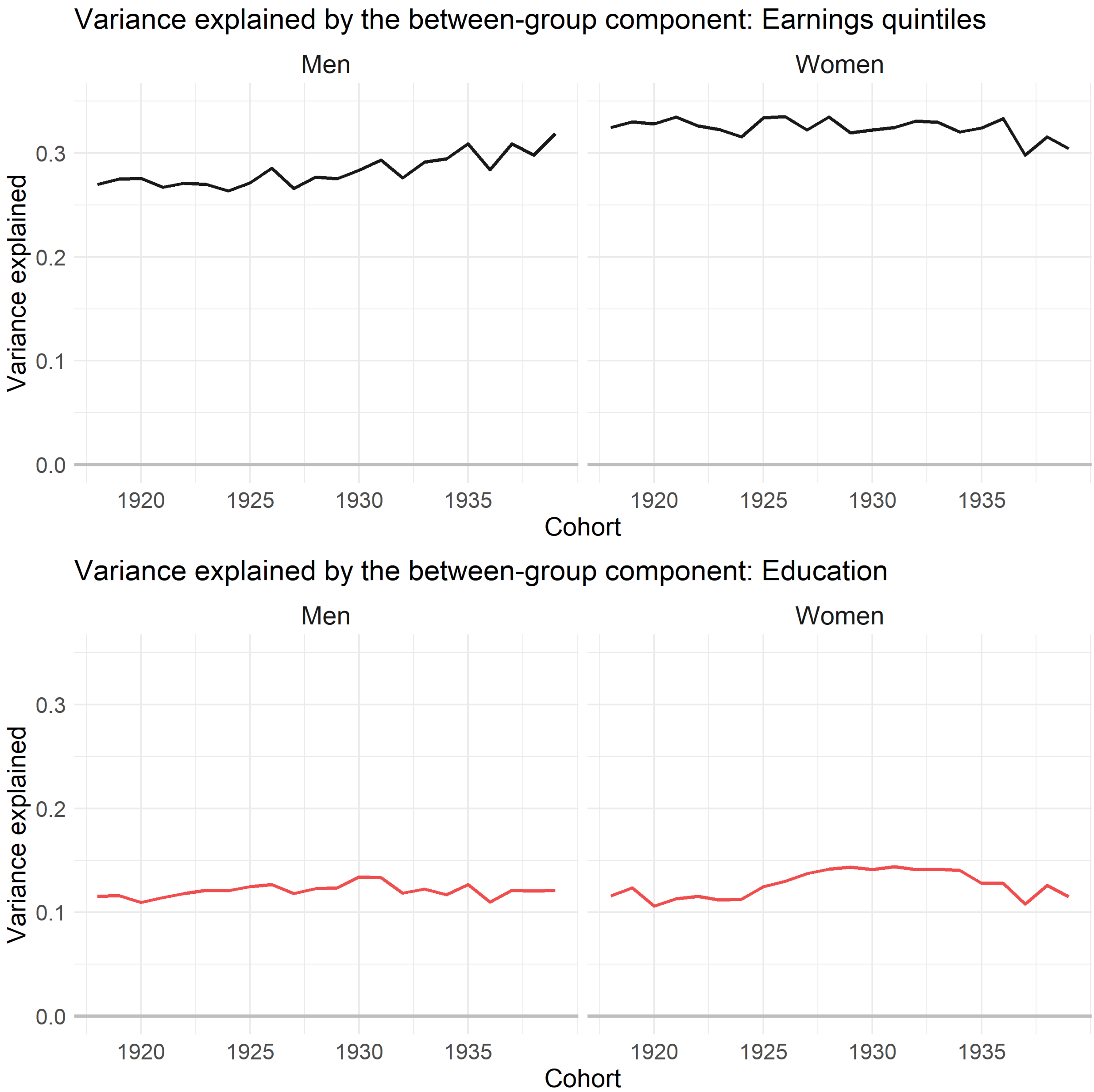

Figure A5. Total variance in lifetime pension explained by earnings quintiles (upper panels) and education (lower panels). *Source*: Authors' calculations based on Swedish register data. *Notes*: In the variance decomposition in the upper panels, we divide individuals into five equally-sized quintile groups based on average earnings between ages 50 and 59, separately by gender. In the analysis in the lower panels, we drop individuals with unknown educational levels, and have three levels of education in the decomposition: primary, secondary, and tertiary education.

