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Agenda item 5: Mortality

LIFE EXPECTANCY ADJUSTMENTS IN THE NORWEGIAN PENSION REFORM

Invited Paper

Submitted by Statistics Norway[1]

Abstract

Many countries are reforming their pension systems because of population ageing. In some countries, including Norway, the monthly pension will depend on a flexible age at retirement and the remaining life expectancy when people retire, besides earned pension rights.

An important issue in this connection is whether the pension should depend on the projected cohort life expectancy for the retiring cohorts, or whether it should only depend on observed period values. In some countries the thinking is that use of projections would introduce a subjective element and also politicize the production of population projections. However, even if only period measures are used to compute the pensions, there is a fiscal need for projecting the future total annual expenditures for old-age pensions. Moreover, individuals approaching the retirement age would like to know how much pension they can expect to get, when they are considering when should retire. Thus, a pension system cannot entirely escape the need for projecting the life expectancy.

If *projected* life expectancies are used to compute the pensions, the methodology for making the mortality projections matter. Should simple and transparent methods be used or more sophisticated approaches like the Lee-Carter method? How often should the forecasts be made? Who should make theme and who should approve them? What happens if the real life expectancies improve faster than projected?

If *period* life expectancies are used to compute the pensions, some cohorts may claim that they are receiving lower pensions than previous cohorts because of random changes in the life expectancy and that this is unfair. Thus, there is a need to develop robust and transparent

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statistical methods also when only period measures are used to avoid political and legal problems.

The paper will present the discussion and recommendations regarding the use of period versus projected life expectancy in the new pension system for Norway, which will be introduced in 2010. A brief description of how the life expectancy enters the computation of the pension will also be given.

Introduction

The increasing proportion of elderly has led many countries to reconsider their pension systems. The changing dependency burden will make it difficult or impossible in the future to provide for elderly part of the population with regard to pensions, in addition to health care. An important element of many recent pension reforms has been to stimulate people to work longer and retire later. This can be achieved by introducing a flexible retirement age that rewards those who postpone their retirement. This has been done in countries like Sweden and Latvia.

If people can choose when they retire, their annual (or monthly) pension should depend on their remaining life expectancy, otherwise the pension system expenditures may grow beyond the sustainable. Basically, the pension rights or pension wealth for each individual who retires should be divided by the number of additional years they may expect to live.

The life expectancy is not constant, however. It has been increasing rapidly in many countries for many years, also for the elderly. Thus, the estimation of the annual pensions needs to take the increasing life expectancy into consideration. There are a number of concerns in this regard, both of a general and a practical nature:

- How should the remaining life expectancy be translated into an annual pension?
- What kind of estimate for the remaining life expectancy should the used, projected or observed values?
- There are significant random variations from year to year in life expectancy and survival probabilities for most populations, in particular for a relatively small population such as the Norwegian. Thus, there has to be some smoothing of the numbers. What method should be used for this?
- How can the increasing life expectancy be built into the pension system?
- Should estimates of the life expectancies used in the calculation of pension be based on period or cohort mortality measures?
- How should the difference in life expectancy between men and women be treated in a pension system?

The present paper will look at these issues and explain how we are proposing to solve them in Norway.

The new pension system in Norway the divisor[2]

The pension wealth for a person at the age of retirement is the sum of annual entitlements over the life course:

[2] This section is based on Brunborg et al. (2007) and Stølen (2007).

$$(1) \qquad W_A = a \cdot \sum_{t=0}^{A-1} I_t \cdot (1+i)^{A-t} \ ,$$

where
W_A = Calculated pension wealth at retirement age A,
a = Pension premium as a share of the income base for pension entitlements,
I_t = Income base for pension entitlements in year t, and
i = Nominal rate of interest relevant for pension entitlements.

This pension wealth shall be distributed over the pension years for the person. In a fully funded or a quasi-actuarial pay-as-you-go system with defined contributions, the yearly pension benefit is determined by

$$(2) \qquad \overline{B}_{K,A} = W_A / \Phi_{K,A} \ ,$$

where
$F_{N,K,A}$ is the expected present value of future pension benefits calculated from the lower retirement age N per unit pension benefit for a person in cohort K who retires at age A.

