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Adjusting Pay-as-you-go Financed Pension Schemes to Increasing Life Expectancy*

By Winfried Schmähl and Holger Viebrok

Abstract

This paper deals with the impact of increasing life ›expectancy on pay-as-you-go (PAYG) financed pension schemes and measures that aim at solving the resulting budgetary problems. Relevant determinants for financial considerations are particularly the ratio of beneficiaries to contributors and the pension level. The focus is on measures that directly integrate indicators of life expectancy into pension calculation. The authors discuss the effects of a) a general reduction of the pension level by introducing a life expectancy indicator into the pension formula, b) a reduction of the initial average pension at a given retirement age or c) an increase of the retirement age itself because of increasing life expectancy. The authors conclude that postponing retirement is an adequate measure for coping with the financial effects of increasing life expectancy.

Zusammenfassung

Der Aufsatz behandelt die Auswirkungen der steigenden Lebenserwartung auf umlagefinanzierte Alterssicherungssysteme wie zum Beispiel die gesetzliche Rentenversicherung in Deutschland und mögliche Maßnahmen, um den entstehenden Finanzproblemen zu begegnen. Für die finanziellen Auswirkungen sind insbesondere das Verhältnis von Rentnern zu Beitragszahlern und das Rentenniveau bedeutsam. Im Zentrum der Betrachtung stehen vor allem Maßnahmen, die die steigende Lebenserwartung direkt in die Rentenformel integrieren. Die Autoren diskutieren die Auswirkungen a) einer allgemeinen Senkung des Rentenniveaus, b) einer Veränderung der Rentenabschläge in Abhängigkeit vom Rentenbeginn sowie c) einer Anhebung des Rentenalters bei steigender Lebenserwartung. Die Autoren folgern, dass die Heraufsetzung der Altersgrenzen eine angemessene Antwort darstellt, um auf die finanziellen Konsequenzen steigender Lebenserwartung in umlagefinanzierten Alterssicherungssystemen zu reagieren.

JEL-ClassifiCation: J14, J26, H55, J18

* This paper has benefited from comments by three anonymous referees.

1. Introduction

Besides fertility and migration, mortality is one of the three determinants of the level of population as well as of its development and structure. In this paper, we are dealing solely with the impact of increasing life expectancy on pay-as-you-go (PAYG) financed pension schemes and discuss measures coping with the resulting budgetary problems.

This special focus, however, should not be misinterpreted as a statement on the widely discussed question of PAYG versus capital funded pension schemes. Funding is already an important characteristic of occupational as well as of personal pension schemes beside PAYG schemes in many countries, like Germany. For example, the German government decided to attach more importance to supplementary schemes, in particular to the third tier (private old age provision), whereas the statutory old age pension scheme shall remain PAYG financed. Such a shift usually implies distributive effects among cohorts, because more time is available for younger cohorts to accumulate appropriate savings. Though this subject is not within the scope of this paper, it belongs to its general conditions. Because all tiers have to fit into a comprehensive concept for the development of the old age security system, we place our focus on the impact of certain policy options in the PAYG financed part of old age security for different cohorts.

We also refer to reform measures that have been decided on or implemented in several countries aiming at a reduction of public expenditure in old age security. Some of these measures try to take the increasing life expectancy explicitly into consideration and introduce indicators for life expectancy directly into the pension scheme. This will be discussed in detail.

We mainly compare the following two alternatives and some of their effects:

1. Reducing the general pension level for all cohorts at a certain point in time,
2. Cohort-specific adjustments, especially
   a) cohort-specific pension levels or
   b) a method of linking the retirement age to the increase in life expectancy.

We only need a simple model to remind us of some basic interrelationships. German demographic indicators are used to illustrate some of our arguments, but this should be considered as an example only. In order to clarify the relevance of the German figures, we place the demographic situation into that of the other OECD-countries at the beginning of section 2. Our conclusions, however, are more generally related to earnings-related PAYG financed insurance schemes, in which benefits at least depend on the length of the working period. Such a scheme may be a 'defined benefit' scheme as well as a 'notional defined contribution' (NDC) scheme (Cichon 1999), but a direct link between contributions themselves and benefits is not essential for our arguments.

2. Demographic Changes

2.1 Changes in the Old Age Dependency Ratio

Old age dependency ratios are often used as an indicator for an increasing 'burden' in aging populations. Figure 1 shows a remarkable increase in this ratio (with age groups defined at 65+ / 15 – 64) between 1960 and 1997 for many of the OECD Countries. It is well known that the reasons for this increase can be found in two processes: the rapidly declining fertility rate in particular at the end of the 1960s and the decreasing mortality especially of older persons, resulting in higher life expectancy.[1] In addition, the rates are affected by the consequences of the two world wars.

In order to get some more generalizable figures, we use an imaginary static population as a basis for further considerations in the following. It is constructed exclusively from age-specific mortality rates. Therefore we assume that mortality by age and sex and the number of birth remains constant over time or rather fertility is exactly as high as necessary to sustain the number of women and men within the population. These assumptions fulfilled, cross-sectional as well as longitudinal analyses lead to the same frequencies within the age-groups.