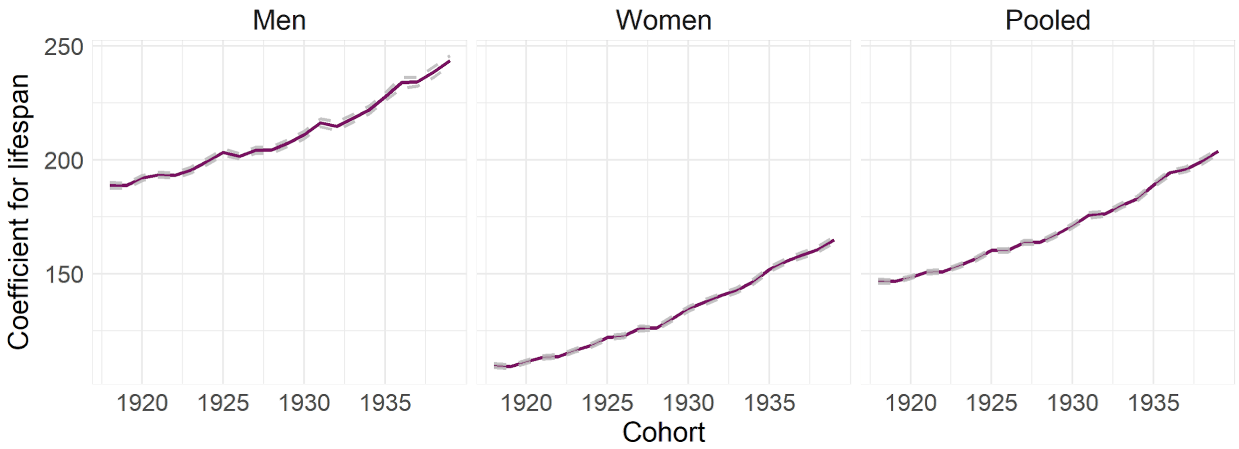

Figure A6. Coefficients for lifespan in the full models predicting lifetime pension. Left: Men. Middle: Women. Right: Pooled (men and women). *Source*: Authors' calculations based on Swedish register data. *Notes:* The coefficients are for lifespan for cohort-specific full models. Grey dashed lines denote 95% confidence intervals. Other predicting variables include earnings, education, civil status, occupation (EGP), and metropolitan county.

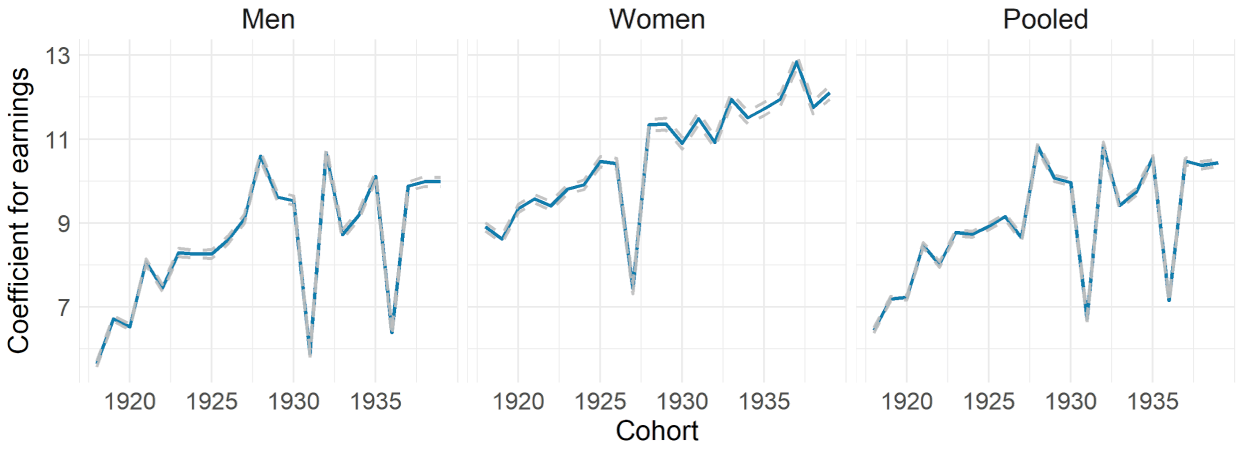

Figure A7. Coefficients for earnings in the full models predicting lifetime pension. Left: Men. Middle: Women. Right: Pooled (men and women). *Source*: Authors' calculations based on Swedish register data. *Notes:* The coefficients are for lifespan for cohort-specific full models. Grey dashed lines denote 95% confidence intervals. Other predicting variables include lifespan, education, civil status, occupation (EGP), and metropolitan county.

