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# Trends In Life Expectancy And Lifespan Variation After Retirement

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# Trends in Life Expectancy and Lifespan After Retirement


## Abstract

It is well known that life expectancy has increased over time. As a result, individuals spend more time in retirement compromising the stability of national pension systems. Recent reforms to pension systems aim to alleviate this issue by increasing retirement ages so that life expectancy at retirement remains constant over time. However, life expectancy does not describe the complete demographic panorama after retirement. The variation of individual lifespans and its effects in pension systems have been largely overlooked in the definition of retirement ages.

In this study we analyze trends in life expectancy and lifespan variation after retirement by socioeconomic groups. We compare two demographic settings arising from a fixed retirement age against a moving retirement age linked to changes in life expectancy. We show that while life expectancy remains constant after the proposed retirement age, higher variation of lifespans persists affecting lower socioeconomic groups.


Keywords**:** longevity, socioeconomic disparities, lifespan variation

## Section 1: Background

Life expectancy at birth has increased over time (Oeppen and Vaupel, 2002). As a consequence, a great number of individuals make it to retirement ages but also individuals from more recent generations are spending more time in retirement than those from previous ones. This pattern has several implications to national economic outcomes (Sanderson and Scherbov, 2017). Many OECD countries have decided to link retirement ages to changes in life expectancy (OECD, 2017). In Denmark, for example, the statutory retirement age in 2017 was 65 years but it will gradually go up targeting a retirement age were remaining life expectancy is 14.5 years (OECD, 2015). With this indexation rule, it is expected that life expectancy remains constant after retirement.

A largely neglected aspect in pension planning is the variation in the ages at death (denoted to as lifespan variation). This dimension of longevity is related to the uncertainty about the length of life after retirement. Differences in lifespan variation between socioeconomic groups (SES) are translated into an overlooked dimension of social inequality in health and survival since groups experiencing less variability can plan more effectively their retirement, whereas other groups face greater uncertainty about their survival (van Raalte et al., 2018). In Denmark, (Brønnum-Hansen, 2017) found that lifespan variation has stagnated among people from the lowest income quartile whereas decreasing variation is observed among individuals that belong to the highest quartiles. Similar results have been found in Finland (van Raalte et al., 2014), Spain (Permanyer et al., 2018) and in the United States (Sasson, 2016). All four studies conclude that lower socioeconomic classes experience higher lifespan variation at all levels of life expectancy.

It is worth noting that these studies have measured lifespan variation either from the perspective of a newborn (Brønnum-Hansen, 2017) or from the viewpoint of young adults (i.e. conditioning upon survival to age 25 in Sasson (2016), to age 30 in van Raalte et al. (2014) and to age 35 in Permanyer et al. (2018)). However, individuals face different levels of uncertainty throughout their lives depending on the factors or events ahead that could potentially kill them and on how such factors are distributed across the remaining lifespan. For example, a newborn is exposed to certain diseases that a person in their adolescence is not. Likewise, mid-life years are strongly affected by external mortality such as road accidents, while cardiovascular diseases and neoplasms are the main causes of death among the elderly. The number of deaths attributed to these factors varies at each age and across countries. Currently in developed populations, infant mortality is at its lowest levels, whereas most of the deaths occur past age 80 (Human Mortality Database, 2017). Thus, the uncertainty about the survival of a newborn is different to the one experienced by a young adult or a person in their post-retirement ages. This results into different levels of lifespan variation depending on onset age of calculations.

By using data retrieved from the Danish registers, this study analyzes trends in life expectancy and lifespan variation after retirement by socioeconomic groups. We analyze the trends that arise from a fixed retirement age versus a moving age linked to changes in life expectancy. We determine differences in socioeconomic groups and address the possible implications of such socioeconomic disparities.

## Section 2: Material and Methods

Databases covering the entire Danish population for the time period 1985 to 2016 were used in this study. We subdivided the population into five socioeconomic status (SES) groups at each age and each point in time by using a newly developed affluence measure (Cairns et al., 2019) based on individuals' income and wealth. People in the lowest quantile pertain to the lowest socioeconomic group whereas those in the top quantile are the ones from the highest socioeconomic group. As in Cairns et al. (2019), we restrict the age dimension to individuals above the age of 50 with a lockdown at age 67, indicating that individuals are maintained in the same socioeconomic group during the post-retirement years.

