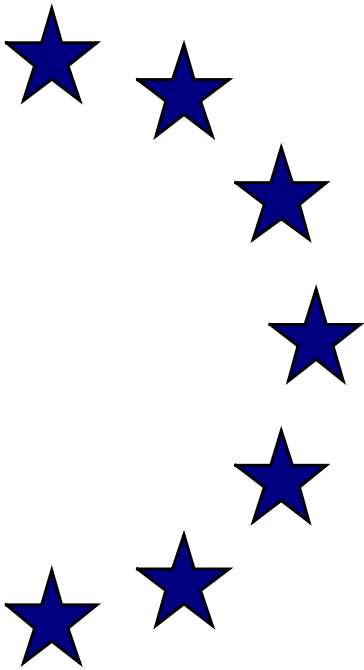


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**Pension reforms : key issues illustrated
with an actuarial model**

by
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and Financial Affairs

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Pension Reforms:
key issues illustrated with an actuarial model

by
Heikki Oksanen*

Abstract

The paper examines pension reforms under ageing. With stylised facts, ageing is traced to low fertility and increasing longevity. Given these persistent factors, pension systems must be reformed to avoid an unfair burden being left for future generations.

The main results for reform blueprints are:

- (1) In a Defined Benefit (DB) system, partial pre-funding is needed to achieve intergenerational fairness unless benefits are sufficiently reduced; partial privatisation is an option for the management of the accumulating funds.
- (2) Transition from a DB to a Notional Defined Contribution (NDC) system is another reform option; it reduces the replacement rates to levels which match prescribed contribution rates; an NDC public pillar can be accompanied by a second pillar, managed by the private sector.
- (3) An effective retirement age increase is necessary to moderate the increase in pension expenditure and to preserve adequate pension levels.
- (4) Pension reforms have important effects on public finance target setting.

The presentation is non-technical and does not require prior knowledge of pension reforms.

JEL classification: H1, H5, H6

Keywords: Pension reform, pre-funding, privatisation, defined benefits, notional defined contribution system

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Caveat

Views expressed in the paper are exclusively those of the author and do not necessarily correspond to those of the European Commission, for whose Directorate-General for Economic and Financial Affairs the author is working.

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EXECUTIVE SUMMARY

This paper addresses the design of pension reforms under ageing populations caused by low fertility and increasing longevity. Reforms are assessed, in particular, with regard to *financial sustainability* and *intergenerational fairness*. As a benchmark for the latter it is required that all generations with the same fertility and longevity should pay the same proportion of wage to pensions to earn the same replacement rate and retirement age. Correspondingly, if the demographic factors differ from one generation to another so also should the pension benefits and/or the replacement rate.

Defined Benefit system to be pre-funded

A pure PAYG Defined Benefit (DB) system is always sustainable by definition if contributions are increased to cover expenditure at every moment in time. Under ageing, however, this represents an unfair burden sharing across generations. A criterion introduced in this paper requires that the generation which reduces fertility and/or lives longer than its predecessors, should correspondingly pay more for the same replacement rate and retirement age. Thus, under ageing, contribution revenue should exceed pension expenditure, creating a fund. Based on stylised facts for EU-15, this implies that contribution rates should now be increased drastically, leading to pension fund accumulation of over 150% of GDP in the next 60 years.

The size of the projected fund corresponds to the order of magnitude of pension funds in some EU Member States, but the high contribution rates required make it unrealistic as a reform proposal. However, the message of this projection is important: people should be informed of what they should pay into a public pension system if they want to preserve current benefit levels and retirement age, and if they want to be fair to future generations. If they are not prepared to pay this price, then they should – individually and collectively - accept pension reforms which involve reducing the replacement rate and/or increasing the retirement age.

We show that under the projected ageing, a retirement age increase of about three years is required to moderate to any significant degree the required rise in contribution rates in the long run. The resulting partial funding is, however, not much affected by this as the induced reduction of pension expenditure and increased contribution revenue in the short run should not immediately lead to lower contribution rates. Rather, the induced surplus should be saved for covering future expenditure.

This leads to the result that a vast range of pension system options for a stylised EU-15 economy imply pension fund accumulation of 100-150% of GDP in the next 60 years, of which 2/3 in 30 years. Only if replacement rates were radically reduced would the need for partial funding be removed.

Once the case for partial funding is established, the question about management of the accumulating funds arises, except where the government initially has a large debt and uses the accumulating funds for debt amortisation. In other cases, special institutions could be established to place these funds. Depending on attitudes towards the role of the state, partial privatisation by diverting part of contribution payments to a second pillar might become attractive. A fully funded second pillar has desirable properties with respect to a firm link between contributions and benefits, is therefore actuarially fair and

reduces labour market distortions. It should be noted, however, that this is achieved at the expense of deterioration of the publicly managed first pillar in these same respects.

The new approach presented in this paper for reforming a DB system under ageing to achieve intergenerational fairness through partial pre-funding is meant to be easily understandable and applicable in practise. Fortunately, it is not necessarily in contradiction to other arguments presented elsewhere. Rather, an argument that a combination of a PAYG and a funded pillar is advantageous as it helps to diversify various risks is an additional one and reinforces the case for implementing pre-funding. Furthermore, funding may ease labour market distortions, increase total saving and GDP, and also lead to higher returns on pension contributions. These are possible additional positive effects of funding, but as they might be controversial and depend on circumstances in each case, it should be seen as a merit that the argument pursued in the present paper does not depend on them. In addition, the method here leads to a time path for partial pre-funding and/or privatisation, which can be considered to be a proxy for fair burden sharing across generations during the transition period.

Transition to a Notional Defined Contribution system

Transition to a Notional Defined Contribution (NDC) system is an alternative way to achieve financial sustainability and intergenerational fairness in the public pension system. If the personal accounts to which the contribution payments are recorded are set to earn an interest equal to the rate of growth of contributions (i.e. wage bill growth if the coverage remains constant), replacement rate is automatically reduced so that pension expenditure adjusts to contribution revenue.

During a transition to an NDC system, however, a deviation from financial balance may occur, depending on how the rules are set to transform the accumulated DB rights to NDC accounts and also on the possible changes to retirement age. Sustainability of the system may therefore require a transfer from the general government budget or specific adjustments to pension fund parameters during the transition period.

As the projected ageing leads in an NDC system to a considerable reduction of the replacement rate, the introduction of an additional pension contribution, which is transferred to a newly established fully funded second pillar (or to a voluntary third pillar) becomes an option. This would lead to partial funding of the pension system as a whole, with a roughly similar level of contributions and replacement rates as in a partially privatised DB system. Thus, the two alternative reform blueprints may lead to similar outcomes in these respects, although they differ drastically with respect to rules for determining contributions and benefits, and also require quite different measures for managing the transition. They also cope in different ways with any further changes in demographic factors or in retirement age.

Implications for setting targets for public finance

As a public pension system falls within general government finances, any surplus or deficit has a direct effect on public finances as a whole. The effects of pension reforms on contribution payments, pension expenditure and funding are key indicators, but in addition, the choices of whether government gross debt is reduced, whether reserves are built within the public sector, or whether the pension system is partially privatised, all directly influence public finances. Consequently, any projected path for the financial balance of a pension system and any pension reform considered or implemented have

marked implications for public finance target setting, notably for the overall balance of the general government. A method is presented which leads to a translation of the pension reform results to a target path for public sector balance in each particular case.

As an example, in the case of a mono-pillar DB system, in which the retirement age increases by three years and accrual rates are adjusted so that replacement rates settle at around 60%, the target for government surplus is 1½-3½% of GDP. A partial privatisation would reduce this target, and possibly even justify a deficit, depending on the pace of ageing and size and timing of privatisation.

In the case of an NDC system, the long-run target for government deficit is not affected by ageing, provided that the system is well-designed so that pension expenditure adjusts to contribution revenue. However, the possible deficit during the transition needs to be financed by drawing from other government revenues. Correspondingly, if a surplus appears - which would happen for example if the retirement age increases - it can be used for financing any public expenditure.

Robustness of the results

The results here are based on an actuarial model, which means that it covers only the pension system. This does not, however, hamper much the applicability of the results. The rest of the economy is represented by various assumptions and it would be easy to show the effect of a change in any given assumption. Furthermore, most of the results are very robust, if it is assumed that pensions are indexed to wages or to the wage bill, which may be a good approximation of reality in the long term. Also, the general conclusions do not depend imperatively on the interest rate assumption, which reiterates the conventional view that the interest rate exceeds by a given margin the growth of the wage bill.