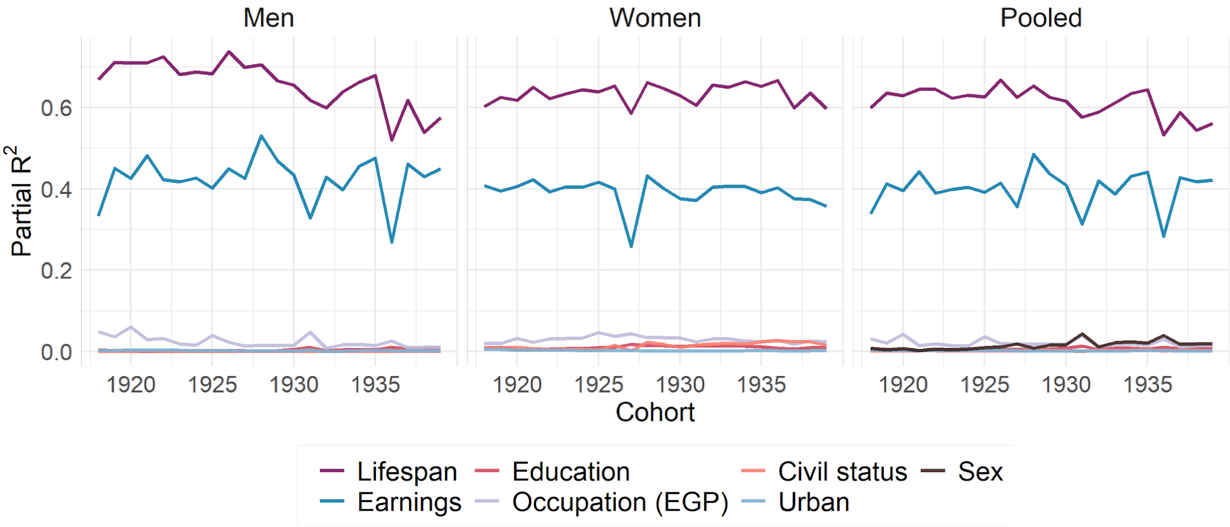

Figure A8. Partial R^2 for lifespan, earnings, education, occupation (EGP), civil status, and metropolitan county. *Source*: Authors' calculations based on Swedish register data.

Figure A9. Relative importance of predicting variables and residuals. *Source*: Authors' calculations based on Swedish register data. *Notes:* The sum of the non-grey parts is equivalent to the R^2 of the regression models. The decomposition of R^2 uses the method proposed by Lindemann, Merenda, and Gold (1980): R^2 partitioned by averaging over orders.