Our analysis is based on two different retirement ages: a *fixed* retirement age at age 65 and the *target*($r$) retirement

age stipulated in the Danish pension reform Danish Ministry of Economic Affairs and Interior (2018). The target retirement age requires life expectancy after retirement to be constant at 14.5 years. Thus, *r* is the age that solves the equation *e*(*r*) = 14.5, where *e*(*r*) denotes remaining life expectancy at age *r*. Such age is calculated based on the mortality regime of the total Danish population. We also computed values for $r_{ses}^{sex}$, which denotes the hypothetical retirement age of each subpopulation based on their own mortality profile such that $sex = female, male$ and $ses = 1, 2, \ldots, 5$ denotes the socioeconomic status, where 1 is the lowest and 5 is the highest respectively.

We computed remaining life expectancy after ages 65 and *r* for each socioeconomic groups and by sex. At age *r*, life expectancy (Preston et al., 2000) is denoted as:

$$e(r) = \frac{\int_r^\infty l(x)dx}{l(r)},$$

where $x \geq r$ and $l(x)$ represents the probability of surviving to *x*.

The coefficient of variation of the distribution of lifespans, *CV* (*x*), is the preferred measure of lifespan variation. This measure does not depend on the level of mortality overtime (Wrycza et al., 2015). A property that is particularly important in our study because we compare the shape of the distribution of deaths after age *r*, which changes over time. An absolute measure of variation such as lifespan disparity (Brønnum-Hansen, 2017) or the standard deviation of the distribution of lifespans could lead to different results since they hinge on the onset age of calculation, which in this study varies according to age *r*. The *CV* (*x*) is simply calculated as the quotient of the standard deviation of the distribution of lifespans after age *x* and the remaining life expectancy at the same age:

$$CV(x) = \frac{\sigma(x)}{e(x)}$$

such that $\sigma(x)$ denotes the standard deviation on the death distribution calculated as:

$$\sigma(x) \equiv \sqrt{\frac{1}{l(x)}\int_x^\infty \big(y - e(y)\big)^2 d(y)dy}$$

where *d*(*x*) denotes the distribution of deaths. *CV* (*x*) is calculated by sex and for each socioeconomic group.