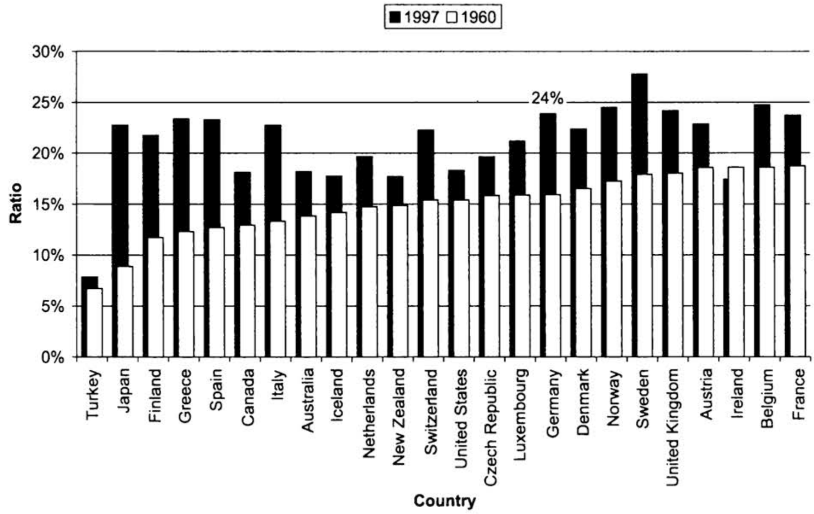
In the next step, we derive several old age dependency ratios from that population. The result is shown in Figure 2, based on the life table 1995 / 97 for Germany. In Figure 2, the age on the x-axis is used as the borderline between the 'elderly' and the 'younger' people within the population, i.e. between the age groups in the numerator and denominator of the old age dependency ratio.

Graph (1) shows the old age dependency ratio that is calculated by using age groups X+ / [15 up to (X-1)], where X indicates the age on the x-axis.[2]

Unlike graph (1), graph (2), starting at age 60, indicates dependency ratios with a fixed number of people in the denominator, taken from the total of

1 For a short overview, see Daykin / Lewis 1999.

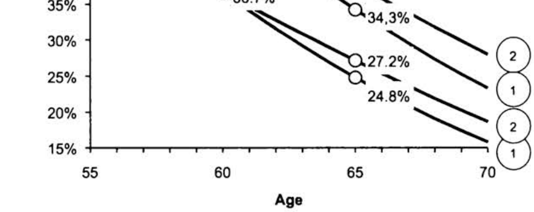
2 To provide an additional explanation: Figure 2 is the result of moving the vertical line in Figure 4 below to the right and evaluating the quotient of the area below the curve on the right side divided through the one on the left side at every point on the x-axis.



Source: OECD 1999, p. 6–7 (database: OECD Labour Force Statistics). Sorted by ratio in 1960

* defined as 65+/15–64, Italy: 14–64, Sweden: 16–64; Belgium, Greece, Iceland: 1996 instaead of 1997; Germany 1960: West Germany only.

Figure 1: Old Age Dependency Ratios* in OECD Countries



Source: Own calculations based upon data of official federal statistics (Statistisches Bundesamt 1997a)

Figure 2: Old Age Dependency Ratios within a Static Population, calculated at different Age-Limits, according to the German Life Table 1995/97

age groups (15 up to 59), i.e. using age groups X+ / (15 up to 59). If all people within these age groups participate in the old age pension system, graph (2) would indicate the systemic dependency ratio, if working life and hence the contribution payments stop after age 59. This could take place, for example, if an existing special pre-retirement scheme bridges the gap between the end of the working period and the beginning of the pension. The resulting difference between (1) and (2) at age 65 is 3.5 percentage points for women and 2.4 percentage points for men. This is relatively small compared to the expected development of the old age dependency ratio until 2030 (see below).

We can see by the comparison of ratios in Figure 1 with ratios in Figure 2 that mortality (in Germany) leads to relatively high dependency ratios even in a static population. Under these assumptions the old age dependency ratio defined at age 65 (i.e. age classes 65+ / 15 – 64) would be 24.8% for men and 34.3% for women (see Figure 2, graphs (1)). Although these ratios are higher than the empirical ones today, they are substantially lower than predicted for the future.[3] That future increase is caused by declining mortality as well as by low fertility rates since the end of the 1960s.

It is not necessary to emphasize here that the development of the population structure is only one of the determinants that affect the budget of a pension scheme. For financial considerations, the ratio of the number of beneficiaries (pensioners) to contributors ('pensioner ratio', 'systemic dependency ratio') is decisive. Especially the labour force participation rates and their changes result in important differences in both variables. But also the development of average pensions and average wages are significant for the financial conditions of the pension scheme (for details see below). The question whether a higher number of pensioners results in higher pension expenditure depends, amongst other things, on how pensions are calculated and whether the pensions are adjusted to the development of (average) wages or not.[4]

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[3] Figure 1 above shows for Germany a combined ratio of 24% for men and women in 1997. According to own calculations (based on data of Enquete-Kommission 1998: 114), the old age dependency ratio at age 60 (60+ / 15 – 59) will increase from 38% (women and men) in 2000 up to 61% in 2030 and 63% in 2040, whereas the stable ratios at age 60 are 36.7 and 48.1, respectively (see also Figure 2).

