Equitable Normal Pension Age Modified in Terms of Fertility Level

extended abstract

1 Introduction

One of the most important and very often discussed demographic phenomena in the recent decades is population ageing. Its economic, social and political consequences are broadly mentioned not only by experts and politicians, but also by the public and media. All (not only) economically advanced populations face or will very soon face the ageing process. Most of the indicators of population ageing are based on the assumption, that the threshold of old age is unchanged in time, fixed, equal usually to 65 years of age (which is the threshold of the retirement age in many countries). Chronological age is a very simple and easily understood characteristic and thus it is regarded as useful in the specification of public policies. But this "traditional" approach is in contradiction to the continuing changes in demographic development, especially to the decrease in mortality rates and so the increase in the life span and also the increase in the healthy life span.

Ryder (1976) established (almost 50 years ago), a new way of determining the threshold of old age. He suggested the point of entry into old age as the age at which the (remaining) life expectancy is equal to a given, relatively low, value, say 10 years. The idea of an old age threshold flexible in time, depending not on the (standardly used) chronological age but on the remaining life expectancy, was used later by several authors, e.g. by Fuchs (1984). Thirty years ago, Siegel (1993) proposed to determine the old-age threshold as the age when life expectancy equals 15 years.

This alternative concept of the definition of human age was very particularly treated by Sanderson and Scherbov in several papers. They introduced a new forward-looking definition of age (so-called prospective age) and argued that, along with the usual backwards-looking concept of age, this definition provides a more informative basis to discuss population ageing (Sanderson and Scherbov, 2005, 2007). The use of the prospective instead of the traditionally used chronological age threshold of old means that the old age threshold is (assuming declining mortality rates) rising in time. The rise of many indicators of ageing will then not be so dramatic in comparison with indicators defined by the standard way (Sanderson and Scherbov, 2013, 2014). Calculations of some prospective indicators for the population of EU 28 countries were published e.g. by Šídlo, Šprocha, and Ďurček (2020a).

One of the most serious consequences of the population ageing is the issue of financial stability and sustainability of old-age pension systems. A fixed retirement age threshold will cause, that the decrease in mortality would result in an increase in the length of time of pensions receipt which could be a serious threat to the financial sustainability of pension systems. Pension reforms at present times in many states include the idea of further increasing retirement age even above the standard threshold of 65 years. The concept of prospective age can be used for the determination of the flexible retirement age threshold reflecting the previous as well as expected future permanent increase in life expectancy. But the simplest idea to determine the retirement age threshold as the age at which the remaining life expectancy would reach a fixed value (say 15 or 20 years) would mean that the period of economic activity would grow while the period of pension receipt would remain constant and so the relative period of pension receipt would drop.

Sanderson and Scherbov introduced the concept of the so-called intergenerationally equitable normal pension age – ENPA (Sanderson and Scherbov, 2013). The retirement age threshold is determined in such a way that the ratio of the (expected) number of person-years lived by members of each cohort in the pension phase of life to the (expected) number of person-years lived in the economic activity period of the same cohort remains stable over time and space for all population cohorts regardless of their mortality rates. Calculations of the intergenerationally equitable pension age for Czechia, Hungary, Poland, and Slovakia (V4 countries) were published by Šídlo, Šprocha, and Ďurček (2020b).

Fixed normal pension ages are already in many countries often being replaced by variable ones. For people to understand, accept, and voluntarily adjust to changes in national pension ages, two criteria must be met. The rationale for pension age policy must be compelling, simple, and transparent, and the resulting policies must be clearly intergenerationally equitable. The so-called intergenerationally equitable normal pension age is an analytically-based determination of pension age policy that meets both of those criteria. The proposed pension age (varying with changing mortality conditions) expressed the idea that members of each birth cohort must receive approximately as much money in pension benefits as they contribute to the pension system. At the same time, the pension tax rate, as well as the ratio of annual pension income to the wage in the pre-pension period, are supposed to be unchanged in time. The pension age is then determined in such a way that the proportion of time spent by the cohort in the retirement age to the proportion of adult life is the same for each cohort. (Sanderson and Scherbov, 2014)

The old-age pension system in many countries is based not on the cohort, but on the pay-as-you-go (PAYG) principle. In such a case the ENPA principle would guarantee the financial stability of the pension system only in the case of a population of stationary type, i.e. under fertility at replacement level (or adequate compensation of lower fertility by foreign immigration). The proposed ENPA reflecting fertility could be determined by stabilizing the ratio of the number of person-years lived by members of the cohort in the pension phase of life to the number of person-years lived in the economic activity period by the cohort of their children. The size of this children's cohort depends on the completed fertility rate of the parents' cohort.
A very simple and rough indicator of the financial burden of the PAYG pension system is the adjusted old-age dependency ratio (AOADR) defined as the ratio of the population at retirement age to the population at productive age using the actual retirement age threshold instead of standard 65 years.
The article will present calculation of standard ENPA and fertility-adjusted ENPA and corresponding AOADR for Czechia and some other European countries.