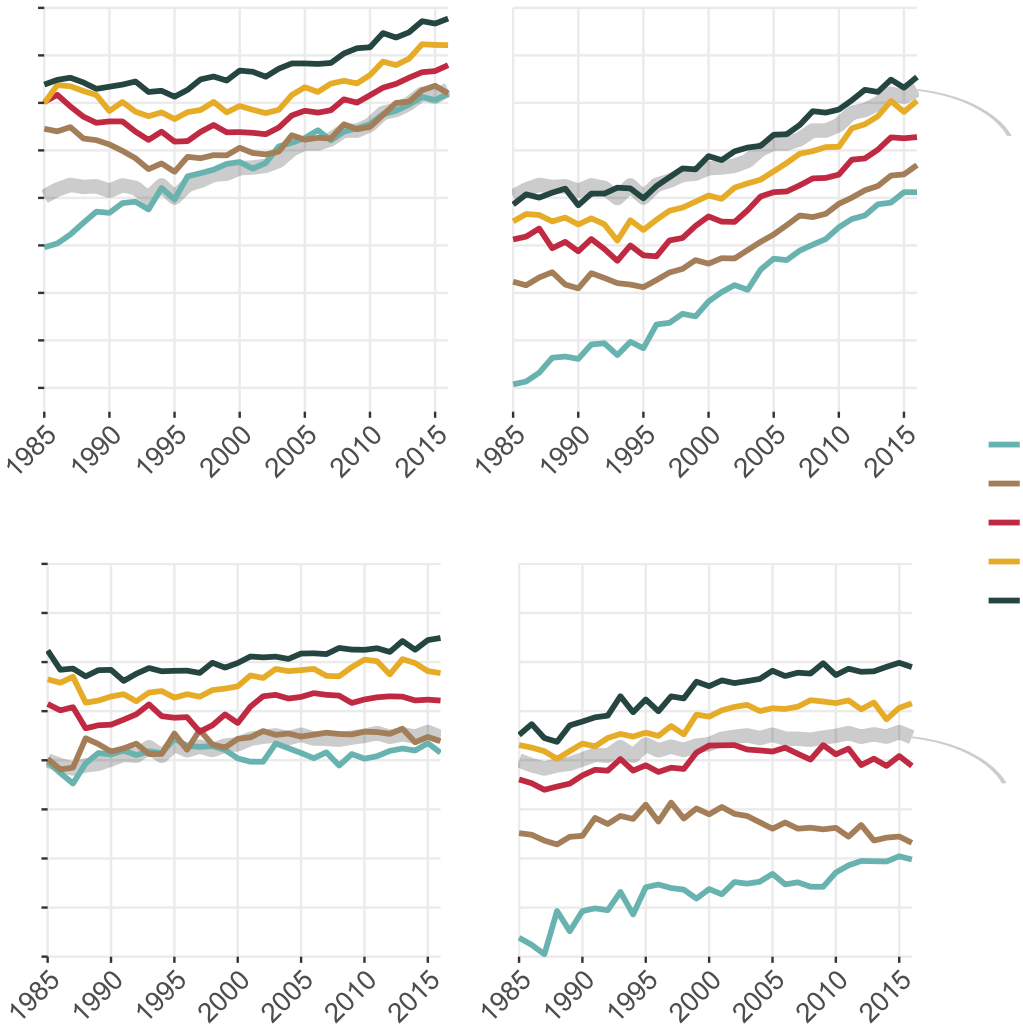
## Section 3: Results

Panels A and B of Figure 1 show trends over time in the age at which remaining life expectancy is 14.5 years. The grey line portrays values of such age for the total population (*r*). The coloured lines represent the hypothetical ages for specific socioeconomic groups by sex assuming that individuals belonging to each socioeconomic group could retire at different ages according to their own mortality regime. From 1985 to 1995, *r* calculated for the total population stagnated around 67 years. From 1995 and onwards, *r* trended upwards and reached values of 71 years in 2016. Similar patterns over time are observed across socioeconomic groups, however, disparities appear when focusing on the specific levels of $r_{ses}^{sex}$. The age at which $r_{ses}^{sex}$ =14.5 is higher for upper socioeconomic groups than for lower ones. Such socioeconomic disparities prevail over time since distances between quantiles remain somewhat similar.

**Figure 1**

TRENDS OVER TIME IN THE AGE AT WHICH LIFE EXPECTANCY IS 14.5 YEARS (PANELS A AND B) AND THE PROBABILITY OF SURVIVING TO THAT AGE DURING 1985-2016 (PANELS C AND D). COLOURED LINES DEPICT

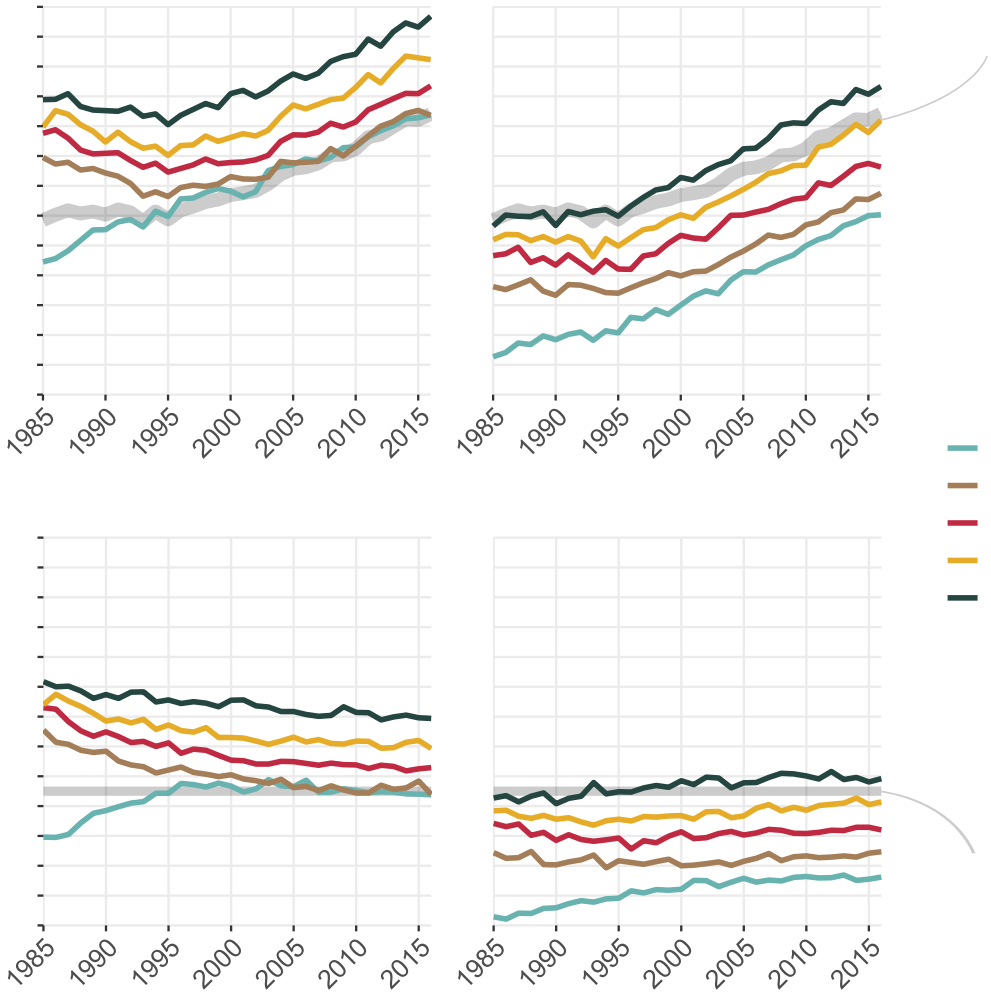
VALUES FOR SPECIFIC SOCIOECONOMIC GROUPS (SES). GREY LINES REPRESENT VALUES FOR THE TOTAL POPULATION.