[4] For Germany, the association of the German statutory pension insurance agencies (VDR) calculates a so called 'standardized pensioner ratio' in order to eliminate the effects of such structural changes. This ratio is expected to rise from 42.5 in 2000 up to 60.6 in 2030. This is an increase of 43%, whereas the demographic old age dependency ratio is expected to increase much more in Germany if one uses the definition (60+ / 15 – 59) of the ratio (see above). According to the German Ministry of the Interior (Bundesministerium des Innern, without year) this ratio will increase from 40.9% in 2000 to 73.2% in 2030, an increase of about 80%.

2.2 Developments in Mortality and Life Expectancy

Investigating the effects of increasing average life expectancy, it is important to know in which age segment a decrease of mortality takes place. For a long time, an increase of the average life expectancy (at birth) was achieved – amongst other things – by a decrease in infant and child mortality. In recent time, an increase in life expectancy is above all a result of a decrease of mortality rates in old age. For example in West Germany, the life expectancy at age 65 has increased relatively much more than the (average) life expectancy at birth (see Table 1). This increase in the life expectancy of the elderly has mostly been underestimated in the past.

Table 1

Life Expectancy at Birth and at Age of 65 in West Germany 1960 – 1995

Life table	At birth		At age of 65	
	Males	Females	Males	Females
1959/60	66.69	71.92	12.38	14.37
1993/95	73.53	79.81	14.79	18.57
	Change in percent			
1960/95	10.3	11.0	19.5	29.2

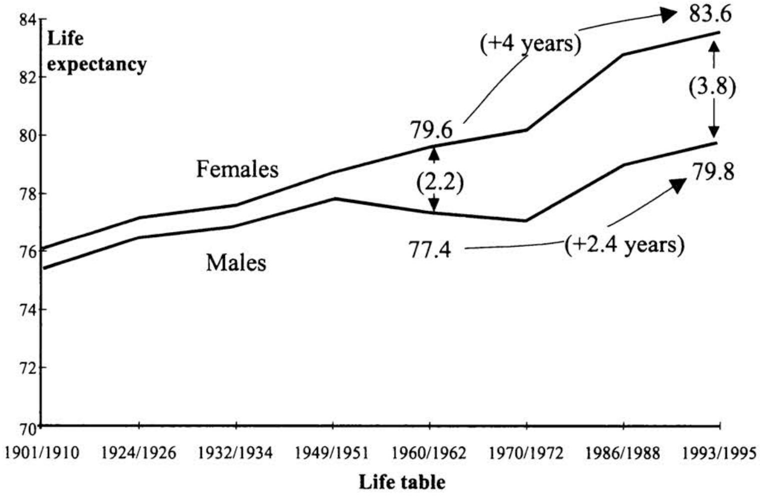
Source: Enquete-Kommission (1998: 45, table 14).

Especially during the past two decades, the increase in further life expectancy for the elderly was remarkably higher than in the previous period since the beginning of the twentieth century. This is shown in Figure 3 as an example for the life expectancy of persons aged 65.[5]

In West Germany around 1960, the life expectancy for women aged 65 was 79.6 years on average, the further life expectancy thus was about 14.5 years.

[5] These data are based on cross-sectional mortality tables and refer to West Germany (1949/51, without the federal state 'Saarland', however). – Life expectancies in East Germany were and are below those in West Germany. Changes also arose in the situation after the unification: "A comparison of mortality in the East and West of Germany prior to and after the unification shows a divergence of life expectancy for men up to age 50, while the differences in life expectancy for women decreased"; (Sommer 1996: 18). A comparison between East and West Germany for the period 1950 – 1995 is given in Enquete-Kommission (1998: 46, Fig. 5). In general, an approach of the life expectancies in East and West Germany is expected due to the increasing similarity in living conditions.

It increased by additional 4 years to 18.6 years until the mid-nineties. Life expectancy for men is clearly lower. Moreover, the difference in (average) life expectancy for men and women even increased during the recent decades. Around 1960 it was 2.2 years, while in the middle of the nineties the life expectancy of women aged 65 was then 3.8 years more than that of men.



Source: Statistisches Bundesamt (federal statistical office) 1997b: 76.

Figure 3: Development of Life Expectancy at Age 65, West Germany

Not only the increasing life expectancy in general but also the higher difference in the life expectancy for females and males affects the financial situation of pension schemes, because not only (ceteris paribus) the average duration of contributors' pensions increases – but also of survivors' pensions.

Hypotheses about the future development of mortality and life expectancy are rather controversial. As already mentioned, deaths more and more shift into higher adult age (the curve of survivors increasingly approaches a rectangular form). "Populations are aging, but even given current age distributions, about one-third of male deaths and half of female deaths in developed countries occur after age 80" (Vaupel / Lundström 1996: 278). Therefore, in highly developed national economies a further increase of life expectancy is based on the decrease of mortality at higher age.