The paper presents a method to analyse pension reform options, and illustrates results based on simple stylised projections on ageing. The results may be sufficiently close estimates for the orders of magnitude of a variety of effects and therefore usefully serve the on-going debate on pension reforms. It is noteworthy, however, that although the simple demographic projection broadly mimics the current demographic projections for EU-15, it rather underestimates it in the next 30 years. As our calculations relate only to pension expenditure, omitting other age-related public expenditures, the real world problems may well be even more serious than those illustrated in this paper. This should be kept in mind if any alleviating factors are brought into the discussion.

Institutionally, the approach is sufficiently general to render results which can be applied in many countries. To tailor reforms to any individual country, more accurate modelling details and real demographic data could be introduced in order to derive more precise results.

1. Introduction

1.1. The purpose of this paper

The threat to the financial sustainability of the pension systems in most European Union Member States, Candidate Countries and elsewhere has become a major economic policy issue. Briefly, the problem stems from the fact that the pension systems established in many countries after WWII have now matured, bringing a full pension prescribed in the said systems to most people covered, while at the same time demographic developments have turned adverse so that the ratio of pensioners to contributors is increasing rapidly.

Twenty years ago, it was still believed that the problem of adverse demographic development would only be temporary, caused by the post-WWII 'baby boom' generation retiring. Gradually however, a consensus projection has emerged that low fertility and increasing longevity will lead to a rise in the old age dependency ratio until around 2040, and that the new high level will persist beyond that date. In Western Europe these two principal demographic factors are: (1) *fertility* declined in the 1970s - to about 1.7 children per woman, well below the 2.1 required for reproduction - and has remained persistently at that level, and (2) *longevity* has increased considerably, and is still expected to increase by nearly five years from 2000-2050. Of course, the latter factor would not represent a problem were the retirement age to increase correspondingly. As it has in fact decreased in the past and aggravated the problem, one of the most important policy challenges now is whether or not this trend can be reversed.

The consequences of ageing for public finances and for economies as a whole are now well recognised, but being clear about the seriousness of the problems encountered and about the required measures is not easy as such explanations require a time horizon that extends over many decades. Furthermore, discussion on pension reforms is often complicated by the many intended purposes and unintended side effects of pension systems, which makes it difficult to draw a line between the major issues and details.¹

In the present paper we emphasise the two major demographic factors, fertility and longevity, and their consequences under alternative pension systems and, most importantly, under alternative transition paths from one system to the other. Our chain of arguments goes as follows:

- (1) We note that in an ageing society, if the current pension replacement rates are maintained, fairness across generations requires that the currently working generation should not only finance the pensions of the current retirees but also pay in contributions exceeding the current expenditure, in order to pre-finance part of their own pensions. This means that the systems should move to partial pre-funding.
- (2) Partial funding can take place within the public sector or be a result of partial privatisation. Privatisation could be designed so that the outcome is identical for the key pension system indicators, but it will always have significant effects on public sector finances. Thus, this interaction between the public and private

¹ A survey of people's opinions on pensions in four major EU countries reveals awareness of the looming crisis, but knowledge about the current facts, not to mention reasoned strategies, is fairly low, see Boeri, Börsch-Supan and Tabellini (2001 and 2002).

sectors may confuse the discussion on pension reforms and considerably affect political choices.

- (3) Our first argument for partial funding rests on the assumption of maintaining the current replacement rates. The other extreme option is that these rates be decreased so that the current contribution rates provide the required financing. To arrive at this outcome in the long run, one solution is a transition to a Notional Defined Contribution system.

From these elements we arrive at *two basic blueprints for a pension reform*, a transition either to a pre-funded and possibly partially privatised Defined Benefit (DB) system, or to a Notional Defined Contribution (NDC) system possibly accompanied by a fully funded second pillar. In both these reforms the level and/or the ratio between contributions and benefits change under ageing, and a change in the retirement age will affect the outcome significantly.

1.2. Key properties of alternative pension systems

We confine the treatment to mandatory pension systems, while voluntary individual pensions are merely touched upon. For most results it makes no difference whether the system, or some part of it, is mandatory by law or quasi-mandatory under a collective agreement.

Among mandatory schemes, three basic dimensions are relevant:

- (1) Does the system provide Defined Benefits (DB); or does it require Defined Contributions (DC);
- (2) what is the degree of funding; and
- (3) what is the degree of actuarial fairness?

Except for one extreme case, namely a Fully Funded DC system - which is by definition also fully actuarially fair - these three dimensions are distinct from each other, and may therefore form many combinations. We can find any degree of funding and actuarial fairness in a DB system as the system may accumulate assets and the link between contributions may or may not be close. A DC system may operate without reserves, in which case it is said to be a pure Pay-As-You-Go (PAYG) system, based on notional accounts operated under an administratively set notional interest rate - i.e. an NDC PAYG system). Alternatively, a public DC system can be funded to any degree. The degree of actuarial fairness is always rather marked in a DC system, but it always depends on various administrative rules, e.g. on the notional rate of interest, and the treatment of genders (on this taxonomy see Lindbeck, 2001, and Lindbeck and Persson, 2002).

We shall comment on the reform scenarios with regard to all three dimensions. However, in the present paper we also highlight two other properties of pension systems and their reforms. The first is *financial sustainability*. To define this, it must be noted that any scenario in which debt accumulates without limit is financially unsustainable. Such a case should always be judged as unfeasible as the system breaks down sooner or later. Sustainability allows accumulation of debt (or assets), but it is required that the debt (or

asset) converges to some constant percentage of a scale of the economy, which in the framework of the present study is the wage bill. In some cases we specifically look into the transfer from another branch of public budgets, which is required to make the pension system financially sustainable (or to make a transfer from the pension system in order to prevent infinite accumulation of assets).

Financial sustainability is a necessary condition for a scenario to be relevant, but this requirement can be met by an infinite number of financing modes. For instance, a DB pure PAYG system is financially sustainable by definition: contributions are adjusted to cover expenditure at each point in time. Subsequently, there are an infinite number of time paths for revenue, which may match the given expenditure in a sustainable manner.

To make a distinction between alternative financing paths, a second criterion of *intergenerational fairness* enters the picture. It looks into actuarial fairness specifically across successive generations. Under the specific rules determining the pension benefits in each system, we can identify only a limited number of financing modes which meet a certain benchmark for intergenerational fairness, which we shall define below. Under most cases there is only one such revenue mode, but we shall in practise accept a range of outcomes as there is a certain degree of arbitrariness in judging what is fair.

Secondly, alternative options, all of which can be regarded as fair across successive generations, are then constructed by varying the determinants of both benefits and the financing modes. The aim of the present paper is to be as explicit as possible on the underlying rules of the system and to analyse how they operate under an ageing population. Intergenerational fairness is a key factor which drives the results for the degree of funding in each case.

1.3. Agnosticism about arguments for funding in previous literature

In this introductory chapter we want to be clear about the position of the present paper in the more general controversy over transition to pension funding and privatisation. Without attempting to give an extensive assessment of this controversy², we first explain how the competing schools see two key themes, and show that it is not necessary for us to take a fixed position on those issues.

Rate of return in alternative pension arrangements

Most arguments in favour of transition from pure PAYG systems to funding and privatisation of pension financing in previous literature rest on the difference in return on contributions paid in the two systems. For funding, the rate of return is taken to be the rate of interest in the financial market, either on government bonds or on a portfolio composed of bonds and equity. This is normally higher than the rate of growth of the wage bill (or more precisely, of the contribution base), which is the internal rate of return in a pure PAYG system which is on a steady path.

² There is a somewhat more systematic review in Oksanen (2001a), and more extensive ones can be found in the references therein, in particular, Holzmann (1999), Sinn (2000), Orzag and Stiglitz (2001), UN Economic Commission of Europe (1999) and The World Bank (1994).

Under these assumptions, it may initially appear that the funded system is more efficient, and therefore, a shift to funding will after a while give returns which outweigh the extra burden to be suffered by the generation which has to save for its own pension and at the same time honour the rights already accrued in the PAYG system.

There is, however, a flaw in the above reasoning. A counter-argument that a shift to funding does not give a net welfare gain was clearly formulated by Breyer (1989, also 2001): a consistent analysis requires that the returns to funds and the discount rate to compare income streams at different points in time has to be the same, thus a shift to funding does not increase total welfare, but rather, distributes it differently across generations.

The same broad conclusion was neatly derived by Sinn (2000): the difference between the market interest rate and the internal rate of return in the PAYG system does not indicate any inefficiency in the latter. Rather, it is the implicit interest paid by the current and future generations on the implicit pension debt accumulated because some past generations received benefits while not having (fully) contributed to anybody's pensions themselves. Under certain assumptions, continuation of the PAYG system is a fair arrangement to distribute this past burden between the current and all future generations.

