When Danes have only 15 years to live: Implications of linking retirement age with life expectancy

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Abstract

It is well known that life expectancy at birth has increased over time in developed populations. This has created intense debates about how retirement age should be adjusted to changes in longevity. In Denmark, retirement age will be linked with life expectancy. The indexation rule is set so that the statutory pension age will be the age at which remaining life expectancy is 14.5 years (x_{15}). However, the demographic implications of such rule are still unexplored.

The purpose of this paper is to characterize the distribution of deaths after age x_{15}. The analysis is performed using high-quality individual mortality data. We segregate such data into socio-economic status by using a newly developed affluence index. We look at indices of lifespan variability and reveal what sub-populations would be more disadvantaged with the new pension system rules. Finally, we associate our results with economic outcomes in order to unravel the implications of linking retirement age with remaining life expectancy.

Keywords: Danish longevity, socio-economic status, lifespan variability, pension age

Background

In coming years, many OECD countries will increase their retirement age. In Denmark, Finland, Italy, the Netherlands, Portugal and the Slovak Republic such increases will be done by linking retirement age to changes in life expectancy (OECD, 2017). This means that, on average, the retirement period will increase relative to people's lifespans. In Denmark, life expectancy indexation of the pension age is tentatively set such that the age when a person receives an old age pension will be the age when remaining life expectancy is about 14.5 years (OECD, 2015). Increases in Danish pension age will be done gradually over time resulting in the highest retirement age among OECD nations.

Linking retirement age to life expectancy has to be carefully addressed due to the complex dynamics of increasing longevity in low-mortality nations. Vaupel and Lundstrom (1994) analysed ages when remaining life expectancy in Sweden is either two or five years. They found that for both males and females, there were little changes between the first decades of the 20th century (1900-1930), however,

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there were substantial shifts from the decade of 1930s onwards. For males, the age at which two years of life expectancy are left increased by almost four years, from 94.4 to 98.1. For females, the corresponding shift was close to five years increased for males by almost three years, from 80.9 to 83.7. For females, the increase was five years from 82.5 to 86.7. From this perspective, elderly Swedish men are four years younger than they used to be and elderly Swedish females are five years younger. These results indicate that (1) progress in reducing mortality rates has accelerated over time, (2) acceleration is greater for males than for females and, (3) the acceleration varies depending on the age groups. According to frailty theory (Vaupel et al., 1979), progress in reducing mortality rates at younger ages makes it more difficult to make progress at subsequent ages if the persons whose lives are saved are frail and vulnerable. Hence, progress in reducing cohort mortality rates at younger ages masks the true rate of progress at older ages. These factors have to be carefully considered when defining retirement age linked to life expectancy.

Denmark has one of the lowest degrees of income inequality in the world (Causa et al., 2016). However, recent studies have proven that mortality disparities exist between sub-populations. Brønnum-Hansen (2017) studied trends in lifespan variability over time by income quartiles in this country. He found that mortality inequality has stagnated among people from the lowest quartile whereas mortality compression is observed among the highest quartiles. Van Raalte et al. (2014) found similar results in Finland: lower socio-economic classes are disadvantaged since they experience higher lifespan variation at all levels of life expectancy. Diminishing demographic inequalities is one of the main expected outcomes of linking retirement age with remaining life expectancy. Nonetheless, such objective seems unlikely to be achieved since Van Raalte et al. (2014) and Brønnum-Hansen (2017) showed that some sub-populations experience more uncertainty about their age at death than others. Thus, we hypothesize that a uniform extension of pension age (by linking it to remaining life expectancy of the total population) could result in a disadvantageous setting for lower socio-economic classes. Such scenario could have several implications on the national economic outcomes.

This study looks at changes in Danish longevity. The distribution of deaths after the age at which remaining life expectancy is 14.5 years (denoted to as x_{15}) is analysed. We examine trends in age x_{15} and the probability of surviving to this age ($l_{x_{15}}$) using register data by sex and by socio-economic status over time. We address differences in such indicators among sub-populations determined by socio-economic status. Finally, we investigate how linking the retirement age to x_{15} would affect economic outcomes such as national pension expenditures.

Data

The data used in this study comes from two sources: Human Mortality Database (2017) and Statistics Denmark. We first calculated x_{15} and lifespan variability measures using cohort data for the total population of Denmark from 1835 to 1910. Cohort life tables were retrieved from the Human Mortality Database (2017). This database includes high-quality information on death rates and life tables' functions (e.g., life expectancy) for more than 40 populations.