Two developments have to be considered (see Figure 4): (1) Is there a decrease in mortality in the upper age range with the maximum life span remaining largely unchanged or (2) is there a shift in the upper 'limit' for the maximum life span as well? In the latter case, the number of very aged persons (e.g. persons aged 80+) would also increase. With regard to the question as to what extent an extension of the life span may be assumed, different hypotheses are supported in the literature.[6]

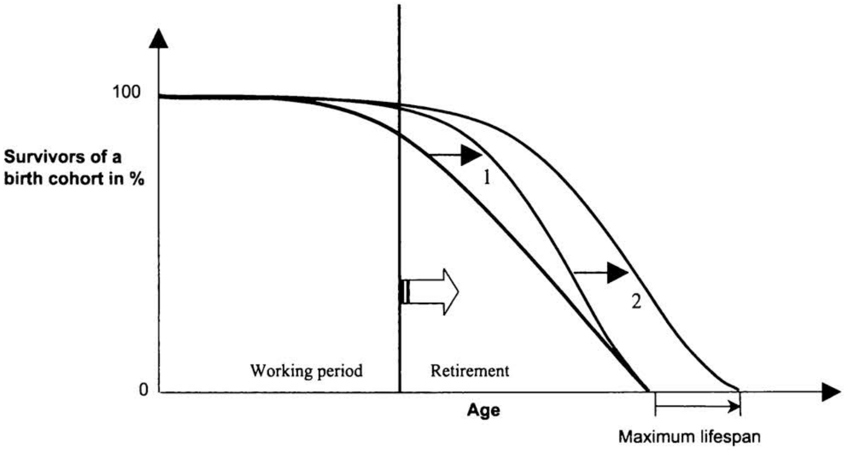


Figure 4: Changes Resulting in Higher Life Expectancy

Increasing life expectancy for the elderly is assumed in the population prognoses, for example, for Germany. The assumptions are mainly orientated toward the fact that in many other highly developed countries a significantly higher life expectancy has already been reached. On the other hand, one should remember that expectations concerning the future are often strongly shaped by the developments of the recent past. In a long-term perspective – e.g. for growth processes in biology – for many variables, there is often a development with a at first slow, then accelerated increase, which later decelerates again (S-shaped development).

As can additionally be seen from Figure 4, the effects of postponing retirement age (shift of the vertical line) on the number of retirees and people at working age (areas below the curves) depend particularly on mortality at retirement age (i.e. the slope of the curve at retirement age). Effects of changing the retirement age are discussed below.

6 For discussion, see Vaupel/Lundström (1996) and the literature given there, as well as Manton, Stallard and Corder (1998), Enquete-Kommission (1998: 48 f.) and Birg and Börsch-Supan (1999: pp. 72–79). In the population projections of the United Nations the maximum life expectancy has increased by 10 years within 15 years; see Enquete-Kommission (1998: 49).

3. Consequences for Pension Schemes

3.1 Systemic Dependency Ratio and Pension Level as Key Determinants

The basic relationships between central variables in a PAYG pension scheme can be described by a straightforward mathematical analysis. Provided that the expenditure of the scheme is mainly for pensions, they can be calculated as a product of the number of pensioners (NP) and the average pension (AP). With (R) as the total of revenues, we define the budget constraint as

(1) $$R = NP \cdot AP$$

The revenues are from contribution payments (C), which are composed of the contribution rate (c), the number of contributors (NW) and their average income (AW):

(2) $$C = c \cdot NW \cdot AW$$

Hence it follows that

(3) $$c \cdot NW \cdot AW = NP \cdot AP$$

Two basic equations can easily be derived from that.

(4) $$c = \frac{NP}{NW} \cdot \frac{AP}{AW}$$

As can be seen from (4), the contribution rate that is necessary to balance the budget (if there is no other revenue) can be determined as a product of the *'pensioner ratio'* $\frac{NP}{NW}$ and the average gross *pension level* $l = \frac{AP}{AW}$. This can be converted to:

(5) $$\frac{c}{l} = \frac{NP}{NW}$$

This simply denotes that for budgetary equilibrium the ratio of contribution rate to pension level (l) must equal the pensioner ratio.

When an increase in the number of pensioners takes place (as ceteris paribus in case of an increasing life expectancy), a new combination of contribution rate and pension level is needed. It can be achieved for example by a constant contribution rate but lower pension level, i.e. by cutting down the whole scheme, or by a constant pension level but rising contribution rate. But under no circumstances can a solution be achieved which leaves contributors and pensioners better off at the same time. In Germany as well as in other countries, these relationships lead to demands for measures aiming at reducing the general pension level. Such measures are in contrast with cohort-specific ones below.

3.2 Long-Term Effects

The long-term or intertemporale relationships within old age pension schemes play an important role for the determination of policy options. Because a PAYG old age pension scheme is based upon the confidence of getting equivalent benefits in old age in return to contribution payments, every public discussion on cutting benefits not only causes fears of losing future income, but also resistance against further payment of contributions.

In earnings-related pension schemes, on which we focus here, an increase in employment reduces the pensioner ratio, at least in the short run. But in the long run every insured working hour creates new future pension claims (for detailed analyses see Schmähl 1989, 1990). An increase in the number of insured employees must be followed by a steady growth of employment in order to maintain low contribution rates in the long run (Viebrok 1999).