In a defined benefit system pension the yearly benefits have to be standardized for the following reasons. First, to give persons equal average benefits as with a predefined system, e.g. the present. Second, to counteract the increasing life expectancy by decreasing the yearly pension. In the proposal for a new pension system in Norway the pension benefits are standardized according to the life expectancy for persons born in 1943 who retire at age 67 in 2010 when the new system is planned to be implemented. The aim is that their pension benefits for these persons be the same according to the old and new system. To achieve this the *divisor* d has been introduced, which for persons from cohort K who retires at age A is defined as:

$$(3) \qquad d_{K,A} = \Phi_{K,A} / \Phi_{1943,67} \, .$$

The standardization implies that the divisor for persons from the 1943 cohort who retire at age 67 in 2010 is identically equal to 1.

In the special case where the nominal rate of interest is assumed to equal wage growth, F expresses the sum of the survival probabilities above the considered retirement age A calculated from the lower retirement age N:

$$(4) \qquad \Phi_{N,K,A,r=0} = \sum_{x=A}^{\infty} p_{N,K,x} \ ,$$

where
$p_{N,K,x}$ = Survival probability for persons born in year K from the lower retirement age N to age x.

By combining equations (7) and (10) we find that the divisor at pension age A for a person from cohort K is estimated by:

$$(5) \qquad d_{K,A} = \frac{l_{62,A,K,K+60} \cdot e_{A,K,K+60}}{l_{62,67,1943,2003} \cdot e_{67,1943,2003}} \ ,$$

where

$e_{A,K,t}$ is the expected remaining life expectancy at age x for cohort K based on observations for year t, and

$l_{62,A,K,t}$ is the probability that a person from cohort K survives from the lower pension age 62 until pension age A based on the mortality observed in year t.

As mentioned above we set $d_{1943,67} = 1$.

Thus, with some simplifying assumptions the divisor can be estimated as a function of life expectancies and survival probabilities, i.e. of purely demographic and no economic parameters.

Figure 1. Divisor by retirement age for selected cohorts

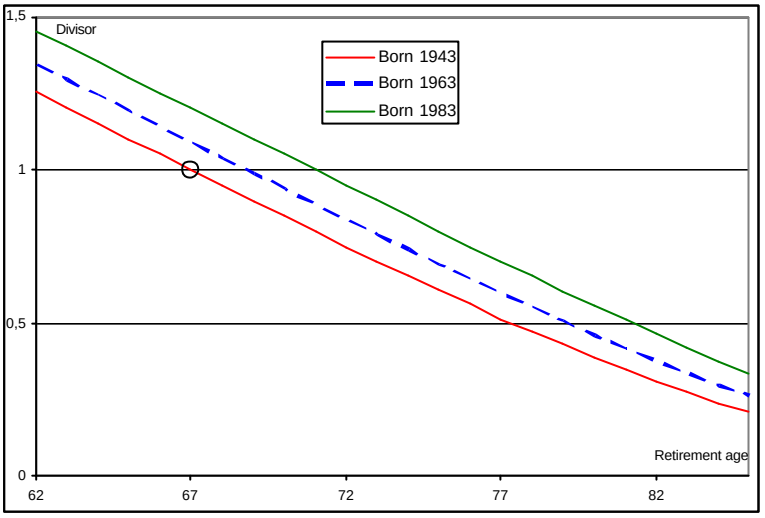
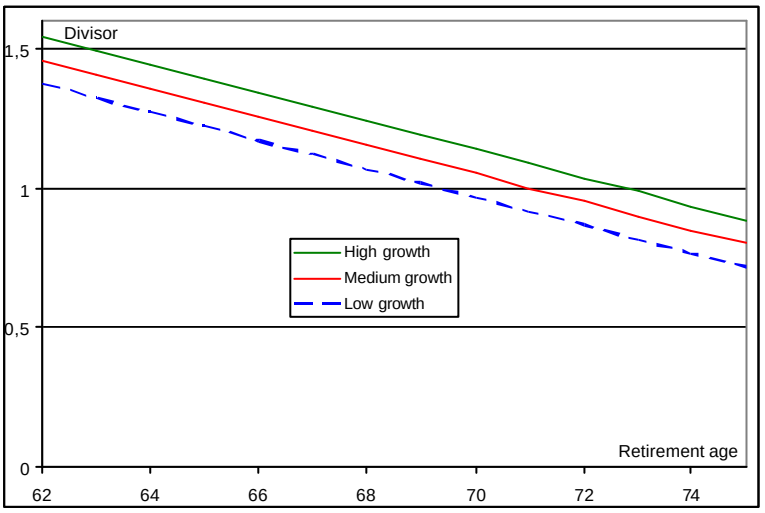