A recent reaction and precision from the proponents of funding is presented by Feldstein and Liebman (2001, p. 63-64): as our economies are still growing, it is proven that the marginal product of capital exceeds the social discount rate of future consumption. Thus, increased national saving induced by a shift to funding of pensions increases total welfare. It is therefore socially optimal to take this gain and share it between the current and future generations.

Again, the response from those sceptical towards funding is that the additional saving could be achieved in many other ways, and there is no valid reason why the pension system should be used for this more general purpose. Feldstein and Liebman (2001) admit this, but maintain their view that it is advisable to reform the pension system to achieve this positive effect, regardless of the possibility that some other means could, in principle, lead to similar results.

A parallel chain of arguments and counter-arguments can be followed as to the question of whether pension funds increase welfare by allocating capital towards investments with higher return. The first argument is that in the long run, equity investment has a higher return than bonds, and that the privately managed pension funds may take advantage of this difference. The counter-arguments to this are again two-fold: (1) if it is assumed that markets are efficient, then risk-adjusted returns are equal and there is no gain from pension funding, or (2) if it is assumed that the markets are not efficient, there are many ways to change the allocation of capital, including the government borrowing from the market and investing in risky assets, and there is no compelling reason why the pension system should be used for this purpose (e.g. Orzag and Stiglitz, 2001).

The conclusion from this review of arguments is that a transition to pension funding can not be undisputedly argued only on the basis of differences in rates of return or interest rates. One needs to go further, to political economy arguments referring to political suitability of pension funding for acquiring welfare gains, as compared to other means. To judge this, one has to look into the initial institutional structure and evaluate the

prospects of finding the political will to make the required, in most cases major, changes to the pension system.

In the present paper we do not need to take a position on this controversy. We do not build the argument for partial funding or privatisation on the difference in the rate of return on pension fund investment over government bonds or social discount factor, but in the first place simply assume a uniform interest rate. Instead, our argument is built on fairness of redistribution, accepting that gain to one is loss to another. Despite this, we can also show how a possible difference in the rates of return affects the results.

Labour Market Distortion

In many treatments of pension reforms one pertinent issue is the distortion in the labour market caused by pension contributions, which are perceived as a tax on wages, while the contributions to a fund with individual accounts, even if mandatory, are supposed to be perceived by employees as saving for their future pension. For this reason, it is argued, a transition to funding improves welfare by eliminating this wasteful labour market distortion. There certainly is a point in here as pension contributions are perceived more as a tax the more intragenerational redistribution takes place, and it is normal that this is more often the case in public DB PAYG systems. But to treat the contributions to a public system as a tax and those to a privately managed funded pillar as individual savings gives a grossly exaggerated picture in favour of funding. In many PAYG systems there is a link between contributions and future benefits at the individual level, and if not, this link could be strengthened by various modifications to the rules, even without introducing funding. A transition to an NDC is a case in point and proves that the link between contributions and benefits and the degree of funding are two separate issues, not to be confused with each other.

Thus, we are not building the argument for partial funding on avoiding labour market distortion, though this does not mean that we want to dismiss this argument. It is certainly relevant in most cases, and serves to strengthen our argument, based on other factors.

1.4. The actuarial model

Our results are derived from an actuarial model into which we feed stylised facts about the demography, the parameters of alternative pension arrangements, and transitions from one system to another. Most conclusions are illustrated with simulation results.³

In our actuarial model, successive yearly cohorts are followed through their lives. They start as children, work and give birth to the next generation, and then retire. The model covers only the pension system, leaving the economy outside the model unspecified. This has two major advantages: (1) the model remains relatively simple, and (2) the relevant variables which are exogenous to the pension system are transparently fixed by assumption. The key exogenous variables are the premium of the interest rate over the wage bill growth, real wage growth, and inflation. As for the interest rate, our assumption

³ The scenarios are derived using a model, S-PRISM for Stylized Pension Reform Illustration and Simulation Model, created by Patrick Wiese and copyrighted by Actuarial Solutions (email: JPWiese@hotmail.com).

means that it moves with the wage bill, reflecting in a simple and conveniently assumed manner the reduction of the number of workers caused by low fertility. As for the real wage (reflecting change in labour productivity) and inflation, it is comforting that most results below will not depend on these variables as we additionally assume that pensions are indexed to wages (or to the wage bill). This may be a good approximation of reality in the long term, thus making most of our results applicable very generally. The model would allow for any other assumptions with regard to indexing rules and consequently to wage rate and inflation assumptions, but as illustrating such cases leads to a very rapid increase in possible combinations, it is left for further studies.

There are a number of issues relevant for the comparison of the alternative pensions systems which are left completely outside the present paper. While *intergenerational fairness* is in the forefront of our analysis, the parallel question of *intragenerational distribution* of income, i.e. redistribution between different socio-economic groups, is not treated here (we simply assume homogenous labour). Yet, *intragenerational* distribution is most often one of the objectives of public pension systems. This should not, however, reduce the relevance of our results based on intergenerational redistribution, as they would also hold in situations where *intragenerational* redistribution takes place.

Most results are reported as a percentage of the wage bill (after pension contributions). To give a rough key to relate the figures to GDP, it is sufficient to point out that the wage bill was roughly 40% of GDP in 2000 in EU-15. Thus, assuming simply that the pension system covers all employees, multiplying the figures related to the wage bill by 0.4 gives them as percentages of GDP. This serves as a rough estimate throughout the period.⁴ In EU Candidate Countries, the ratio of the wage bill covered by the pension system to GDP is lower – perhaps one third - as the share of the wage bill and the coverage of the pension systems are lower.

1.5. Outline

In Chapter 2 we introduce the key concepts for typical pension systems in a very simple setting, including an assumption of a stationary population. Our simple and counterfactual presentation serves to illustrate the elementary effects of a partial privatisation of a pure PAYG system, and to discuss actuarial fairness in the context of an increase in retirement age.

Chapter 3 presents the challenge of ageing, firstly, for a Defined Benefit (DB) system, where, in order to achieve intergenerational fairness, partial pre-funding is required. Secondly, we present a transition to a Notional Defined Contribution (NDC) system, with the main result that replacement rates adjust downwards to match the contribution revenue fixed under this system.

Chapter 4 introduces further parametric reforms to the DB system and an increase in retirement age, and discuss a partial privatisation of a pre-funded system.

⁴ This ratio may decrease slightly to give space for the increasing pension contributions without hitting return on capital only. Other factors related to distribution of income between capital and labour affect this percentage as well, but for the present purposes a rough figure is sufficient.

Chapter 5 gives a comparison of a reformed DB system and a transition to an NDC system, with some comment on full funding.

Chapter 6 analyses and illustrates the long-term effects of ageing and pension reform on public finances more generally. Government balance targets should noticeably depend on pension the system in each case and on the reforms to be undertaken.

Chapter 7 discusses a few macroeconomic aspects related to pension reforms, notably total saving in the economy and labour market effects.

Chapter 8 gives a short summary and the main conclusions.

2. Pension systems, privatisation and actuarial fairness under stationary population

2.1. Base case assumptions

We assume that all people live 20 years as children, work for 40 years until the age of 60, and enjoy retirement for 18 years. The retirement age and life expectancy of 78 years correspond to the current EU averages. Working for 40 years is on the high side, but is assumed here for simplicity and does not effect our overall results.

In this chapter we assume a stationary population, i.e. equal births and deaths per annum. Most results discussed here would also hold (with slightly modified figures) were we to assume that the population grows or declines at any constant rate.

The increase in real wage rate (w) and labour productivity are assumed to be 1.75% per annum. Wage is defined as 'gross wage after payment of pension contributions' (which are often formally paid by the employer; if paid by the employee, then the definition would change to 'the wage after pension contributions but before taxes'). Under a stationary population and a mature pension system the share of the wage bill of GDP is constant.

Inflation is assumed at 1.5% per annum (p.a.).

Interest rate (r) is assumed, in the base case, to be uniform at 1.5 percentage points (p.p.) above the rate of change of the wage bill (wb). This order of magnitude is conventionally assumed in long-term analysis. Note that zero for this difference gives the floor for the interest rate in a dynamically efficient economy.

2.2. The Defined Benefit (DB) pension system

It is assumed that in the past a public DB pension system was established so that workers would earn an annual pension right equal to 1.5 percentage points of their salary, thus working for 40 years gives a 60% replacement rate (pension to wage ratio).⁵ After establishing the system, contribution rates are assumed to have increased only to cover current expenditure so that no reserves were accumulated. We then start to monitor the system at a point in time when it is mature, i.e. all pensioners having worked for the full 40 years, and having gained the full 60% pension. An assumption that the pensions in payment are indexed to the wage rate keeps the replacement rate at 60% through time.