As we can see, the set of policy options in the case of a rise in the pensioner ratio can be described as a dilemma: lowering of the pension level tends to increase poverty in old age and intensifies resistance against the payment of contributions as does, on the other hand, an increase of the contribution rate. Higher contribution rates may also be harmful to employment and economic growth. Even additional employment may eventually produce future budgetary problems.[7] In our opinion only a combination of several measures is able to lessen the financial impact of the demographic changes and the distributive effects (some of which are discussed below). A limitation of the expenditure in the first tier is to be included as well as relying more on the second and third tier of old age provision, i.e. a change in the public-private-mix of old age provision. The question is how to mix the different measures in an optimal manner.

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7 One additional possibility not discussed here is to increase the federal grant (financed by taxes).

4. Responding to Increasing Pension Expenditure due to Rising Life Expectancy

4.1 Overview

In this section we discuss a few alternatives to limit the development of the expenditure of PAYG public pension schemes.[8] As mentioned in our introduction, these alternatives have to fit into a comprehensive concept that includes public, occupational and private forms of provision for income during old age in order to avoid undesirable distributive effects. Especially cuts in the level of public pensions are easier to cope with, if alternative options for old age provision are available and feasible.

Ceteris paribus, an increase in life expectancy increases pension expenditure because of the rising number of pensioners at a given point in time. A great variety of measures exist to respond to this by

a) increasing revenue from contribution,

b) using alternative financing methods like funding within the system,

c) reducing the development of expenditure by influencing either the pensioner ratio or the average pension level.

As mentioned above, we focus here on the expenditure side of PAYG pension systems by contrasting two types of measures: those which lower the pension level in general and those which link the calculation of the pensions to life expectancy of different cohorts. The latter can be done by cohort-specific pension levels or by postponing the retirement age thereby influencing (amongst other things) the pensioner ratio. Under certain conditions, however, the latter two alternatives lead to the same result.

Proposals aiming at postponing retirement age usually refer to the 'normal' or 'regular' pension age, at which the pension can be started without actuarial deductions. In the following, we use the term 'standard' pension age to refer to this age, which is not identical with the retirement age actually chosen. But if someone prefers to retire earlier, deductions have to be taken into account. Thus, the average pension decreases, if the behaviour remains unchanged despite a raised standard pension age. But on the other hand, in contrast to postponing the standard pension age, a general reduction of the pension level affects all cohorts, whether their life span is expected to rise or not.

8 For a general discussion of different options, see Schmähl 1987.

4.2 General versus Cohort-Specific Reduction of the Pension Level

In Figure 5, we compare the amount of the yearly pension that can be paid depending on the retirement age and on two different life expectancies (80 and 85 years of age). We additionally assume that the individual accumulated pension payments are to remain constant and that no adjustment of the pension takes place. Furthermore, our view is limited to life expectancy (i.e. no age-specific mortality rates are taken into consideration) and to a world without interest or discounting of future consumption. Although this model surely lacks analytical richness if we would like to compare capital funded versus PAYG pension schemes, it is able to explain a few basic relationships.

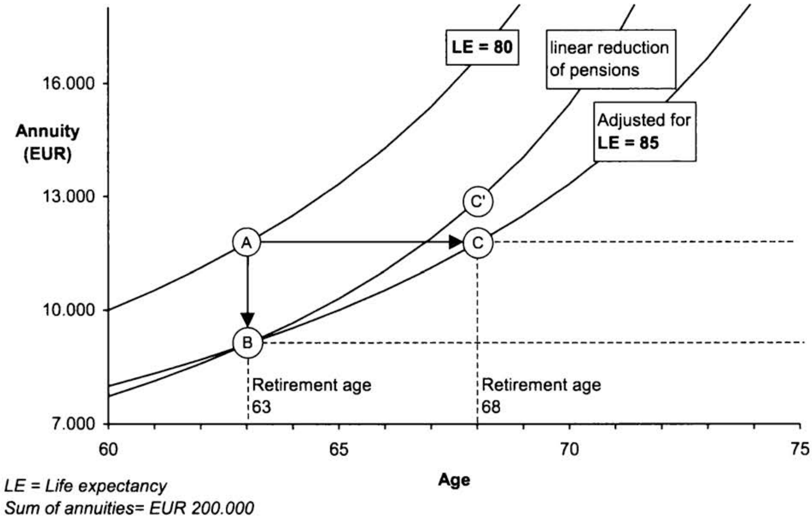

Figure 5: Lowering the Pension Level versus Postponing the Standard Retirement Age

The slope of the above curve through (A) represents the respective pension deductions at a certain retirement age, based on a life expectancy of 80 years.[9] We want to emphasize clearly that not only the pensions, but also the deductions need to increase with the pension age chosen. An adjustment to an increase of life expectancy leads to a lower pension (for example point (B) at retirement age 63) and to lower deductions at a certain retirement age

9 In a broad view the slope equals actuarial fair deductions, but Figure 5 includes neither interest nor pension adjustments nor age-specific mortality rates. Hence the present value simply equals the sum of payments during lifetime.