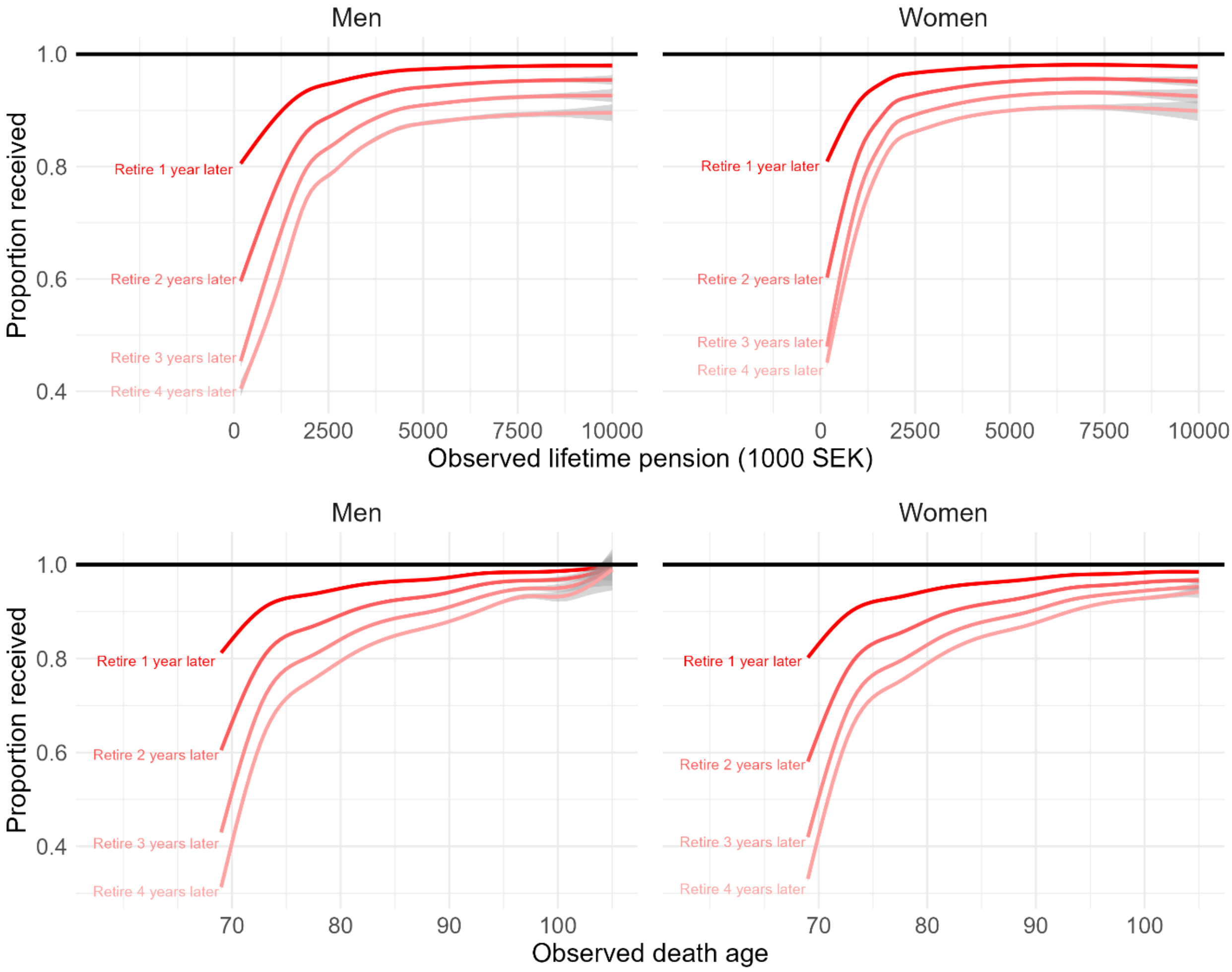

Figure A10. Proportion received across observed lifetime pension (upper panels) and observed death age (lower panels) in the scenarios of increasing retirement ages. *Source*: Authors' calculations based on Swedish register data.