2 Methodology

We assume that the economic activity period starts at the age of 20 and lasts until retirement age is reached. If $\alpha(g)$ denotes the equitable normal pension age (ENPA) of the birth cohort g, its value can then be determined as the (unique) solution of the equation (Sanderson and Scherbov, 2014).

$$\frac{T_{\alpha(g)}^{(g)}}{T_{20}^{(g)}-T_{\alpha(g)}^{(g)}}=\frac{T_{\alpha(g_0)}^{(g_0)}}{T_{20}^{(g_0)}-T_{\alpha(g_0)}^{(g_0)}}, \qquad (1)$$

where g_0 is some reference cohort. The cohort life tables should be used for calculations; $T_x^{(g)}$ denotes the T_x value of the life tables for the birth cohort g. The left-hand side term of equation (1) can be interpreted as the ratio of the number of person-years lived by members of the cohort in retirement age to the number of person-years lived by the same cohort in productive age. The right-hand side term of equation (1) can be replaced by an appropriately chosen constant value. The solution $\alpha(g)$ of the equation (1) is found using the linear interpolation method.
It is clear that the value of ENPA depends only on mortality trends, not on fertility and migration trends. It could be financially sustainable in the long term in a funded pension system. In a pay-as-you-go system, the assumption of fertility on replacement level (or corresponding "replacement" migration level) would be necessary to ensure the long-term functioning of this system. In the case of declining fertility and low net migration, the system based on the ENPA idea may be financially unsustainable. Due to the population decline, the ratio of the number of person-years lived by members of some cohort in retirement age to the number of person-years lived by the cohort of their children (whose contributions pay for the pensions of the parent generation) in productive age may be significantly higher than that indicated by equation (1).
A possible modification of the ENPA reflecting fertility level (ENPARF) may be done as follows. The denominator of fraction (1) will be replaced by the total number of years lived in productive age not by the cohort g, but by the cohort of their children. The ratio of the size of the cohort of children to the cohort of their parents can be estimated as the ratio of the completed fertility (CCF) of the cohort to the value of 2.1, which ensures replacement level fertility.
The value of ENPARF for the birth cohort g can then be determined as the solution of the equation

$$\frac{T_{\alpha(g)}^{(g)}}{(T_{20}^{(g)}-T_{\alpha(g)}^{(g)})\cdot\frac{CCF^{(g)}}{2.1}}=\frac{T_{\alpha(g_0)}^{(g_0)}}{(T_{20}^{(g_0)}-T_{\alpha(g_0)}^{(g_0)})\cdot\frac{CCF^{(g_0)}}{2.1}}, \qquad (2)$$

where $CCF^{(g)}$ denotes the completed cohort fertility of the birth cohort g.
Cohort life tables are usually unavailable. They can be calculated using a series of period life tables covering all years of living of the cohort. The cohort probabilities of dying can be estimated as the average of appropriate period probabilities of dying by the formula

$$q_x^{(g)}=\frac{q_{g+x,x}+q_{g+x+1,x}}{2}, \qquad (3)$$

where $q_x^{(g)}$ is the cohort table probability of dying at the age x for the birth cohort g, $q_{t,x}$ is the period table probability of dying at the age x in the year t. Unisex probabilities of dying (the average of males' and females' values) were used for further calculations.
The cohort life tables are then calculated by known standard formulas. Values of T_x depend on mortality rates of ages equal to x and higher. The value of ENPA does not depend on mortality rates until 20 years of age and so sufficient data for calculations of ENPA for the birth cohort g are probabilities of dying in the years $(g+20)$–$(g+\omega)$, where ω denotes the highest assumed age, say, e.g. 110 years. Cohort fertility rates were estimated using period values in the same way.

A very simple and rough indicator of the financial burden of the PAYG pension system is the adjusted old-age dependency ratio defined as the ratio of the population size at the retirement age to the population size in the productive age

$$AOADR = \frac{S_{t,r(t)+}}{S_{t,20-r(t)}} . \qquad (4)$$

where $S_{t,x}$ is the population size at time t at the age x, $r(t)$ denotes the retirement age threshold at time t. The linear interpolation principle is used for calculations in the case of the not integer value of retirement age.

The equitable normal pension age reflecting fertility does not take into account the fact that in Czechia as well as in many other countries, low fertility is usually partially compensated by positive net migration. In such a case, the increase in the retirement age determined according to the ENPARF principle could be slowed down somewhat, provided that the financial stability of the pension system is maintained.

The financial stability of the pension system would be ensured in the case of long-term stable AOADR values. The financial stability of the PAYG pension system in the period (t_1;t_2) can be defined by the requirement that the ratio of the sum of the number of people of retirement age in each year of the period to the sum of the number of people of working age in the same period be equal to the required value R, i.e.

$$\frac{\sum_{t=t_1}^{t_2} S_{t,r(t)}}{\sum_{t=t_1}^{t_2} S_{t,20-r(t)}} = R. \qquad (5)$$

The value of reduced ENPARF (RENPARF) for the birth cohort g can then be defined by the formula

$$RENPARF^{(g)} = ENPARF^{(g_0)} + (ENPARF^{(g)} - ENPARF^{(g_0)}) \cdot k \qquad (6)$$

where the value of k is such that the equality (5) holds.

3 Data source and calculations

The data source for the probabilities of dying in the period 1960–2023 will be the life tables of the Eurostat database (Eurostat, 2023a). Since 2023 the baseline mortality scenario and the lower mortality scenario of the Eurostat population projection were used (Eurostat, 2023c). The mortality scenarios will be determined by age specific mortality rates m_x, the corresponding probabilities of dying q_x were calculated according the known formula

$$q_x = \frac{m_x}{1+(1-a_x)\cdot m_x} , \qquad (7)$$

where a_x quantifies the average number of person-years lived in the given age interval by those who die in the interval. With regards to the generally accepted assumption of a uniform distribution of the exact age of deceased persons for all ages except 0, the value of a_x is set to 0.5 for all ages x>0; a_0=0.8. (See Eurostat, 2023b, CZSO, 2023.) After 2100 the probabilities of dying are supposed to be equal to the values of 2100. The retirement age is assumed to be the same for males and females. Unisex probabilities of dying (the average of males' and females' values) were used for further calculations.

The data source for the calculation of AOADR will be the real or projected population structure (Eurostat, 2023d).

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