(slope at point (B) compared to that at point (A)). In this case – i.e. if the deductions are adjusted, too – cutting the pension level and postponing the standard pension age lead to the same result, if we neglect external effects (mainly the normative strength of the standard retirement age on the labour market). If the sum of payments *and* the annuity are to remain constant at the same time, although life expectancy increases from 80 to 85, the pension age must be postponed, in this case to 68 instead of 63 (point (A) to (C) in Figure 5).[10] In this case, the deductions at the new higher age are the same as they have been at the former lower age.

Simplifying very much, we can say that this is the essence of the Swedish pension reform with respect to the adjustment of pensions to life expectancy. It completely holds for birth cohorts that are born later than 1953. The Swedish pension reform introduces a 'notional defined contribution' scheme, i.e. accumulated nominal individual contribution payments (including some 'interest') are transformed into an annuity by dividing the accumulated pension claims of a cohort by its (remaining) life expectancy (Scherman 1998: 421). Although the earliest possible retirement age remains 61 for all cohorts in Sweden, this in fact gives incentives to a postponement of the retirement age as shown in Figure 5. The Swedish pension scheme, however, remains PAYG financed. This approach has also been implemented in Latvia and Poland.[11]

The former German government took another direction. An additional 'demographic factor' was inserted into the adjustment formula with the 1999 pension reform act[12] (for details see below). It aimed at a step-by-step reduction of the general pension level by about 8% – 9% due to the development of life expectancy at age 65. This factor has meanwhile been abolished and replaced by an ad-hoc reduction of pensions adjustments by about 4% in 2000 and 2001. Both measures imply that all pensions will have been reduced by this percentage compared to the previous rules.

Given a *fixed* pension age, the reduction of expenditure could in fact be achieved also by such a general linear reduction of the pension level (described for example by a movement from point A to B in Figure 5). But given a *flexible* retirement age (as it is the case in Germany), this leads to different effects if other retirement ages are actually chosen, because the actuarial deductions are not adjusted at the same time. For instance, a linear reduction that results in the same pension amount at retirement age 63 (shown by

10 If we assume that the end of the working period follows that shift because the working period is extended, the pension accrual increases to an greater extent because of the additionally acquired pension claims. For details see below.

11 For details see Rutkowski 1999, Schmähl and Horstmann 2000.

12 Rentenreformgesetz 1999.

the line through (C') in Figure 5) leads to a higher pension amount at retirement age 68, shown by (C') in comparison to (C). Hence in this case the sum of payments varies due to behaviour, i.e. due to the actually chosen retirement age.

Deductions that are too low give incentives to retire earlier. This also holds, however, for people or cohorts with an above average life expectancy, if deductions are calculated as an average for all people or cohorts. Deductions that are too high lead to greater losses of income for early retirees than necessary. This could happen, if the (linear) deductions at a constant percentage rate that are used in many countries (like in Germany), are applied to a postponed standard pension age without any adjustment (they should be increasing as described above).

4.3 General Reduction of the Pension Level

Introducing the life expectancy of the respective cohort into the initial calculation of pensions clearly affects cohorts in such a way that the lower life expectancy is, the higher are annual pension benefits (if the present value of accumulated contributions remains the same). As mentioned above, in Germany in 1997 another approach was taken by introducing a specific indicator, the so-called 'demographic factor', into the formula for adjusting all pensions.[13]

Although it never came into force, because the new government suspended it after the election to the Federal Parliament in September 1998, we document the formula here. It is:

$$APV_t = APV_{t-1} \cdot \frac{AWN_{t-1}}{AWN_{t-2}} \cdot \left(1 + \frac{\frac{X_{t-9}}{X_{t-8}} - 1}{2} \right), \tag{6}$$

where t denotes the actual year and APV the 'actual pension value' (equivalent of one earnings point, see also footnote 13). Since 1992, pension adjustment in Germany's statutory pension scheme is based on the development of

[13] In the German pension system, old age pensions are related to the 'average relative earnings-position' during the working period. To be more explicit, pension claims depend linearly on individual 'earnings points', which are calculated as the ratio of individual insured gross earnings to average gross earnings per year. The general pension level is linked to a 'standard pension'. That is calculated as a pension of someone, who was given 45 earnings-points, for example for average earnings during 45 years of insurance. The standard pension amounts to 70% of the average net earnings of all insured people. All pensions are linked to an index of that average pay by adjusting the value of one earnings-point in DM (called 'actual pension value').

average *net earnings* (here symbolised by the first fraction). An additional factor based on the life expectancy at age 65 (X) was included, however with a time lag of 8 years and only with half of its weight. In the next years, this would have reduced the adjustment rate by 0.5 percentage points per year. Obviously, this reduces the pension level compared to an adjustment rate based on average net earnings development.[14]

The suspended adjustment formula (6) consisted of several arbitrary elements:

- The monthly pensions of all cohorts are affected to the same extent, even if their own life expectancy did *not* change.
- The division by two has no systematic reason, just like the time lag and the introduced floor (all are the result of a compromise on different political objectives concerning the pension level).

As mentioned above, the demographic factor was substituted by an immediate ad-hoc cut of the pension level during 2000 and 2001. In these two years, pensions are adjusted to the inflation rate instead of net wage growth. The first rate was expected to be lower.