Figure 2. Divisor by mortality assumptions in the 2005-2060 population projections: Low, medium and high growth of the life expectancy



Gender neutrality

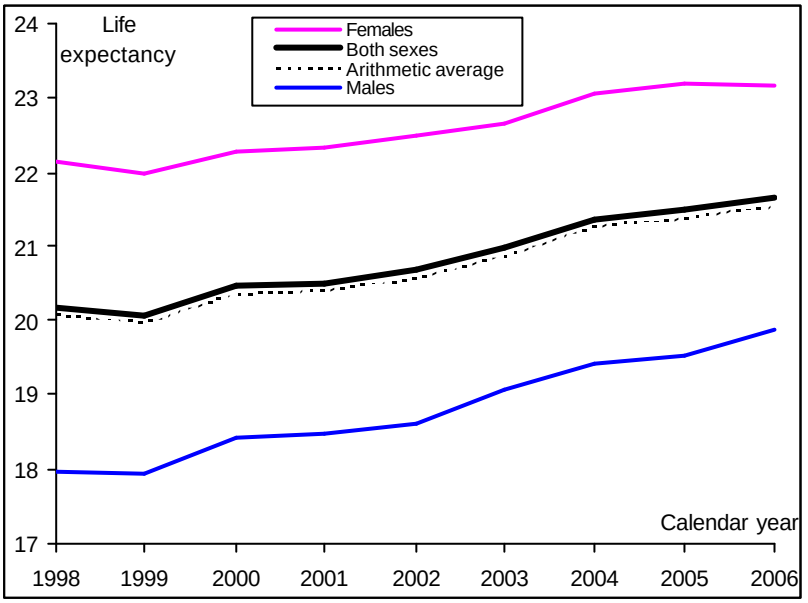
The Norwegian Parliament has decided that the divisor should be gender neutral. Thus, the large difference between male and female mortality should not affect the pension rules. It is

easy to imagine the strong reactions if women would get a lower annual pension than men who retire at the same age because women can expect to live longer than men at all ages, given the same earned pensions rights. Adding to the likely uproar because of such a rule, would be the fact that women have on average much lower earnings over the life cycle than men, which would result in significantly lower pensions.

The male-female mortality differential is, however, one of the basic facts of life and demography (with a few exceptions historically and globally). Thus, mortality measures are almost always estimated for each sex separately. This has also been the case for Norway.

The simplest way of estimating the life expectancy for both sexes combined is to calculate the arithmetic average. This will usually yield acceptable results for the life expectancy at birth, but not for old ages where there are many more women than men. (In Norway today women constitute 59 per cent of the population over 67, the current pension age.) Thus, the best method would be to weight the age-specific death rates by the sex ratio at each age, or even better, to combine all data for men and women and treat them as one sex only. We have done this for Norway, see figure 3