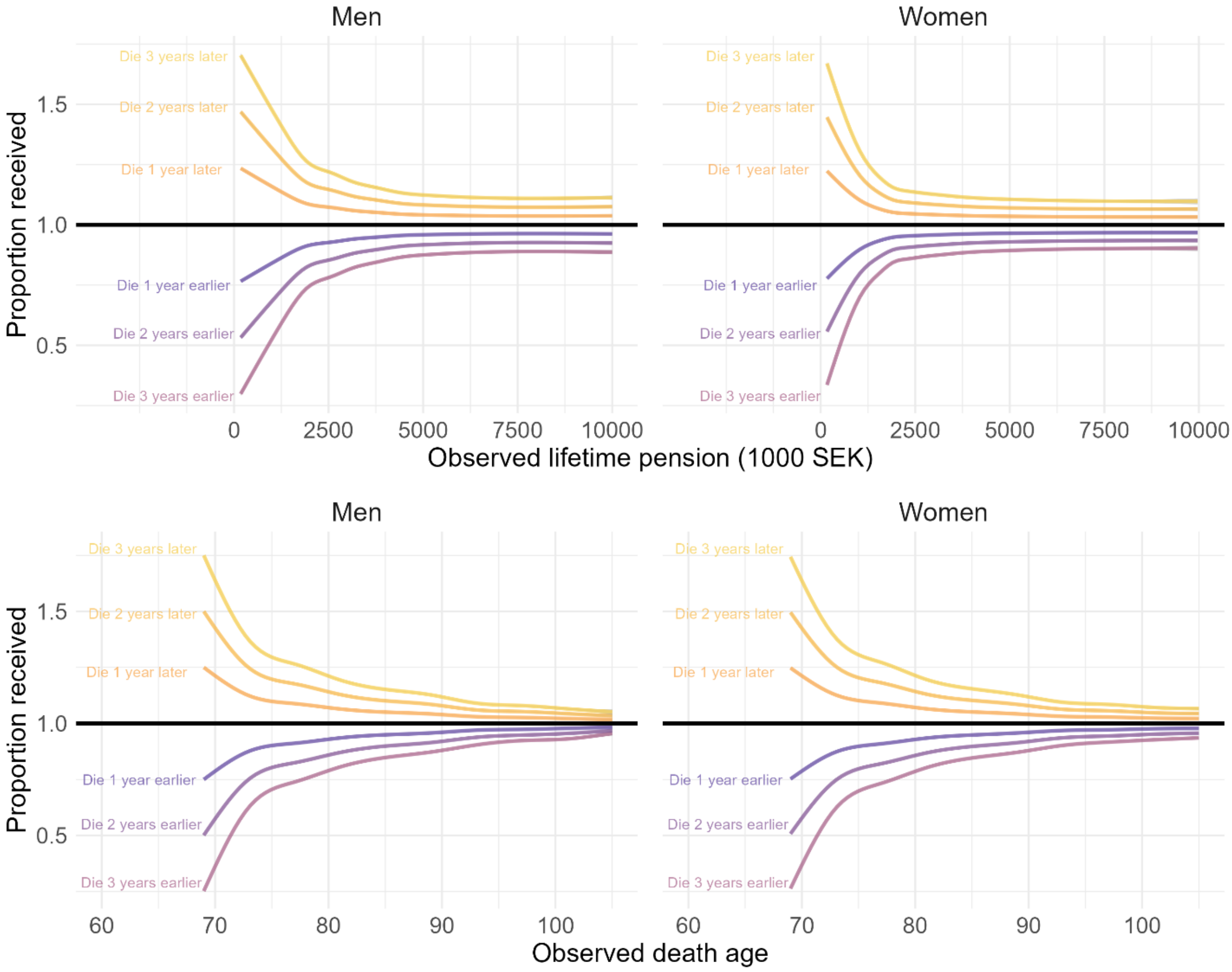

Figure A11. Proportion received across observed lifetime pension (upper panels) and observed death age (lower panels) in the scenarios of changing lifespans. *Source*: Authors' calculations based on Swedish register data.

Appendix 3. Tables

Table A1. Observed yearly pension trajectory from age 80, 1925 cohort

	Mean pension at age 80 (1000 SEK)		Average % change in pension income					
			1 year later		5 years later		10 years later	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Men								
Bottom 20%	125.49	25.13	-0.84	10.67	0.60	6.58	1.52	6.28
Second 20%	170.52	6.99	0.40	1.74	0.49	5.12	0.35	5.93
Third 20%	195.05	7.55	0.33	1.75	0.28	3.99	0.10	5.50
Fourth 20%	228.69	12.31	0.06	2.26	-0.24	5.00	-0.46	6.74
Top 20%	338.06	145.77	-0.57	4.50	-1.25	7.65	-1.56	9.46
Total	211.67	97.87	-0.12	5.40	-0.06	5.88	-0.15	7.18
Women								
Bottom 20%	73.35	10.63	-0.56	68.85	-0.90	12.20	0.72	20.90
Second 20%	93.80	4.18	-0.55	6.68	-1.97	27.09	-1.99	33.98
Third 20%	112.12	6.98	-0.06	8.95	-0.26	16.92	0.04	14.86
Fourth 20%	142.55	10.83	0.06	4.64	0.13	11.20	0.99	16.93
Top 20%	209.30	61.53	-0.31	4.26	-0.73	19.35	-0.46	11.20
Total	126.55	55.11	-0.28	30.11	-0.76	18.56	-0.20	21.23

Source: Authors' calculations based on Swedish register data. *Notes:* Since we only imputed pension data for ages 80 and above, here we only show the trajectories from age 80 for cohorts where we have observed data. In our data, individual yearly pension was stable from around age 70. Individuals were grouped into 20% groups based on their pension income at age 80. Changes relative to pension income at age 80 at 1, 5, 10 years later correspond to pension income at ages 81, 85, and 90. For men the changes are very minor. Changes are larger for women as many benefited from changes making the guarantee pension more generous, as well as occasionally the deaths of their husbands.