4.4 Cohort-Related Standard Pension Age

If life expectancy increases and retirement age remains constant, the span for receiving pensions is extended in absolute and relative terms. Ceteris paribus, the number of pensioners, the pension expenditure and the necessary amount of revenue increases.

In principle, the total amount of pension payments for a cohort between retirement age and the end of the cohort's life-span is (amongst other things) determined by the total number of remaining years of all cohort members until the end of the life-span and by the pension level. If the total number of remaining cohort years is increasing, this can be compensated by an adjustment of the initial average pension and the deductions at a given retirement age or by an increase of the retirement age itself. This is similar to the calculation of initial pension amount in the individual perspective described in Figure 5, but in order to calculate the financial effects of postponing retirement age exactly, we have to take into account that the changing number of

[14] Nominal pension cuts because of the demographic factor were prohibited, thus the formula would only have become effective, if the average net earnings increase was at least as high as the cut. There was also a floor for the pension level introduced, i.e. the demographic factor would have been suspended as soon as this level had been reached. Because of that guarantee and the uncertainty of life span development it was hard to predict, how long this transition process towards the lower pension level would last (surely longer than one decade).

pensioners is not only due to the shift of retirement age but also to mortality at retirement age (see also Figure 4) and the conditions of eligibility for survivors' pensions. Hence a refined actuarial analysis is necessary to determine the appropriate deductions for a certain national pension scheme. That is beyond the scope of our paper.

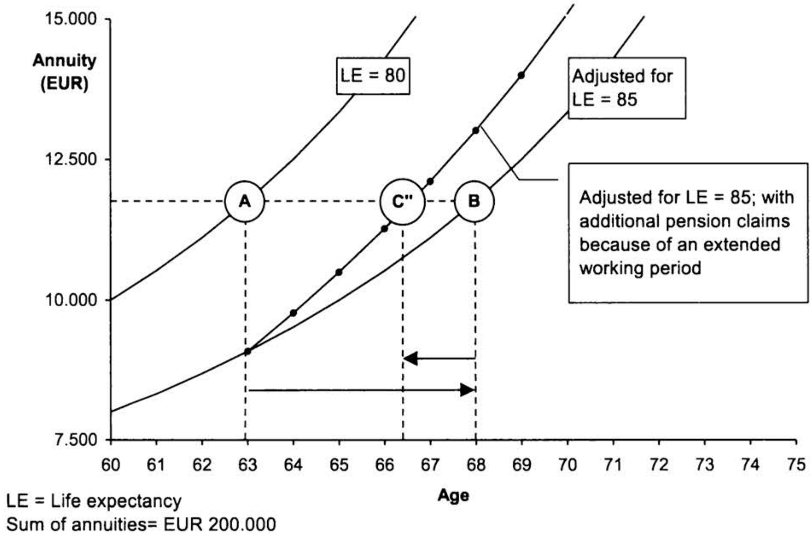

Figure 6: Compensation for Pension Level Reduction by Prolonging the Working Period

How an increase of life expectancy leads to lower annuities based on the assumption of fixed total payments was shown in figure 5. Left aside was the fact that prolonging working life results in higher pension claims in an earnings-related pension scheme, due to the rules of calculating pensions. This can under certain conditions partly cover the reduction of the pension level. This is shown in Figure 6, which is based on Figure 5. Here a new graph (through (C″)) exemplifies the annuities that are possible if we take into account the additional pension claims (and contributions) derived from extending the working period. As can be seen, in order to maintain the monthly pension level it is enough to postpone the retirement age from age (A) to age (C″) instead of age (B), i.e. to a smaller extent.

If life expectancy is increasing, a reallocation of time in the life cycle by extending working life and not by extending the time spent in retirement to the full amount of an increase in life expectancy seems to be plausible: "... there is a natural merit in extending retirement ages and discouraging earlier retirement" (Chand / Jaeger 1996: 31).

However, if retirement age is flexible, the effective retirement age depends not only on the standard retirement age but also on labour market, health and household conditions, income, and individual preferences.[15]

It is possible to increase standard retirement ages based on ad hoc decisions as it is done in many countries. Such an increase is mostly phased in over a long time. Besides ad-hoc increases in standard (and maybe also minimum) pension ages, it could also be based on a *rule* that takes life expectancy development into account. Such a rule could be: if life expectancy increases, retirement ages will be raised, too. This can take place not only for the standard retirement age – i.e. age for taking up the full pension without actuarial deductions – but also for the minimum retirement ages. A possible reason is that otherwise the effect of actuarial deductions from the full pension in case of early retirement reduces the absolute amount of pension benefits 'too much' according to distributive objectives. Such a rule was proposed for Germany as an alternative to a general reduction of the pension level (Schmähl 1997, 1998). To allow workers to adapt to new rules, such an increase in standard retirement age can be announced some years before it becomes effective, i.e. the increase in retirement age follows the development of life expectancy with a time lag of some years.