Figure 3. Life expectancy at age 62 for men, women and both sexes



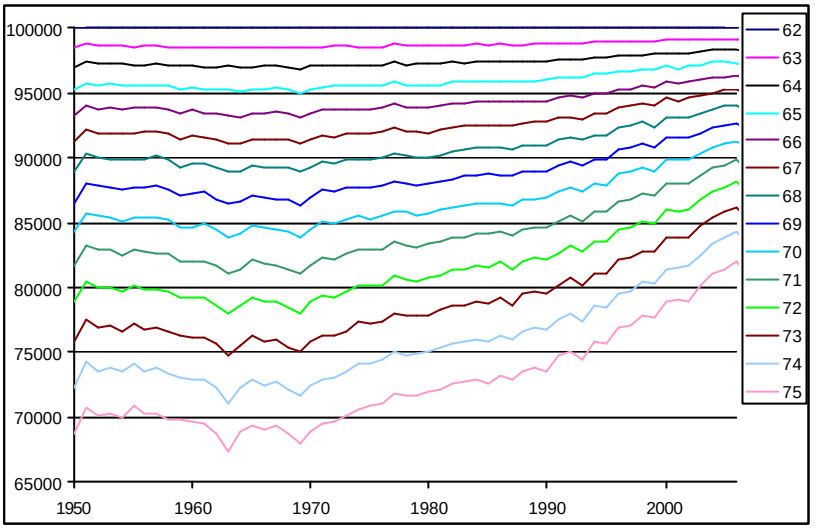
We notice that the arithmetic average for men and women is slightly lower than the life expectancy at age 62 for both sexes combined. Although the difference is small, only about 0,11 years, it could have a significant effect on annual pensions. (The figure also shows that from 2005 to 2006 e_{62} increased strongly for men (+0.36 years) whereas it declines slightly for women (-0.02 years). Using data for both sexes combined removes such anomalies.)

It is not impossible that the government or perhaps Statistics Norway could be taken to court by a group claiming unfairly treatment because poor or biased methodology was used to estimate the pensions, such as the arithmetic average. Because of the importance of this, Statistics Norway has started to estimate and publish life expectancy as well as other mortality measures for both sexes combined, in addition to men and women separately.

Smoothing issues

For relatively small population like the Norwegian (4.7 mill as per 1. January 2007) there is considerable random variation in the mortality rates from year to year and age to age. It is, therefore, necessary to smooth the survival probabilities that are used to estimate the pension divisor. Figure 4 shows the unsmoothed estimates of these.

Figure 4. Probability of surviving between exact ages 62 and x for both sexes, 1950-2006. Per 100 000



In particular, we notice the declining trend from about 1950 to about 1970, which is due to the deteriorating mortality of men. Such trends should, of course, be reflected in the estimates of the divisor

We have experimented with a number of smoothing methods, including 3-, 5- and 21-year moving averages, a 15-degree polynomial, linear and quadratic regression analysis. We have looked at different time periods and done the smoothing for different mortality measures, including e_{62}, e_{67} and $l_{62,A,K}$ (the probability that a person from cohort K survives from the lower pension age 62 until pension age A).

Sophisticated method may give smooth curves over time but have some drawbacks:

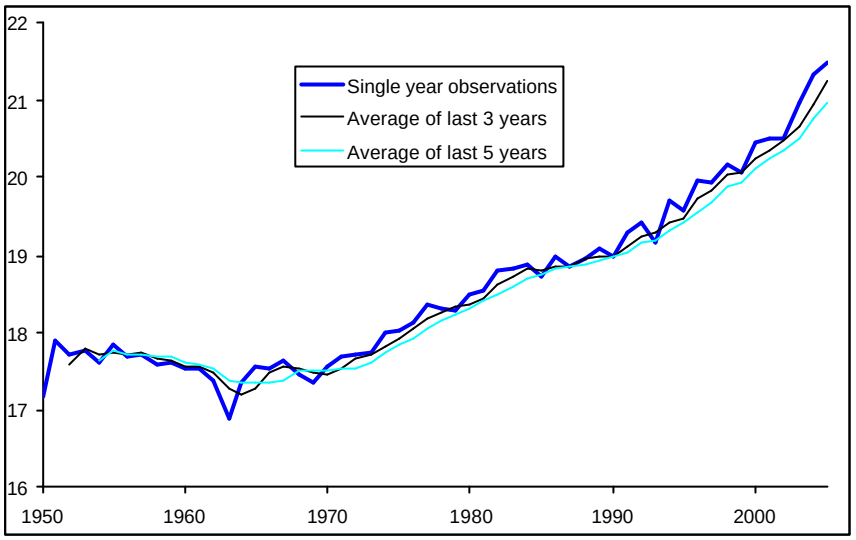
- Sophisticated methods are difficult to explain, both to politicians and to the public. It is hardly feasible to include a description of very complicated methods in a parliamentary report, for example.
- The estimates of the divisor should include the most recent available information. Thus, they should be reestimated every year. This might, however, change the estimates significantly.