We next used register data from Statistics Denmark based on administrative records. The advantage of using such dataset is that we are able to identify each individual across all components of the public register system, which includes the Population Register, the Integrated Database for Labour Market Research, the Income and Tax Register, and the Cause of Death Register. Thus, we have individual information on date of birth, education, labour market status, income, wealth and cause of death. Such data are available from 1980 to 2016.

We subdivided the population at each age and in each year by socio-economic status. Rather than categorizing individuals by solely using their last income (Brønnum-Hansen, 2017), we subdivided the Danish population by socio-economic status with the *affluence index* proposed by Cairns et al. (2017). The advantage of using such index relies on the fact that it is obtained from income and wealth data over time. Therefore, changes in socio-economic status over the life course are captured in the model resulting in a better representation of socio-economic groups in Denmark.

Methods

In this study we measure lifespan variability by looking at Keyfitz's entropy (H), which is defined as the elasticity of life expectancy with respect to mortality change (Keyfitz and Caswell, 2005). H can be seen as a measure of inequality in the length of life. Thus, populations exhibiting values of H close to zero are more equal in terms of mortality. Conversely, values of H close to 1 indicate high lifespan inequality. At age x_{15}, H is calculated as $H = \frac{e^{\dagger}_{x_{15}}}{e_{x_{15}}}$, where $e^{\dagger}_{x_{15}}$ denotes life disparity.

Life disparity is defined as the average remaining life expectancy at the age when death occurs, or alternatively the average years of life lost in a population attributable to death (Vaupel, 1986; Vaupel and Canudas-Romo, 2003):

$$e^{\dagger}_{x_{15}} = \frac{\int_{x_{15}}^{\omega} f_x e_x dx}{l_{x_{15}}}, \tag{1}$$

where f_x is the life table death density at age x, e_x is the function of remaining life expectancies at age x and $l_{x_{15}}$ is survivorship function at age x_{15}.

Results

We first analysed all-cause mortality for Danish individuals born between 1835 and 1910. Figure 1 reveals that the distribution of deaths after age x_{15} has shifted towards older ages. Recent cohorts exhibit more peaked death distributions than the older ones. This indicates that the majority of deaths have gradually been concentrated in narrower age intervals.

Figure 1 about here

The age at which remaining life expectancy is 14.5 years (x_{15}) has increased over time for birth cohorts between 1835 to 1910 (see Panel A of figure 2). For females, x_{15} has trended upwards more rapidly than for males. Female x_{15} was 61 years for the 1835 cohort and it reached almost 68 years in 1910. x_{15} was 60 years for males born in 1835. Thereafter, x_{15} reached levels of about 63.5 years for the 1880 cohort and remained constant afterwards. Panel B of Figure 2 shows that the probability of surviving to age x_{15} has increased over time and that such probabilities are very similar for both sexes. A person born in Denmark during 1935 had a 40% chance of surviving to age x_{15}. In 1910 a Danish newborn faced a probability of almost 65%.

Figure 2 about here

In spite of the fact that x_{15} has increased for both sexes, Keyfitz's entropy (H) after such age remains constant over time. Panel C of figure 2 shows that H takes values around 0.5 for all analysed cohorts. This finding has two demographic implications: (1) the probability of surviving to ages beyond age x_{15} decreases linearly with age and (2) lifespans above age x_{15} are at the same levels of inequality. The later one may imply misleading conclusions about the social benefits of the Danish pension reform. In this regard, linking retirement age to x_{15} seems a fair initiative in terms of mortality since at country level and regardless of their sex, individuals face similar uncertainty about their age at death during post-retirement years. However, it is not clear cut whether these trends prevail among different socio-economic groups or not.