If life expectancy rises, e.g. by one year, the increase in retirement ages will be less than one year. Calculating the distribution of one year of additional life expectancy (at age 65) between (a) an increase in working period and (b) an increase in additional time in retirement (to fix the new standard retirement age), two possibilities are mentioned for illustrative purpose:

1. Calculation in the PAYG-Scheme: assuming the aim is not to increase the contribution rate and not to reduce the average (gross) pension level, we start with a pension level $l = \frac{AP}{AW} = 0.5$, a contribution rate $c = 0.2$ and the pensioner ratio $\frac{NP}{NC} = 0.4$. Under these conditions, the increase of life expectancy by one year would increase NP, if retirement age remains constant. Based on these data the allocation of an additional 12 months (to leave the pensioner ratio constant at 0.4) lead to a 8.6 months higher standard retirement age as well as earliest age for initial eligibility for an old age pension. This would also result in 3.4 months of additional time in retirement.
2. Aaron and Reischauer (1998: 101) propose a rule for distributing additional years (after the phasing in of the standard retirement age in the

[15] There exists a great number of publications dealing with the connection of mortality decrease with development of morbidity, e.g Manton et.al. (1997). Wise (1997) demonstrated by means of an option value analysis based on data of a great firm, that the behaviour also depends strongly on the benefits of occupational pensions.

US from 65 to 67 in 2011[16]: "Workers who spent the same proportion of their adult lives in retirement as those terming at 62 in 2011 would receive unchanged benefits. In other words, if retirement represented one-fourth of adult life in 2011, a one-year increase in adult longevity would lead to the benefit cut associated with a nine-month increase in the age at which unreduced benefits are paid".

To retire before the standard retirement age results in a lower pension because of (actuarial) deductions. If workers know the 'rule of the game' and can expect an increase in the retirement age, they are confronted with the decision to work longer and not to receive a reduction in pension or to retire earlier with lower benefits.

4.5 Resulting Distributive Effects among the Pensioners

Several preconditions are necessary to implement an extension of working life in case of further increase of life expectancy: labor market conditions that allow workers to remain employed; retraining also of older workers; possibilities to 'save' for retirement (either as individual additional savings or via the firm as occupational pensions or on time-saving accounts) in order to have assets in case of earlier exit from the labour force. Savings may be used to bridge the time span between exit and taking up full pension or to compensate deductions in case of retirement before the standard retirement age.

If the 'standard' retirement age is raised but the effective retirement age remains unchanged, eventually strong cohort effects occur among the pensioners for several years, because only certain cohorts, in particular those who retired after the reform and during periods with high unemployment rates, are affected.

On the other hand, the fact that only future retirees are affected by postponing the retirement age fits well into a concept that includes a gradual shift from the first to the third tier. As mentioned at the beginning of this paper, such a shift eventually discriminates against older cohorts, if it is realised by a general reduction of the pension level, because older cohorts eventually will not have enough time to accumulate appropriate savings. (This should, however, be viewed in connection with the distributive effects of other measures within the cohort's life span.) In contrast to a general reduction of all pensions at the same time, the linking of retirement age to life expectancy does not affect older cohorts and younger people have the possibility to provide privately for their income in old age. This is the more im-

16 US Government had decided to phase this in by 2022.

portant, the greater the pressure is to reduce the pension level for other reasons, e.g. because of low fertility rates. A second problem is, however, that the remaining high contribution rates eventually do not allow for additional private savings, especially in lower income groups. This may be solved by modifying the income tax rates.

Postponing the retirement age cannot cope with *all* demographically induced financial problems of the pension scheme, like a declining fertility rate, and especially not with sudden shocks that reduce revenues. But it is well suited to deal with the financial consequences of the gradually increasing life expectancy, especially if the labor market conditions allow for compensating the deductions by extending the working period.

5. Conclusion

Demographically induced financial problems in PAYG pension schemes are in the centre of pension reform debates in many countries. The reasons for a rising old age dependency ratio are mainly past declining fertility rates and currently rising life expectancy. The paper dealt with the latter, i.e. reduction of mortality. It was argued that the financial consequences of the increasing life span for a PAYG pension scheme should be compensated for by raising the standard retirement age (and eventually the earliest retirement age, too). If actuarial deductions (that make the system to a great extent independent from individual decisions on the effective retirement age) are implemented this would reduce the pension level if behaviour remains unchanged. But as was demonstrated in this paper, because of the additional contributions and claims resulting from extending the working period in an earnings-related pension scheme, the postponement of retirement age must not be as long as the increase of life expectancy. Additional years of one's life are shared between work and retirement.

Several rules that aim at raising the retirement ages and ensure stable conditions for long-term decisions were presented in this paper. Whether they are suitable at all depends mainly on labour market and working conditions as well as human capital development, personnel policy and the institutional framework of individual old age provision. Furthermore, social policy has to consider the country-specific structure of the entire old age-security system, including the first tier and supplementary schemes. Linking the retirement age to the slowly increasing life expectancy fits into a concept that gradually puts more emphasis on capital funded supplementary schemes, because more time is available for members of younger cohorts to build up appropriate savings.

Raising retirement ages, however, responds correctly to the increase in life expectancy, but not to declining fertility. Hence measures of this kind as discussed above are often a necessary, but not a sufficient condition for financial stability of pension schemes. In particular, the impact of unemployment and low fertility makes it harder to sustain the current pension level and may lead to further differentiated measures that could not be considered in this paper. However, postponement of the retirement age is also necessary for the future sustainability of PAYG pension schemes in aging populations.

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