Table A2. Descriptive Statistics

Variable	Mean	SD	Min	Max
Women	0.51	0.50	0	1
Cohort				
Cohort 1918~1924	0.36	0.48	0	1
Cohort 1925~1929	0.22	0.42	0	1
Cohort 1930~1934	0.20	0.40	0	1
Cohort 1935~1939	0.22	0.41	0	1
Lifetime pension (1000 SEK)	3190.85	2483.34	3.00	230126.77
Lifespan at age 65 (year)	19.48	8.86	0.00	41
Pre-retirement earnings (1000 SEK)	208.98	147.29	3.00	21498.63
Yearly pension age age 70 (1000 SEK)	172.51	102.98	3.00	7842.53
Occupation (EGP)				
I (higher grade professionals)	0.07	0.26	0	1
II (lower grade professionals)	0.13	0.33	0	1
IIIa (higher grade non-manual employees)	0.08	0.27	0	1
IIIb (lower grade non-manual employees)	0.07	0.25	0	1
IVa+b (Small proprietors, artisans, etc.)	0.06	0.23	0	1
IVc (farmers and self-employed workers)	0.04	0.20	0	1
V+VI (skilled workers)	0.11	0.31	0	1
VIIa+b (non-skilled workers)	0.27	0.45	0	1
NA (including those not employed)	0.18	0.38	0	1
Education				
Primary school	0.65	0.48	0	1
Secondary school	0.25	0.43	0	1
Any college and above	0.08	0.28	0	1
Education missing	0.03	0.16	0	1
Years of education	8.88	2.56	7	19
Civil status				
Married	0.77	0.42	0	1
Divorced/separated	0.10	0.30	0	1
Widowed	0.03	0.17	0	1
Never married	0.10	0.29	0	1
Metropolitan county	0.34	0.47	0	1
N		1694133		

Source: Authors' calculations based on Swedish register data. *Notes:* We used an eight-category version of the EGP scheme. I: higher grade professionals, administrators, and officials; managers in large industrial establishments, and large proprietors. II: lower grade professionals, administrators, and officials; higher grade technicians; managers in small industrial establishments; supervisors of non-manual employees. IIIa: higher grade routine non-manual employees (administration and commerce). IIIb: lower grade routine non-manual employees (sales and services). IVa+b: small proprietors, artisans, and so on, with and without employees. IVc: farmers and small holders; self-employed workers in primary production. V+VI: skilled workers. VIIa+b: non-skilled workers and agricultural laborers. 1694133

Table A3. Pearson correlations between key variables, cohort combined.

	Years of education	Pre-retirement earnings	Pension at age 70	Lifetime pension	Lifespan
Men					
Years of education	1.00				
Pre-retirement earnings	0.44	1.00			
Pension at age 70	0.45	0.79	1.00		
Lifetime pension	0.36	0.60	0.77	1.00	
Lifespan	0.11	0.13	0.14	0.70	1.00
Women					
Years of education	1.00				
Pre-retirement earnings	0.42	1.00			
Pension at age 70	0.44	0.80	1.00		
Lifetime pension	0.39	0.63	0.75	1.00	
Lifespan	0.09	0.08	0.08	0.65	1.00

Source: Authors' calculations based on Swedish register data.

Table A4. Pearson correlations between key variables for men, by cohort groups.