Our conclusion is that averaging over 5 years ensures a sufficient smooth development. There are, for example, no cases after 1970 where this average has been declining. The disadvantage of the 5-year averages is that we “lose” the observations for the two last years. If there is a positive trend in the survival probabilities, the average for the five last years will be lower than the estimate based on observations for the last year only. (Note that the 5-year moving average yields exactly the same estimates, of course. The only difference between the 5-

year moving average a_t and the average for the five last years for year t, is that the former cannot be estimated for years t and t-1, unless there is a special procedure for estimating the tails.) The use of consistently too low estimates does not matter, however, when we use the divisor to calculate the annual pensions.

In Sweden the same conclusion was reached, that 5-year averages yield sufficiently robust estimates.

Figure 5. Mean remaining life expectancy for both sexes at age 62, 1950-2006



Cohort versus period mortality

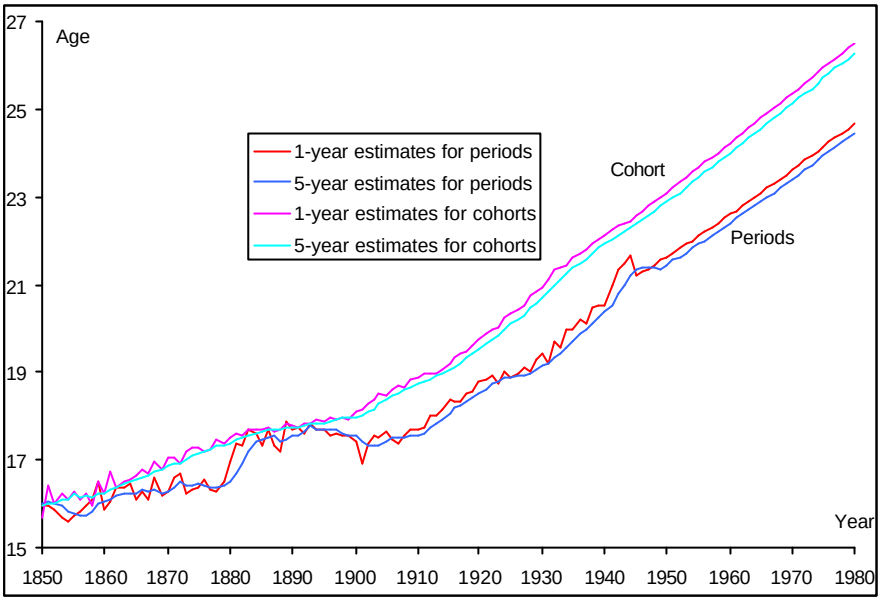
The new pension system in Norway will be implemented in 2010. Thus, the first cohort that will be able to retire according to the new system is the 1948 cohort, which will turn 62 in 2010. In 2009, when the members of this cohort is considering whether to retire or not in the following year, the most recent available estimate of the life expectancy at age 62, e_{62}, will be the estimate based on observations for 2008, which will become available in April 2009. This estimate is made on the basis of data for persons 62 and older in 2008, i.e. those born in 1946 and before.

Figure 5 shows that period e_{62} has increased rapidly for more than thirty years, after a decline from about 1950 to about 1970. (This decline was caused by an unfavourable mortality development for middle-aged and older men.) What about the *actual* number of years lived after age 62? It is likely that the declining death rates for older people in recent years will also affect the cohort life expectancy age ate 62. If a cohort lives much longer than the period e_{62} at the time of retirement, the pension fund needs to be distributed over more years, which may cause problems for the system.