Figures

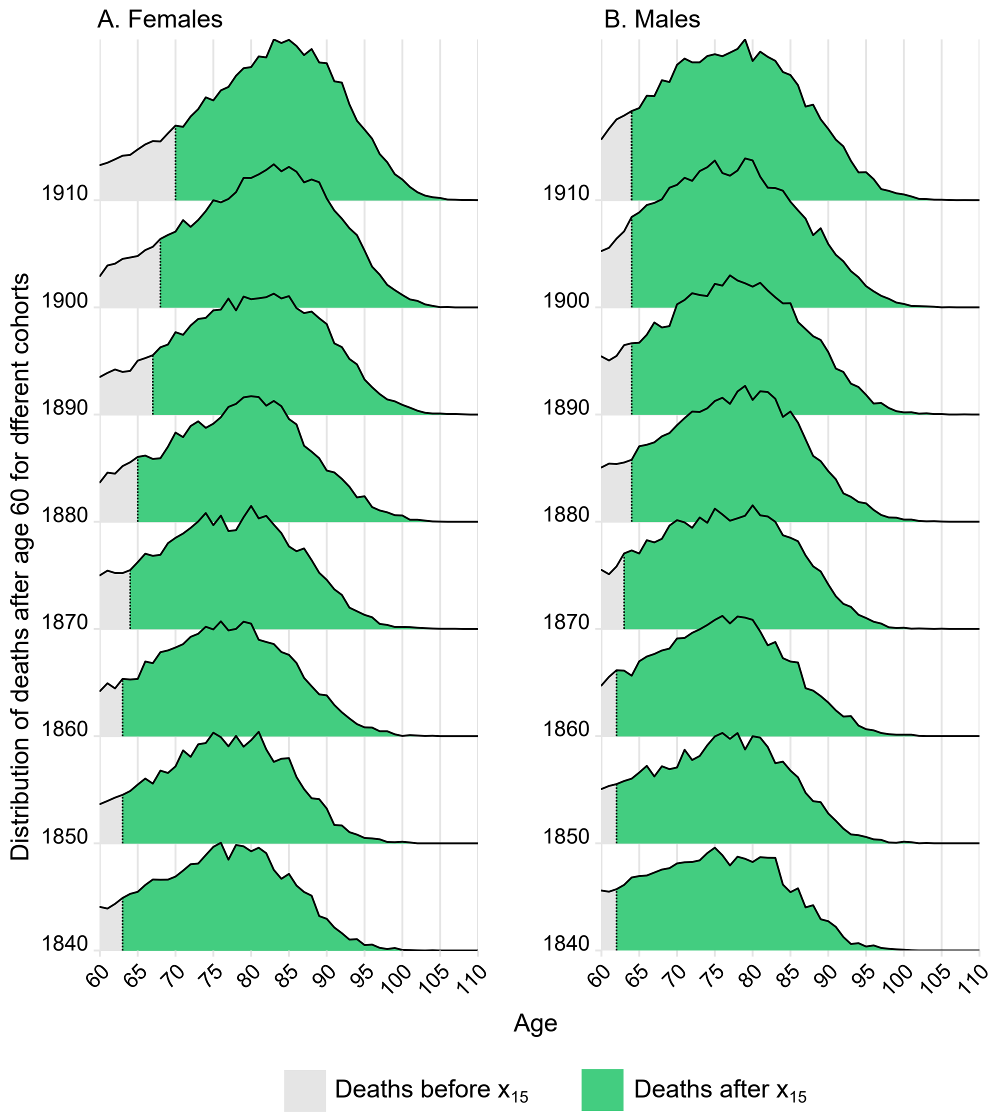

Figure 1: Distribution of deaths after age 60 for different cohorts in Denmark. Both sexes.

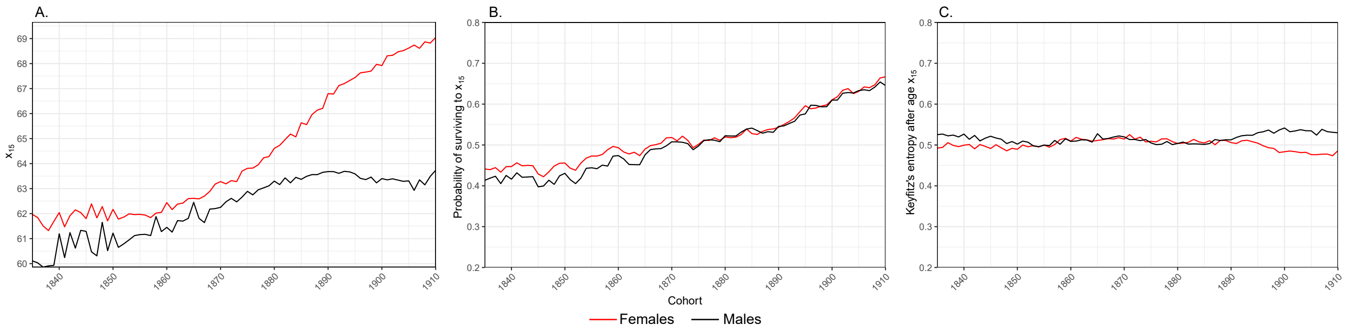

Figure 2: Trends in x_{15}, probability of surviving to age x_{15} and Keyfitz's entropy at age x_{15} for cohorts between 1835 and 1910. Both sexes.

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