How likely is that members from different socioeconomic groups survive to retirement? This is a crucial aspect that affects the influx of individuals retiring every year. In Panels C and D of Figure 1, we show the probability of surviving from age 50 to the age at which life expectancy (for the total population) is 14.5 (portrayed by the grey line in Panels A and B of Figure 1). Here we assume that by age 50, most individuals have already reached the peak of their salary careers and accumulated much of their wealth by that age. For the total population, such probability has remained constant over time around values of 0.80 with moderate increases in recent years. By looking at differences across socioeconomic groups we observe that females (from all socioeconomic groups) and males from the fourth and fifth SES quantiles exhibit either equal or higher probability of surviving to *r* than the expected for the population as a whole. Further, males from the lowest two socioeconomic groups show a probability of reaching age *r* much lower than the rest of the population. In spite of the downward trends depicted by males in the lowest socioeconomic group, the probability of reaching the target age *r* was still 10% lower than the total population during 2016.

Figure 2

REMAINING LIFE EXPECTANCY AT AGE AT 65 (PANELS A AND B) AND AGE *r* BY SOCIOECONOMIC STATUS. BOTH SEXES, 1985-2016.




In Figure 2 we show trends over time in remaining life expectancies calculated at ages 65 and *r* by socioeconomic groups and for the total population. It is clear that *e*(65) is increasing over time (panels A and B), indicating that by fixing retirement age, individuals from most recent generations spend more time in retirement than those from previous ones. On the other hand, patterns in *e*(*r*) (Panels C and D) make (by definition) life expectancy to remain constant after retirement. Hence, by setting retirement age to *r*, it is expected that individuals spend gains in life expectancy during working life rather than in retirement. From Figure 2 we observe the socioeconomic disparities after retirement prevail regardless of the age at which individuals retire.

Figure 3

COEFFICIENT OF THE DISTRIBUTION OF DEATHS AT AGE AT 65 AND AT AGE *r* BY SOCIOECONOMIC STATUS. BOTH SEXES, 1985-2016.