In a pure PAYG system the contribution rate is, by definition, at every point in time equal to the replacement rate times the ratio of pensioners to workers, even given a non-

⁵ Alternatively, instead of an annual accrual of pension rights, we could assume for most of our results that the replacement rate is globally fixed at 60% of the wage. While the first system, in which accrual rates determine the replacement rate, can be fully actuarially correct across individuals (or their groups) at each point in time, the degree of actuarial fairness in the fixed replacement rate system is zero. Fairness across generations can still hold in both cases as it depends on the aggregate contribution payments and benefits received by each successive generation.

stationary population, and for any increase in wages, either nominal or real. The assumption of the interest rate is equally immaterial, as no reserves ever appear.

From the assumption of a stationary population, i.e. equal number of people in each yearly age cohort, it follows that the contribution rate required to cover the expenditure is equal to the replacement rate times the ratio of years in retirement to years at work, thus 27% ($= 60 \cdot 18/40$).

The assumptions of the 60% replacement rate and 27% contribution rate are not far from reality in the European welfare states, if we consider occupational pensions, survivors benefits, disability benefits and non-occupational pensions, with all financing coming from contributions and from public budgets. Thus, our orders of magnitude roughly correspond to reality, even if we refer to a grossly simplified institutional structure of occupational pensions financed from wage contributions.

2.3. Fully Funded Defined Contribution (FF DC) system

In a Fully Funded Defined Contribution (FF DC) system, benefits are acquired by contributing to an individual account, and the pension is determined by the contributions, the proceeds of the fund and – normally – by buying an annuity at the moment of retirement. If we assume that the annuity is indexed to the wage rate, we can calculate that with the assumptions above, including $r = wb + 1.5$, a contribution rate of 17.3% leads to a replacement rate of 60%. Thus, 9.7 percentage points of the 27% contribution rate in the corresponding matured DB PAYG system is needed to continuously serve the implicit interest on the implicit debt accumulated when previous generations acquired pension rights without contributing fully to anybody's pensions.

2.4. Partial privatisation with a stationary population

Partial privatisation means that part of the contributions previously paid to the DB public pillar are diverted to a privately managed fully funded second pillar. The previously accrued rights in the public first pillar are assumed to be honoured. The second pillar accumulates funds and provides pensions determined by contributions paid and interest accrued.

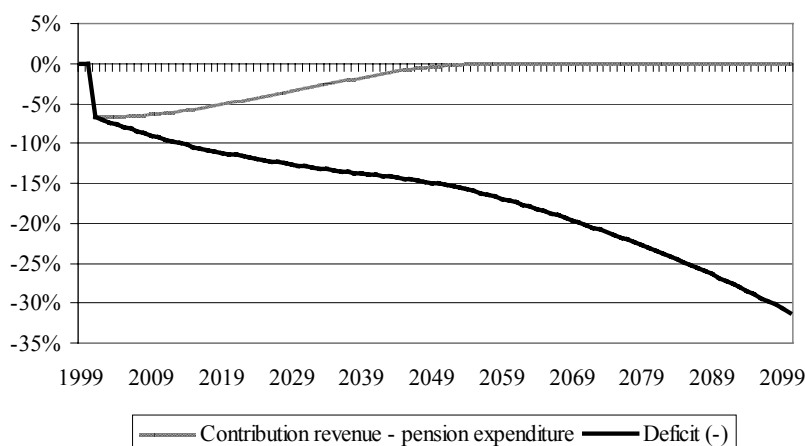
We start with the matured DB system described above and assume that in year 2001 one quarter of contributions, i.e. 6.75% of the wage bill, is transferred to the second pillar, leaving 20.25% to go to the first.

In the first illustration we assume that from 2001 onwards the accrual rate in the first pillar is decreased in the same proportion as the contributions, or from 1.5% to 1.125% per year.

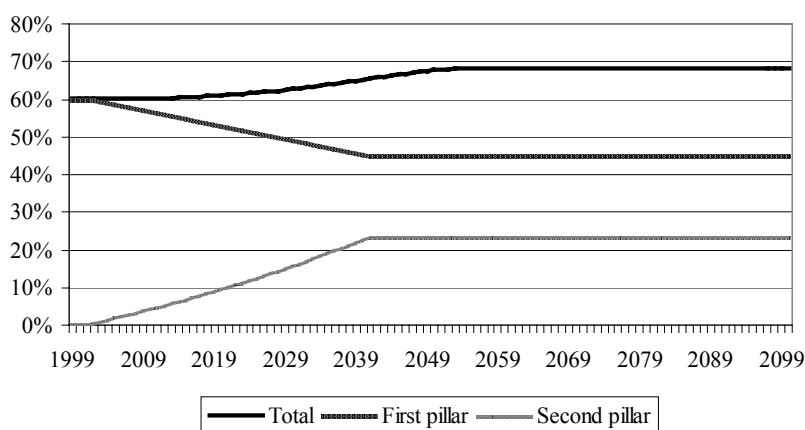
An immediate effect is a deficit in the public pillar of 6.75% of the wage bill: expenditure is given, but less money is received. Over time, expenditure decreases as the rights accrued before 2001 cease and the new lower rights enter into force. By the end of the transition period in 2060, contributions and pension expenditure are equal in the public pillar.

Figure 2.1. Partial privatisation of a stable DB system: DB accrual rate reduced pro rata

First pillar pension expenditure converges to revenue, but deficit explodes as the interest on debt needs to be served.



Explanation:
Total replacement rate increases, but contribution revenue is fixed at 27% of the wage bill.



There are other features, however, illustrated in Figure 2.1, which crucially depend on the assumption that the interest rate exceeds wage bill growth by 1.5%, i.e. $r = wb + 1.5\%$.

Contribution payments cover pension expenditure in the long run, but the debt incurred during the first 60 years leads to an exploding government debt and deficit, an unsustainable path.

One way to comprehend what makes this scenario unsustainable is that the total replacement rate increases from the initial 60% to 68%. The replacement rate from the public pillar reduces to $\frac{3}{4}$ of the initial 60%, or to 45%, but the second pillar gives 23% instead of 15%, as the 1.5% premium in the rate of return to funded assets adds to the accumulating rights. However, no extra resources are made available as the total contribution rate is maintained at 27%. The 20.25% allocated to the public pillar is not sufficient to cover both the pension expenditure and the interest on the debt which arises during the transitional period when pension expenditure exceeds contributions.

Thus, designing privatisation so that the first pillar remains financially sustainable requires changes to the ratio between the contributions paid to and benefits derived from the public pillar. There are an infinite number of options for a sustainable combination, one of them being that the contribution rate is maintained at 20.25% and accrual rates are adjusted so that the total replacement rate is maintained at 60%, which means that the first pillar replacement rate converges to 36.6%.

This case is illustrated in Figure 2.2. Government deficit and debt converge to certain figures, the replacement rates adjusting in parallel, and the permanent funds accumulated in the second pillar exactly matching the permanent debt in the first pillar.

One way to express what happens under privatisation is to say that part of the Implicit Pension Debt (IPD) of the PAYG system, defined as the present value at each point in time of the accrued rights of both workers and retirees, becomes explicit government debt. Before privatisation the IPD is 645% of the wage bill, and it will decline to 394% at the end of the transition period. The explicit debt correspondingly increases to 251%, maintaining the sum of implicit and explicit debt at 645%. The permanent level of funds in the second, privately managed pillar, converges to 251%, exactly matching the increase in government debt.

The main message from this exercise is that privatisation requires that the actuarial fairness in the first pillar be reduced. In other words, as the second pillar produces a return on its contributions which exceeds wage bill growth, the internal rate of return in the first pillar has to decrease so that the average rate of return matches the equilibrium conditions, which remain unaffected by the privatisation. Thus, the second pillar is more attractive for the individual and the attractiveness of the first pillar is correspondingly reduced.

Only under the extreme assumption that the difference between the interest rate and wage bill growth is zero ($r = wb$) is the outcome sustainable without a reduction in the actuarial fairness in the first pillar.