The *cohort* life expectancy e_{62} for the cohorts that will soon retire, such as the 1948 cohort, will only be known after about 2050, when there is almost nobody left. Since this value is not available now it cannot, of course, be used to estimate pensions for the 1948 cohort. Instead we will have to rely on previous experience or projections of e_{62}, see figure 6. The upper graphs show that the cohort e_{62} has been growing steadily. The 1850 cohort lived on average 16 years after age 62 and the 1900 cohort about 18 years. We also see how the increasing mortality of men in the 1950s and 1960s led to a much slower growth of e_{62} for cohorts born between

about 1880 and 1900. For more recent cohorts we do not know the final number yet since they have not completed their life cycle, but we have used the medium variant death rates from the most recent population projection for Norway, for 2005-2060 (Keilman & Pham (2005) and http://www.ssb.no/english/subjects/02/03/folkfram_en/.)

Figure 6. Remaining life expectancy at age 62 for periods and cohorts, 1- and 5-year estimates*



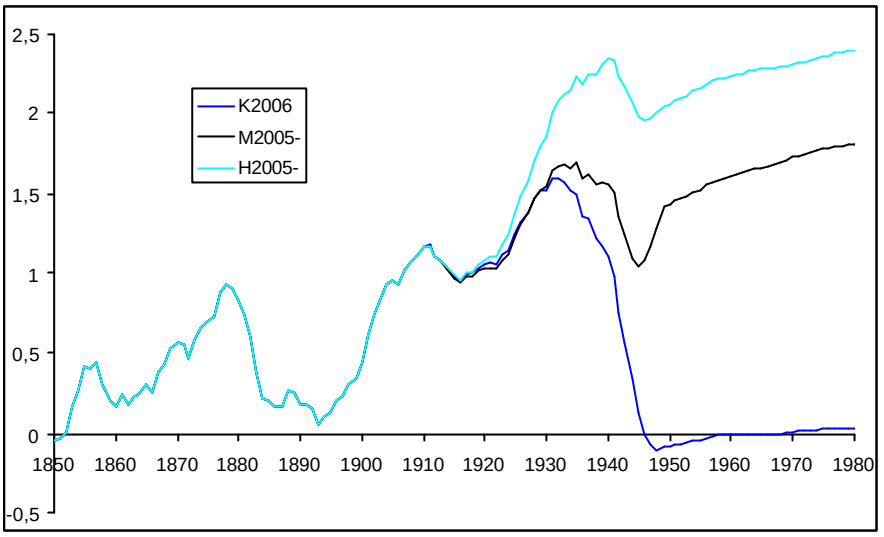
* The x-axis is the year of birth of the cohort. The period values are plotted for the year of observation minus 62.

The lower curves in figure 6 show the period e_{62} plotted against year of observation minus 62, to enable comparison of the cohort and period life expectancy at age 62. The difference between the estimates of these is shown in figure 7. Until about 1915, when only observed values have been used, cohorts lived between 0 and 1 year longer than the period e_{62} at the time the cohort turned 62. After 1915 we have extrapolated the cohort e_{62} with death rates from three different projections: First, the medium variant from the 2005 projection, as in figure 6. According to this projection the cohorts will live between 1 and 2 years longer than the observed period value when they turned 62.[3] The upper curve in Figure 7 shows the difference between cohort and period life span according to the *highest* variant in the 2005 projections (H2005). The lowest curve shows the corresponding difference if the observed period death rates in 2006 remain *constant* throughout the projection period, i.e. until 2060 (K2006). By definition this difference will approach zero over time.

We conclude from this comparison that cohorts may live up to, and perhaps more than, two years longer than the observed life expectancies when the cohorts where able to retire. However, with the use of a divisor as in the proposed Norwegian pension system, it does not matter much if this difference is constant. But if it is changing over time, e.g. increasing as there seems to be a tendency at, it would be more serious for the system.