	Years of education	Pre-retirement earnings	Pension at age 70	Lifetime pension	Lifespan
Men born in 1918~1924					
Years of education	1.00				
Pre-retirement earnings	0.48	1.00			
Pension at age 70	0.46	0.82	1.00		
Lifetime pension	0.35	0.60	0.74	1.00	
Lifespan	0.09	0.12	0.13	0.73	1.00
Men born in 1925~1929					
Years of education	1.00				
Pre-retirement earnings	0.48	1.00			
Pension at age 70	0.45	0.84	1.00		
Lifetime pension	0.36	0.62	0.75	1.00	
Lifespan	0.10	0.12	0.11	0.72	1.00
Men born in 1930~1934					
Years of education	1.00				
Pre-retirement earnings	0.41	1.00			
Pension at age 70	0.43	0.77	1.00		
Lifetime pension	0.36	0.60	0.77	1.00	
Lifespan	0.11	0.12	0.12	0.70	1.00
Men born in 1935~1939					
Years of education	1.00				
Pre-retirement earnings	0.38	1.00			
Pension at age 70	0.42	0.78	1.00		
Lifetime pension	0.35	0.62	0.78	1.00	
Lifespan	0.10	0.12	0.12	0.66	1.00

Source: Authors' calculations based on Swedish register data.

Table A5. Pearson correlations between key variables for women, by cohort groups.

	Years of education	Pre-retirement earnings	Pension at age 70	Lifetime pension	Lifespan
Women born in 1918~1924					
Years of education	1.00				
Pre-retirement earnings	0.39	1.00			
Pension at age 70	0.39	0.80	1.00		
Lifetime pension	0.35	0.61	0.75	1.00	
Lifespan	0.08	0.06	0.06	0.65	1.00
Women born in 1925~1929					
Years of education	1.00				
Pre-retirement earnings	0.39	1.00			
Pension at age 70	0.41	0.78	1.00		
Lifetime pension	0.37	0.60	0.74	1.00	
Lifespan	0.08	0.05	0.05	0.66	1.00
Women born in 1930~1934					
Years of education	1.00				
Pre-retirement earnings	0.42	1.00			
Pension at age 70	0.42	0.77	1.00		
Lifetime pension	0.38	0.61	0.72	1.00	
Lifespan	0.08	0.07	0.07	0.67	1.00
Women born in 1935~1939					
Years of education	1.00				
Pre-retirement earnings	0.41	1.00			
Pension at age 70	0.43	0.79	1.00		
Lifetime pension	0.36	0.61	0.73	1.00	
Lifespan	0.08	0.09	0.07	0.66	1.00

Source: Authors' calculations based on Swedish register data.

Table A6. Gini and additional inequality measures for lifetime pension by cohort, men.

Cohort	N	Mean	Gini	P90/P10	P90/P50	P50/P10	S80/S20	S90/S40
1918	40338	2871.44	0.413	11.59	2.25	5.15	13.34	2.03
1919	40203	2919.79	0.410	11.18	2.22	5.04	13.14	2.00
1920	48365	2984.38	0.404	10.77	2.19	4.92	12.90	1.91
1921	45081	3056.47	0.403	10.85	2.17	5.00	12.86	1.90
1922	41183	3080.86	0.397	11.25	2.16	5.21	12.47	1.82
1923	40594	3181.84	0.396	11.65	2.13	5.48	12.40	1.82
1924	39336	3222.02	0.398	10.81	2.16	5.02	12.48	1.84
1925	38583	3340.86	0.394	9.99	2.11	4.72	12.14	1.80
1926	36883	3423.02	0.384	9.36	2.06	4.54	10.93	1.69
1927	35641	3510.06	0.381	9.29	2.03	4.58	10.77	1.67
1928	35880	3626.93	0.381	9.39	2.03	4.63	10.74	1.67
1929	34305	3685.83	0.381	9.06	2.01	4.51	10.63	1.67
1930	34662	3804.43	0.376	8.70	1.99	4.36	10.21	1.62
1931	34169	3885.81	0.377	8.91	2.02	4.42	10.39	1.63
1932	33803	4013.30	0.372	8.31	1.99	4.18	9.87	1.58
1933	32401	4076.43	0.368	8.19	1.98	4.14	9.74	1.54
1934	32434	4163.64	0.367	8.05	1.98	4.06	9.56	1.53
1935	33492	4339.94	0.367	8.09	2.00	4.05	9.50	1.53
1936	34569	4458.97	0.365	7.75	1.99	3.90	9.26	1.51
1937	35468	4563.65	0.368	7.74	2.00	3.86	9.33	1.54
1938	37010	4642.66	0.378	8.20	2.06	3.98	9.98	1.64
1939	38544	4719.75	0.377	8.08	2.07	3.90	9.86	1.64

Source: Authors' calculations based on Swedish register data. *Notes*: P90/P10 refers to the ratio between the 90th and the 10th percentiles. P90/P50 refers to the ratio between the 90th and the 50th percentiles. P50/P10 refers to the ratio between the 50th and the 10th percentiles. S80/S20 refers to the share ratio of lifetime pension between the top 20% and the bottom 20%. S90/S40 refers to the share ratio of lifetime pension between the top 90% and the bottom 40%.