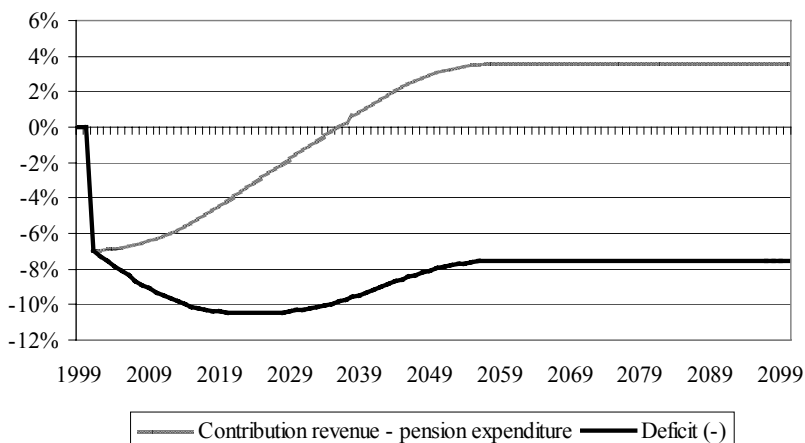
Note furthermore that the stocks of assets and debts mentioned above do not depend on real or nominal wage growth or inflation. However, government deficit is measured as nominal expenditure, including interest payments, minus revenue, and depends therefore on nominal growth even if the real rate of interest, and the stocks of assets and debts as a percentage of the wage bill are given. If, for example, inflation remains permanently at 3% and the nominal interest rate is correspondingly 1.5 percentage points higher, the peak of the deficit would be 14.4% of the wage bill, and would converge to 12.2% on the new permanent path, instead of 10.5% and 7.5% if inflation is 1.5%, as assumed above (Figure 2.2).

This leaves us puzzled about the advisability of privatisation. Something must be missing from the picture above as privatisation is still pursued as a serious option. The explanation is not that the private second pillar may earn a higher rate of return than government bonds. Although it would make the new total replacement rate higher than in the example above, the problem with the public pillar would remain.

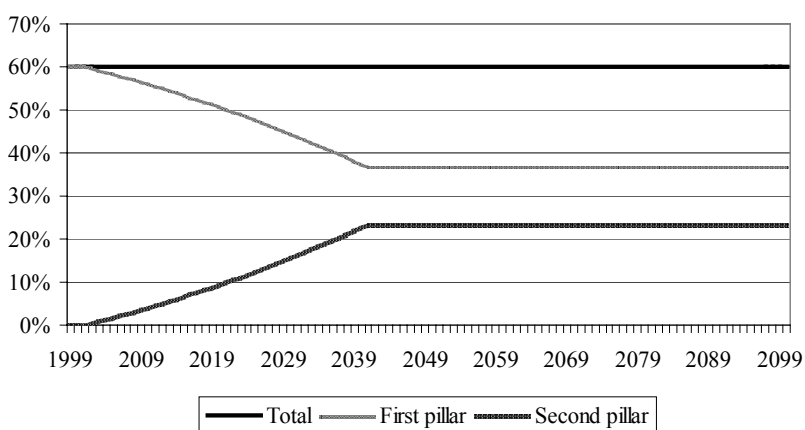
The crucial element above is that we considered a stationary population (though the same results would hold also for a steadily growing population). In such a case continuation of a pure PAYG system can be viable, and arguments for systemic changes seem weak.

Figure 2.2. Partial privatisation of a stable DB system: DB accrual rate reduced to comply with total replacement rate at 60%

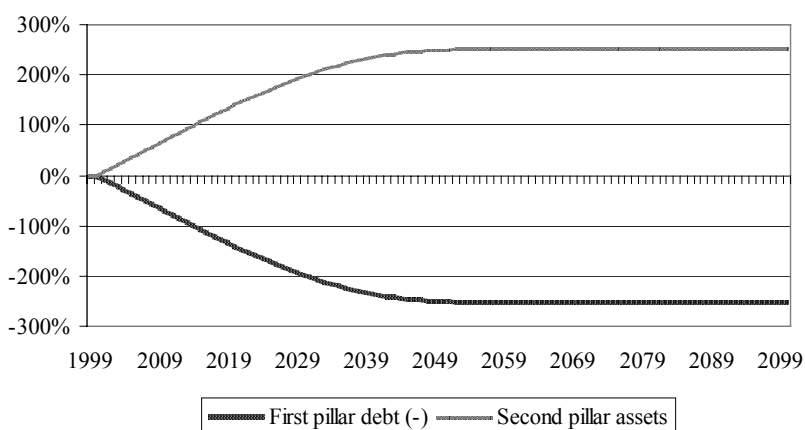
First pillar contribution revenue needs to exceed pension expenditure in the long run to cover the interest expenditure caused by debt accumulation. Deficit converges to a constant proportion of the wage bill.



Replacement rates adjust maintaining the total at constant 60%.



Second pillar assets and first pillar debt match each other.



It was important to demonstrate this to understand that the debate on privatisation is triggered by population ageing, and that the arguments are not captured/valid if population is assumed to be stationary. When the pensions burden increases, sharing it between successive generations becomes a serious issue, leading to a possible accumulation of funds, in which case privatisation enters the picture as a way to shift the management of these funds to the private sector. This will be illustrated in Chapter 3.

2.5. Notional Defined Contribution (NDC) system

A Notional Defined Contribution (NDC) system is one more set of rules for a pension system. It is more recent than the other two main systems described above, but it has already been implemented in Sweden, Latvia and Poland and in some non-European countries as a result of pension reforms in 1990s. The reforms in Italy in the 1990s also contain some NDC features. (Williamson, 2001).

In an NDC system contributions are fixed, registered in notional individual accounts which are remunerated by a administratively fixed rate of interest, and the capitalised value at retirement is transformed to an annuity paid out as a pension. Applications may differ in practise, but if the notional rate of interest is set as the rate of growth of the contribution base (which is the wage bill if complete coverage is assumed), and if projections of life expectancy at retirement are continuously updated, the system has the valuable property that pension expenditure equals contributions in the long-run (though not necessarily in the short run).

An NDC system is not supposed to possess reserves, or, should they exist, they have no relationship to individual accounts. This is exactly what makes the system *notional*. This also means that an NDC system is never developed so that a new system with these rules starts from scratch. Were it so, the system would have accumulated funds like a FF DC system, the only difference being that the rate of return would be determined administratively (and hence contain a rule for handling the surplus or deficit stemming from the difference between the factual and the notional returns on the funds). Thus, while DB PAYG and FF FC can exist and mature on the basis of their respective rules from the beginning, NDC represents a transformation of a DB PAYG system. This has been the case also in practise.

NDC systems normally only cover old age pensions, while disability pensions are financed from the state budget, though perhaps administratively integrated to the old age NDC system. Also, in an NDC system, non-contributory periods like maternity leave are often covered by a contribution from the government budget so that personal accounts continue to accumulate.⁶

The elementary case of a stationary population highlights the similarities between the DB PAYG and NDC for old age pensions. Assume the DB PAYG above, and assume that it is transformed to an NDC at a certain moment so that contributions remain at 27% of wages, but go to individual accounts, and that previously accrued pension rights are honoured. New pensions are then partly determined by the old DB rights and partly by the NDC annuities, so that the proportion of the former declines to zero after 40 years. Of course, the total replacement rate remains at 60%, and the system maintains constant financial balance.

Nothing real changes in this transformation. But again, this equality of the DB PAYG and NDC only holds if the population is stationary (or steadily changing).

⁶ DB PAYG systems can more easily support disability pensions, non-contributory periods etc. as contributions are determined by expenditure and not vice versa as in the NCD system.

2.6. Effects of a retirement age increase and actuarial fairness

The simple setting of a stationary population gives us some elementary results concerning the effects of a retirement age increase on pension expenditure in the long run and on the actuarially fair compensation for postponing retirement.

Consider the identity

$$(1) \quad \text{contribution rate} / \text{replacement rate} = \text{years in retirement} / \text{years at work}.$$

Taking the figures above, i.e. 27%, 60%, and 18 and 40 years, for these four variables, we assume an increase in the retirement age of one year. Maintaining the assumption on the replacement rate, we get a contribution rate of 24.9%. This is also a measure for pension expenditure as a percentage of the wage bill in the new steady state. Thus, expenditure decreases by 2.1% of the wage bill (or 0.8% of GDP assuming that the wage bill is 40% of GDP).

Workers may not agree to work longer if they are not compensated by receiving a higher pension. In a DB system as assumed above, one benchmark could be that the accrual rate of 1.5% holds for the additional year at work, making the new replacement rate 61.5%. In the new steady state, contributions and expenditure are 25.5% of the wage bill, i.e. 1.5% of the wage bill (or 0.6% of GDP) lower than with a retirement age of 60.

In these two examples, pension expenditure decreases because workers do not get fully compensated for their additional year at work. An actuarially fair compensation is by definition an increase in the replacement rate such that the capitalised value of the pension - taking one additional year of contribution payments into account - is the same before and after the increase in retirement age.

The result will naturally depend on the assumption of the interest rate (or discount rate). A simple benchmark is the case where the interest rate is equal to wage rate change. Under this assumption we can simply use the above identity, set 41 and 17 for the years at work and in retirement and 27% for the contribution rate, and conclude that the new replacement rate is 65.1%. This not only holds for the new steady state if everybody shifts to higher retirement age, but it is also gives 5.1% as the actuarially correct accrual rate for the additional year at work for any individual.