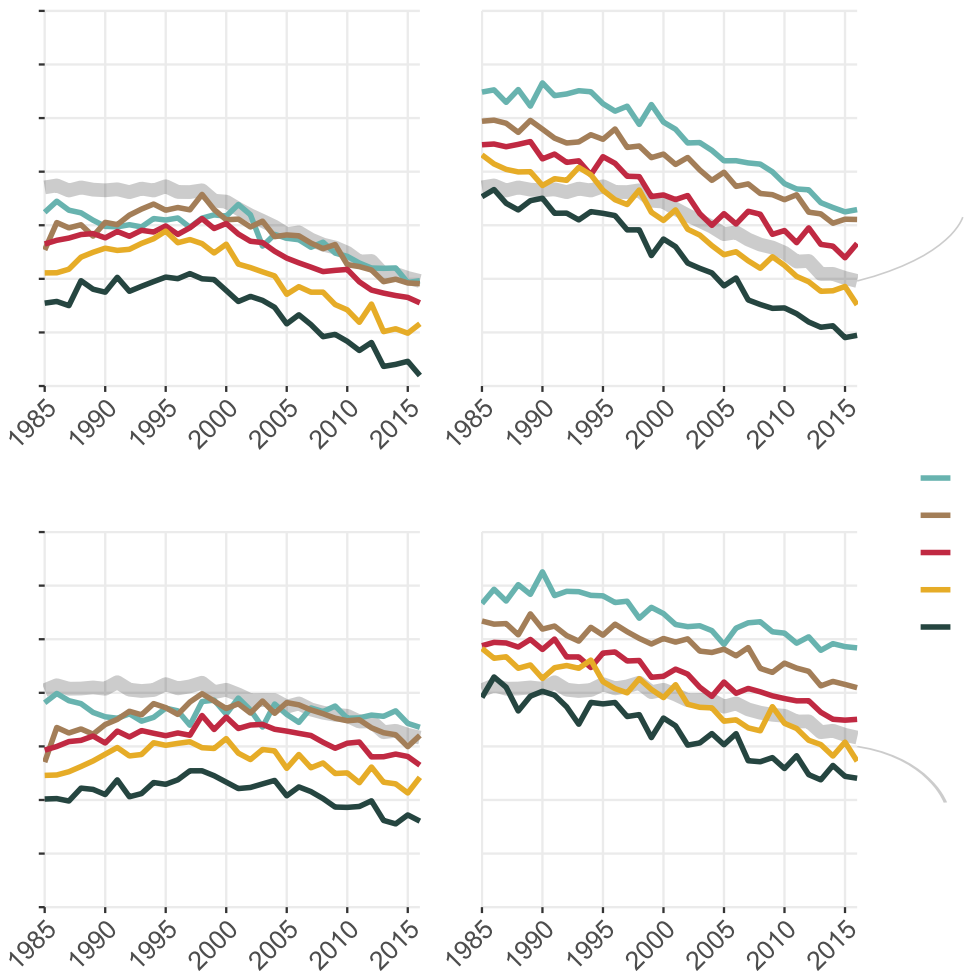



Figure 3 shows the coefficient of variation of the distribution of lifespans calculated at age 65 and *r*, *CV* (65) and *CV* (*r*) respectively. At the population level, we observe that *CV* (65) and *CV* (*r*) remained constant during the period 1985-2000. Thereafter, both measures declined towards values of 0.45 and 0.52 for *CV*(65) and *CV*(*r*) respectively. The decline in *CV*(65) is more pronounced than in *CV*(*r*). This entails that at age 65 individuals experience less uncertainty in their age at death than what they would face under the new reform.

Similar to what is observed in life expectancy trends, upper socioeconomic groups portray an advantage in lifespan variation with respect to the lower ones. Females (and males from the two upper socioeconomic groups) consistently portray lower lifespan variability than the population average. Men from the lowest three socioeconomic groups display lifespan variability values higher than the ones calculated at the aggregate. These trends provide evidence that socioeconomic inequality after retirement not only prevails in life expectancy but also in lifespan variability and that males from the lowest socioeconomic groups are in consistent disadvantage in comparison with other members of the population.

## Section 4: Conclusion

In this study we inspect trends in life expectancy and lifespan variation at retirement by socioeconomic groups. We compare such trends assuming two different retirement ages: a fixed retirement age to 65 and a changing retirement age linked to life expectancy (*r*). We highlight three main findings. First, we find that *r* is trending upwards over time at a steady pace and this pattern replicates across socioeconomic groups. Second, while the increasing trend depicted by life expectancy at age 65 of the total population as a whole seems to be controlled under the new pension scheme, socioeconomic disparities across sexes still exist. Individuals from upper socioeconomic groups enjoy higher life expectancies than the average population. Conversely, those from lower socioeconomic groups exhibit lower life expectancies. Third, we found that individuals face less uncertainty about their age at death at age 65 compared to what they would experience by retiring at age *r*.

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