Table A7. Gini and additional inequality measures for lifetime pension by cohort, women.

Cohort	N	Mean	Gini	P90/P10	P90/P50	P50/P10	S80/S20	S90/S40
1918	43065	2110.34	0.379	7.67	2.33	3.30	8.83	1.61
1919	42673	2140.39	0.375	7.49	2.28	3.29	8.79	1.57
1920	51742	2182.39	0.373	7.44	2.26	3.29	8.80	1.56
1921	48185	2250.07	0.365	7.11	2.20	3.23	8.42	1.49
1922	44362	2258.73	0.367	7.25	2.20	3.29	8.56	1.50
1923	43119	2323.59	0.361	6.99	2.15	3.25	8.36	1.46
1924	42162	2374.26	0.358	6.97	2.13	3.28	8.28	1.43
1925	41037	2476.71	0.358	7.08	2.13	3.32	8.31	1.43
1926	39300	2563.52	0.349	6.73	2.09	3.22	7.74	1.35
1927	38056	2651.37	0.348	6.58	2.10	3.14	7.58	1.35
1928	38409	2684.93	0.342	6.23	2.05	3.04	7.31	1.30
1929	36546	2761.51	0.341	6.20	2.03	3.05	7.27	1.30
1930	37123	2862.28	0.340	6.18	2.02	3.06	7.21	1.30
1931	36059	2968.17	0.340	6.02	2.01	2.99	7.16	1.29
1932	35805	3022.41	0.335	5.87	1.97	2.98	6.99	1.27
1933	33927	3128.59	0.331	5.79	1.96	2.96	6.80	1.24
1934	34223	3164.09	0.333	5.93	1.96	3.03	7.01	1.25
1935	34314	3307.48	0.332	5.92	1.94	3.06	6.98	1.24
1936	36090	3393.34	0.331	5.78	1.93	2.99	6.99	1.23
1937	36568	3474.79	0.328	5.69	1.87	3.04	6.90	1.22
1938	38523	3514.25	0.331	5.79	1.88	3.08	7.11	1.24
1939	39901	3572.41	0.338	6.23	1.88	3.31	7.61	1.29

Source: Authors' calculations based on Swedish register data. *Notes*: P90/P10 refers to the ratio between the 90^{th} and the 10^{th} percentiles. P90/P50 refers to the ratio between the 90^{th} and the 50^{th} percentiles. P50/P10 refers to the ratio between the 50^{th} and the 10^{th} percentiles. S80/S20 refers to the share ratio of lifetime pension between the top 20% and the bottom 20%. S90/S40 refers to the share ratio of lifetime pension between the top 90% and the bottom 40%.

Table A8. Gini in lifetime pension income in hypothetical scenarios, 1928 cohort.

	Men		Women	
	Gini	Change	Gini	Change
Observed	0.381	-	0.342	-
Raising minimum pension	0.366	-3.8%	0.272	-20.3%
Adding tax	0.374	-1.9%	0.324	-5.3%
Changing retirement ages				
1 year later	0.393	3.2%	0.351	2.6%
2 years later	0.406	6.6%	0.361	5.6%
3 years later	0.417	9.5%	0.368	7.8%
4 years later	0.425	11.5%	0.373	9.0%
Changing death ages				
3 years earlier	0.394	3.4%	0.354	3.6%
2 years earlier	0.390	2.4%	0.350	2.3%
1 year earlier	0.386	1.2%	0.345	1.0%
1 year later	0.368	-3.3%	0.333	-2.5%
2 years later	0.356	-6.5%	0.326	-4.8%
3 years later	0.346	-9.2%	0.319	-6.7%

Source: Authors' calculations based on Swedish register data. *Note*: In all the calculations, inflation is adjusted to SEK in the year 2018.

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