If the interest rate is higher than the increase in the wage rate, the actuarially correct accrual rate is correspondingly higher. Table 2.1 gives the results for interest rates 5%, 3%, 0%, and -0.7% above the wage rate change. The last case anticipates the case below, where the rate of interest is equal to the wage bill growth and the number of employees decreases by 0.7% p.a. due to low fertility.

Any deviation from the actuarially correct compensation for additional work can be treated as an implicit tax imposed on pension benefits. If the replacement rate does not increase at all, then the implicit tax rate is 100%. If the standard 1.5% accrual rate is applied on the additional year, then the system reaps 70-80% of the additional revenue (last column in Table 2.1).

Table 2.1. Actuarially correct compensation for a one-year retirement age increase

Assumptions:

- initially, people are at work from age 20 to 59 and in retirement from 60 to 78
- standard accrual rate 1.5% (leading to replacement rate 60% after 40 years at work)
- contribution rate 27% (balancing a pure PAYG, assuming stationary population and pensions indexed to wages)

D	acar	itr
5	7.8	80.9
3	6.7	77.5
1.5	5.9	74.4
0	5.1	70.7
-0.7	4.8	68.7

- d = interest rate premium over wage rate growth,
acar = actuarially correct accrual rate for an additional year at work,
itr = implicit tax rate if accrual rate is 1.5% instead of the actuarially correct one for the additional year.

Note: The calculation for implicit tax rate (itr) does not include the excess of the wage over the would-be pension during the extra year worked. Were it included, the results for the case of $d=0$, for example would be 48.4% instead of 70.7%. However, the direct costs related to working rather than retiring, and the additional utility due to leisure when retired, may match the difference between the wage and pension during this one year. Thus, the simple figures for itr above may give a good approximation of the relevant factors.

Obviously, the figures derived above differ slightly for the second and further additional years at work, and also if the life expectancy increases and therefore the number of years in retirement increases (assuming a fixed retirement age). The main difference, however, is between the small compensation derived from the standard accrual rate (or no compensation at all) and the actuarially fair compensation. The order of magnitude of this difference does not depend greatly on the other factors if we stay within a range of realistic assumptions.

These simple results give a tool to tackle questions related to the attempts to increase the retirement age. If workers have a choice on their retirement age, the incentives to retire may matter significantly. In addition, employers may not have the incentives to train and recruit older workers as this investment is at risk due to possible retirement. These factors may go together: the employer may expect the older worker to stay longer only if the pension system clearly encourages late retirement.

Note that above we only derived the results for long-run effects on pension expenditure or revenue, while an increase in retirement age always has an additional transitory downward effect on pension expenditure too. Depending on the rules of the system, this may have a permanent effect on the balance of the pension system on top of the difference between contribution revenue and pension expenditure. This topic will be discussed further below when illustrating the effects of retirement age changes under alternative pension systems assuming an ageing population.

3. Systemic pension reforms for adverse demographics

As already stated in the introduction, the EU Member States and Candidate Countries are now experiencing unprecedented ageing as fertility is low and life expectancy is increasing. In the 1970s fertility declined to roughly 1.7 children per woman. In 2000 it was as low as 1.5, though partly affected by the increase in the average age of women giving birth. Correcting for this, the temporary underlying fertility rate is now 1.7.

We now enter into our stylised model an assumption that fertility was constantly at 2.1 until 1980, then declined to 1.7 in 1981 and remains at that level. The purpose of this simplified assumption is to show clearly the consequences of one single change in fertility in each pension system, and then to suggest reforms to cope with the adverse effects. In reality, changes in fertility happen gradually as a series of successive changes, and our results would apply to each of them.

Secondly, we also include into the analysis an increase in longevity. Its effects are straightforward if we assume that the retirement age remains at 60: an increase in longevity from 78 to 83 from 2000 to 2050 increases the time spent in retirement from 18 to 23 years.

These two simple demographic assumptions produce an old age dependency ratio, or the ratio between population over 60 years of age to 20-59 years old, which roughly resembles the actual population projections for EU-15. The projected figure starts at a lower level than our simplified one, but then increases faster, as the big post-WWII 'baby boom' cohorts reach the age of 60 and over, so that the change by 2040 is even more dramatic than with our stylised facts (Figure 3.0). The graph also shows that given the assumptions on fertility and longevity, inherent also in Eurostat projections, a further increase in the dependency ratio after 2050 is implied. Thus, without claiming that our results are directly applicable, they may, despite their simplicity, give useful approximations, not forgetting that the real world situation is probably even more worrying.⁷

3.1. Fairness across generations under defined benefits

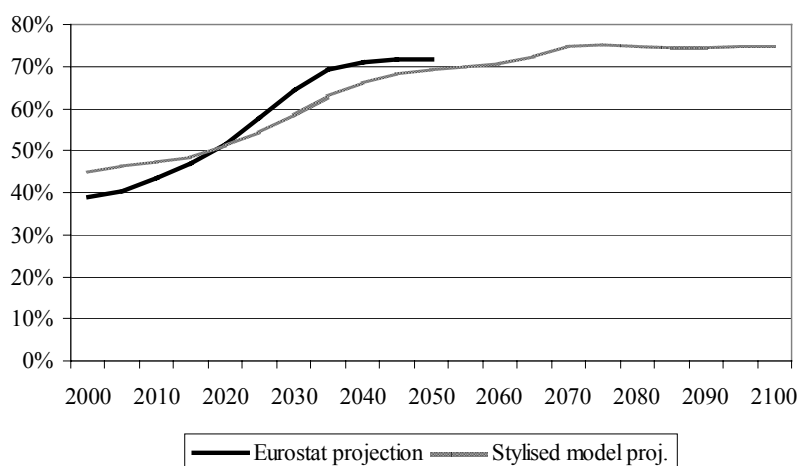
Apart from fully funded personal pension accounts, pension systems redistribute income from workers (or tax payers) to pensioners. However, the redistribution across generations in an accounting sense is not decisive. This can be demonstrated by a simple example: in a mature DB pure PAYG system under a stationary (or steadily changing) population, all successive generations pay an equal percentage of wages to pensions and also receive a pension fixed as an equal percentage of the wage rate. Thus, there is no redistribution of income across generations in a real sense.

Our current topic is to look into distribution across generations in a real sense. We note a permanent decline in fertility, and we assume that the replacement rate is determined as in the example in the previous chapter. Then, the rules of the pure PAYG system mean that the contribution rates have to be increased to cover the expenditure, according to the

⁷ For population and pension expenditure projections for EU-15, see Economic Policy Committee (2001), "*Budgetary challenges posed by ageing populations*".

Figure 3.0. Old age dependency ratio* in EU-15, 1995-2050, and the stylised model projection

A simple assumption of permanent fertility decline from 2.1 to 1.7 in 1981 and an increase in longevity from 78 to 83 years from 2000 to 2050 produce an old age dependency ratio, which roughly resembles the actual population projections for EU-15.



* Old age dependency ratio: ratio of population aged over 60 years to those aged 20-59 years.

increase in the ratio of pensioners to employees. While this is one possibility to keep the system in financial balance, the question of fairness in this scenario must be raised.

If the age of women giving birth is 30 years, it takes 30 years until everybody in the labour force belongs to the group who's fertility was at the new lower level, and 60 years before everybody in the labour force belongs to a cohort born after fertility declined. During this long transitional period, the adults who first invented the low fertility behaviour would, in a pure PAYG system, pay lower pension contributions than any generation coming after. Since every generation is enjoying the same replacement rate, fairness calls for a change in the regime: the first generation with the lower fertility should pay the same percentage of wages in pension contributions as any succeeding generation. Revenue would thus exceed expenditure, creating a fund which would remain constant as a percentage of the wage bill all other things being equal. Thanks to the proceeds from the fund, the contributions paid by all future generations are lower than in a pure PAYG system. This principle, leading to partial funding, was outlined by Sinn (2000) and further developed by Oksanen (2001a and 2001b).

A parallel argument applies for increasing longevity, if the replacement rate and the retirement age are given. In a pure PAYG system contributions are determined by the longevity of current pensioners only. If longevity increases, fairness for the future labour force is not maintained. The currently working generation, which will enjoy retirement for longer than current pensioners, should pay part of their future pensions themselves. Thus, contribution revenue should exceed current expenditure to create a fund. Were the increase in longevity to stop, the fund in relation to the wage bill would stabilise. Of course, if the replacement rate is decreased or retirement age increased, pension contributions and funding should change.⁸

⁸ A reference to a criterion called 'fixed relative position' (FRP) developed and discussed by Musgrave (1986), referred to by Schokkaert and Van Parijs (2001) and Esping-Andersen et al. (2001), might be

Taking these two demographic factors into account, fairness across generations may require departing from a pure PAYG system and obliging the currently working generation to save for part of their own pensions. Note that this argument for partial funding is not built on foreseeable welfare gains for everybody, but purely on distribution of income between generations. If funding then ultimately leads to overall gains to be shared between the successive generations in one way or another, an additional advantage has been gained, though our argument here does not depend on it.