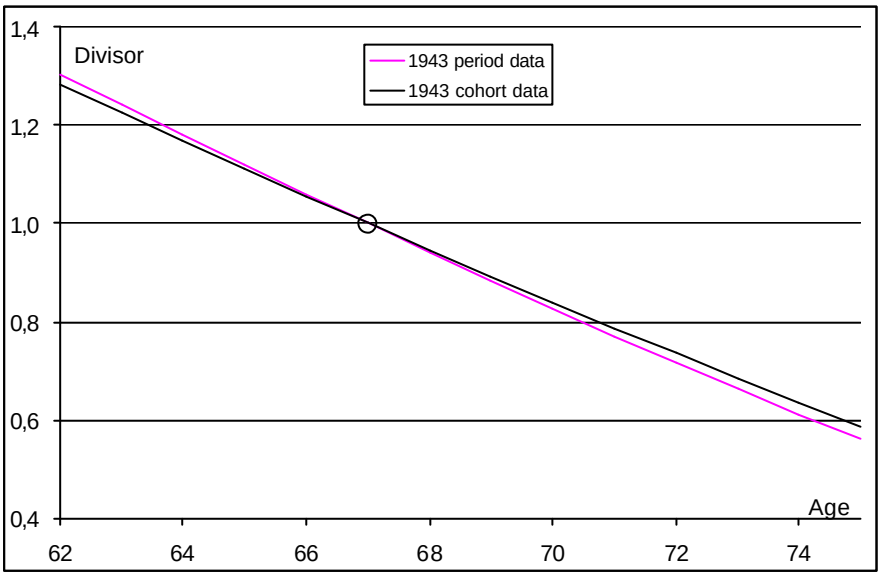
[3] The hump between the 1940 and 1950 cohorts is due to two factors: First, the unusually strong mortality decline since 2004, i.e. after the projections were made, especially for elderly persons. Second, the estimation of projected age-specific death rates from Lee-Carter parameters (Keilman and Pham 2005), introduced a discontinuity in the time series of the death rates between those based on past observations and those used in the projections.

Figure 7. Difference between cohort and period life expectancy at age 62, five-year estimates*



* The x-axis is the year of birth of the cohort. The period values are plotted for the year of observation minus 62.

Figure 8. Divisor based on period vs. cohort data for the 1943 cohort



Projected or "observed" survival probabilities?

It seems natural to use projected values for the estimation of the divisor in the pensions system. This would take care of some of the problems discussed above. There are, however, several problems using projected values:

1. Projections are uncertain. How can the uncertainty be taken care of in the pension system? The pension system administration needs to estimate the actual annual pension for each person who is retiring, depending on the divisor and the income history of each retiree. It cannot use confidence intervals for the pensions. Moreover, people who are considering retirement will most probably not be satisfied with confidence intervals for their annual pension.
2. Who should make the projections? In most countries the national statistical office would be the most qualified to do this. This would, however, introduce a strong political

element into the projections activities. The statistical office could be accused of making life expectancy projections that have been designed to satisfy some certain interests, e.g. those of the government. Moreover, the statistical office could perhaps be used for making unrealistic projections.

3. There is no universally accepted method for making mortality projections. Some may argue that their method is better than the one being used. Moreover, the method should be relatively simple to explain and to use. Finally, reestimation of the projected values when new mortality observations become available might yield quite different estimates.
4. For several decades the life expectancy has been increasing in most countries. This will probably not continue to be the case for ever. It may, however, be difficult to detect in projections. If there is a period of declining life expectancy some cohorts might get a considerably higher pension than preceding cohorts, which they would probably consider unfair.

For these reasons most countries have chosen to base the life expectancy estimated in the pensions system on observations and not on projections. This has been done in Sweden, Poland, Lithuania, Italy and Germany (Palmer 2003; Lindell 2004). However, projected life expectancies are used in the USA and in Latvia, where the projections are made by a government statistical institution and reviewed by an independent committee of experts (Palmer 2003; Technical Panel on Assumptions and Methods 2003).

However, a pension system cannot entirely escape projections of the life expectancy. There are at least two reasons why population projections are required:

- First, to estimate the future fiscal implications of the pension system. The government needs to have estimates of the future pension revenues and expenditures and the expenditures will depend on how long the future retirees will live.
- Second, when people are approaching the minimum age of retirement they will consider whether they should retire or not and for this they will want to know what pension they can expect to get if they retire soon or if they postpone their retirement. For this it is necessary to have life expectancy projections to estimate the expected divisor and the expected pensions.

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