The benchmark for fairness across generations applied here concentrates on distribution of income across generations, and thus does not, for example, depend on real growth in the economy. This can be seen as an advantage of the approach. However, let's look into a possible objection. It could be argued that it is fair that future generations, with a higher per capita income, should pay higher contributions for given pension benefits. This could indeed be the case. However, it is important to note that this does not justify a pure PAYG system. Under ageing, a pure PAYG system determines the ratio between contributions and benefits independently of real economic growth. There is probably no argument for rendering the outcome fair under all possible real growth rates.

Having said this, the benchmark for fairness could be modified to take the growth in welfare into account by adding a parameter determining a acceptable change in the ratio of contributions to benefits as a function of real growth. The illustrations below could be modified to this effect, though the results would then depend on the *expected* rate of real growth, and rules should be specified for coping with deviations from expectations. Thus, we would enter into complicated arguments, while the additional value of the results would be debatable.

Defined Benefit system to be pre-funded

We now maintain the previous assumptions of work, retirement and pension rights accrual rate, but drop that of the stationary population, to derive the fair contribution rate and the consequent degree of funding under ageing. In our search for a fair time path for pension contributions we make one important restriction: at each point in time the pension contribution rate is the same for everyone, as it normally is in DB PAYG system. Thus, when any change takes place, we do not set a different pension contribution rate for the cohorts responsible for the change, but at each point in time all workers pay the same new contribution rate. This means that complete fairness across cohorts is not achieved, but once again, the outcomes always compare favourably with those of a pure PAYG system.⁹

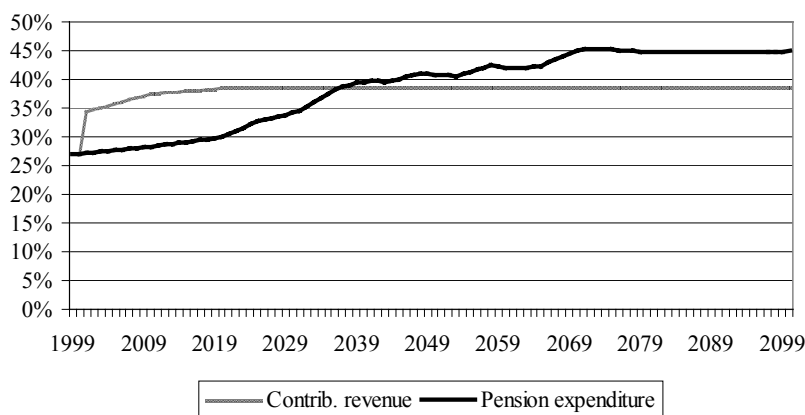
clarifying here. 'FRP' simply means indexation of pensions to wages after pension contributions. This is or has been the case in most European occupational pension systems. We also make this assumption in most scenarios illustrated here. This rule means that, for instance, that as soon as gains from an increase in productivity are reflected in the wage rate, they are automatically shared between current workers and pensioners. However, if demographics change, as it currently does, this rule is not sufficient for intergenerational fairness in a pure PAYG system as it does not bring justice across cohorts with different fertility and/or longevity. The aim of the present section is precisely to explain that under the FRP rule (equivalent to wage indexation) a departure from pure PAYG is required for intergenerational fairness (unless replacement rates are sufficiently reduced).

⁹ Here we deviate from Kifmann and Schindler (2001), who derive useful results for smoothing the implicit tax rate implied by pension contributions and benefits under ageing. One of their results is to show that cohort-specific contribution and/or replacement rates are necessary for smoothing. In our

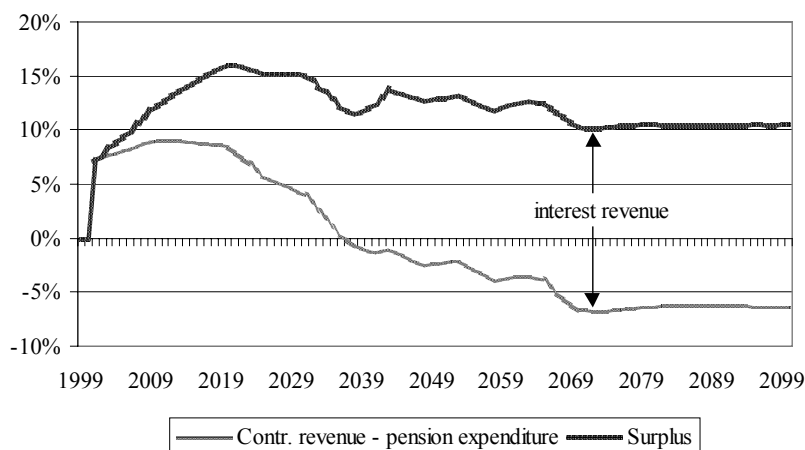
Figure 3.1. A pre-funded DB system: fair contributions, retirement age 60

Fertility declines to 1.7 in 1981; longevity increases gradually from 78 in 2000 to 83 in 2050; contributions increased in 2001 and gradually further to 2020 to correspond to the fertility decline and longevity increase (Scenario 4 in Table 3.1).

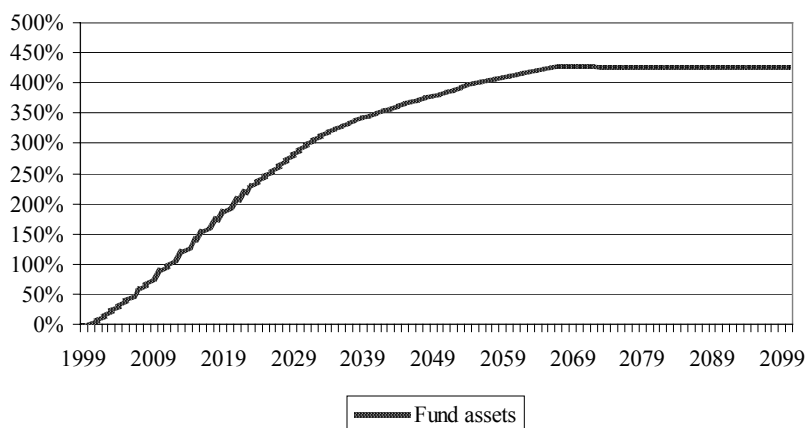
Contributions are gradually increased to 38% for intergenerational fairness. Otherwise, in a pure PAYG, the contributions to be paid by future generations would increase to 45%.



The initial increase in contribution rates produces an asset accumulation which provides interest revenue to support pension financing.



The assets converge to more than 400% of the wage bill, or 175% of GDP.



terminology they are necessary for complete fairness, but we accept that for other pension system purposes and for practical reasons, the contribution rates are the same for everybody at each moment in time. Hence, complete fairness across cohorts is not achieved, while solutions which are as close as possible approximations are striven for.

Figure 3.1 illustrates the application of the principle of fairness in the case of fertility decrease and longevity increase. Expenditure increases to 45% of the wage bill. The contribution rate is increased to 38% by 2020, with an initial immediate jump in 2001, followed by a gradual increase. The details of the derivation of this path are given in Box 1, and Table 3.1.

The surplus peaks at 15% of the wage bill in 2019, converges to 10.5%, and results in a permanent fund of 427% of the wage bill.¹⁰

In Table 3.1 we also report IPD and the difference between IPD and the fund, which, under pre-funding is a measure of the burden to be carried over from one generation to the other in each scenario. Also the latter is larger than the original IPD of 645% of the wage bill before ageing started. The degree of funding, i.e. the ratio between the fund and IPD, is 40% in Scenario 4.

¹⁰ The above results are based on a number of simple, easily understandable assumptions. They can, however, be generalised to a few more complicated situations. One is the assumption that in 2000 the DB system has an initial zero balance. In some systems, though, reserves may have been accumulated, and in others a deficit may have occurred, covered by borrowing directly from the market or by a deficit financed government subsidy. The treatment of these funds in setting future contribution rates and funding rules should depend on whether the funds were accumulated by cohorts before or after the decline in fertility, and on the longevity change in the past. In addition, they depend on the reactions of interest rates to ageing, as this determines the proceeds acquired from funds, whether accumulated previously or in future. We leave this theme to a further study.

Box 1. Derivation of the fair contribution rate under ageing: retirement age 60

To show separately the effects of changes in fertility and longevity, the first two scenarios in Table 3.1 assume a decline in fertility in 1981 but no longevity increase. Scenario 3 presents the pure effect of an increase in longevity by assuming counterfactually that fertility remains at the reproduction level of 2.1. Scenario 4 then combines the two demographic changes.

In Scenarios 1 and 2 a decline in fertility to 1.7 in year 1981 leads to a gradual increase in pension expenditure as a percentage of the wage bill to 34.3% as the ratio between pensioners and workers increases.

In Scenario 1 the contribution rate is increased gradually from 1981. As women give birth between the ages of 15 and 45, the average age is 30. The cohort aged 30 in 1981 will retire in 2010. Thus, the contribution rate should be increased to its new permanent level by 2010.

The new permanent contribution rate is 32%. This produces a sustainable time path which can continue forever under the assumed demography and pension system. The surplus of the system peaks at 7.7% of the wage bill and then converges to 3.6%, producing a permanent fund of 154% of the wage bill. A rough approximation for these figures as a percentage of GDP is obtained by multiplying the above figures by 0.4.

Scenario 2 moves towards reality by noting that the new principle of fairness is invented only for year 2001. It also assumes that those at work in 1981-2000 are not punished retroactively. The contribution rate is set to reach its permanent level in 2010, but now it jumps in 2001 by two thirds of its total increase. The required new permanent contribution level is 32.8%, which is higher than in Scenario 1 as the adjustment was made later. Correspondingly, the surplus and the fund are lower than above.

In Scenario 3 longevity increases from 78 in 2000 to 83 in 2050 without a decline in fertility in 1981. This leads to a level of expenditure in 2050 of 34.5% of the wage bill. Thus the assumed two demographic factors have roughly the same effect on expenditure in the long run.

For longevity increase, the time path for fair contributions is derived as follows: the contribution rate has to correspond to the longevity at the time when the current average worker will enjoy pension rights. The midpoint of employment is at 40 years of age and the midpoint of retirement at around 70 years, thus the lead in timing has to be 30 years. The contribution rate increase must therefore be completed by 2020. Assuming that the new rule is implemented only in 2001, the contribution rate should immediately jump by 3/5 of the total increase in that year. Scenario 3 shows that the surplus and fund accumulation required for a fair preparation for the longevity increase is bigger than that for the fertility decline.

Scenario 4 in Table 3.1. shows the result for the combined effects, also illustrated in Figure 3.1.

Table 3.1. A pre-funded Defined Benefit system: retirement age 60**Assumptions:**

- accrual rate 1.5% per year at work; pensions indexed to wages
- interest rate $r = wb + 1.5\%$ (wb = wage bill growth)
- real wage growth 1.75% and inflation 1.5% (relevant only for surplus and deficit figures)

Scenarios:

- 1: fertility declines to 1.7 in 1981; longevity remains at 78; contributions gradually increased from 1981 to steady state level by 2010.
- 2: fertility declines to 1.7 in 1981; longevity remains at 78; contributions increased in 2001 by 2/3 of the total increase to steady state level by 2010.
- 3: fertility remains at 2.1; longevity increases gradually from 78 in 2000 to 83 in 2050.
- 4: fertility declines to 1.7 in 1981; longevity increases gradually from 78 in 2000 to 83 in 2050; contributions increased in 2001 and gradually further to 2020 to correspond to the fertility decline and longevity increase (**Figure 3.1**).

	Scenario			
	1	2	3	4
Fertility 1981-	1.7	1.7	2.1	1.7
Longevity	78	78	83	83
Pension expenditure in nss	34.3	34.3	34.5	44.8
Contribution rate in nss	32.0	32.6	31.2	38.4
Surplus, max	7.7	6.1	7.8	16.1
Year of max surplus	2016	2017	2022	2020
Surplus in nss	3.6	2.7	7.4	10.5
Fund in nss	154	113	222	427
Imp. Pens. Debt in nss	768	768	875	1066
IPD - fund in nss	614	655	653	639
Degree of funding, %	20.1	14.7	25.4	40.1

Under the assumption of stationary population IPD was 645%.

All figures except fertility and degree of funding are expressed as percentage of the wage bill.

Rough approximation for figures expressed as percentage of GDP obtained by multiplying by 0.4.

nss = new steady state.

Gradual and unknown changes in demographics

Above, we assumed a sudden permanent decline in fertility partly for illustrative purposes, but the approach is not limited to such cases. It can be applied to successive changes in fertility: as these changes occur contribution rates should be adjusted. One advantage of this is that uncertainty about future fertility rates does not pose a serious problem as the changes in contribution rates should only follow observed fertility. For longevity increase uncertainty does pose a problem as the argument for funding follows from the projected increase, which may turn out to deviate from reality. In this case, to minimise the deviations from fairness, continuous corrections to some parameters are needed.

The message from these scenarios

The high increases in contribution rates and extensive funds which need to be accumulated in 30-60 years may seem unacceptable. This does not, however, reduce the value of this exercise. On the contrary, the message is clear: people should be informed

of what they should pay into a public pension system if they want to preserve current benefit levels and retirement age for themselves, but also want to be fair to future generations. If they are not prepared to pay these contributions, then they should accept a reduction in the replacement rate or an increase in retirement age. These options will be illustrated below.

Secondly, we should also note that in some EU countries (Denmark, the UK, Sweden, the Netherlands) pension funds exist which are – or will be according to current arrangements - of the order of magnitude of the one for the combined population projection (Figure 3.1 and Scenario 4 in Table 3.1). Obviously in the countries mentioned above, most of these funds are not managed by the public sector, but that is not essential to our argument above. The management of funds, in particular their possible privatisation, is a separate issue to which we turn in Section 4.3 below.

3.2. Transition to Notional Defined Contribution (NDC) system

As described in Section 2.5, the NDC is a system where contributions are fixed, registered in notional individual accounts which are remunerated by a administratively fixed rate of interest, and the capitalised value at retirement is transformed to an annuity paid out as a pension. The main advantage of an NDC system is that in the long run pension expenditure adjusts to contributions, if the notional rate of interest equals the rate of growth of the contributions (wage bill growth if the coverage remains constant), and if the longevity projections used for determining the annuities are continuously revised to reflect reality.

Under these assumptions, however, it is only pension expenditure which adjusts to contributions in the long run. It is important to note that in an NDC system, any change in rate of growth of the number of employed, or in retirement age or longevity will always cause an initial deviation between pension expenditure and contribution revenue. Even if this effect is only temporary, it leads to an accumulation of asset or liability stocks, which always explode if the market rate of interest deviates from the contribution revenue growth rate. This is generally assumed to be the case (we are assuming a 1.5 p.p. difference). Thus, strictly speaking, an NDC system left alone is always financially unsustainable.

In a mature NDC system, however, the deviation from a financial sustainability is not very large. With the initial values assumed in Chapter 2, a permanent decline in fertility from 2.1 to 1.7 leads, in 78 years (i.e. when the first small age cohort dies), to a debt accumulation of 42% of the wage bill. An increase in retirement age of one year leads to a corresponding asset accumulation of 8%. These are relatively moderate numbers. It is advisable, however, not to forget this aspect when designing an NDC based reform: an additional adjustment mechanism is always needed to guarantee financial sustainability. This mechanism can be a transfer from (or to) the government budget or a modification to one or another of the system's parameters.¹¹

¹¹ For example, in the Swedish system there is an adjustment mechanism, which is needed also because, in the first place, the rate of change of the average wage rate rather than of the wage bill is used as the notional interest rate in the system, see Settergren (2001a).

Having said this, it is important to recognise that the moderate amount of debt or asset accumulation above concerns only a *mature* NDC system, i.e. a system to which all members had belonged throughout their working lives. It takes 63 years (an individual's years in employment and in retirement) before this is the case. Therefore, the really interesting questions concern the combined effects of population ageing and a transition from a public DB to an NDC system. In reality, transition to NDC was invented precisely to deal with the consequences of ageing.

Table 3.2 reports alternative transition scenarios. We go directly to the population scenario combining the changes in fertility and longevity as the NDC system automatically responds to both of these demographic factors. Contributions are fixed at their level of 27% of wages in 2000.

The first two scenarios (Table 3.2) assume that the retirement age remains at 60. In Scenario 1 the transition to NDC takes place in 2001 so that all previously accumulated DB pension rights are fully respected, while everybody starts to earn NDC rights from 2001 onwards. Wage bill growth is set as the notional interest rate (*nir*) for the individual accounts. The same *nir* is also set for the indexation of pensions in payment, although this is not decisive as it is only important that the same rule be used in transforming the accumulated notional capital to annuity and in indexing the pensions in payment. For technical reasons related to the model used, it is assumed that indexation of DB pensions will also shift from wage rate to wage bill growth.

In the long run, the level of entry pensions declines to 40% of the wage rate and the average pension to 36% (the latter being lower than the former because pensions are now indexed to the wage bill rather than the wage rate), and pension expenditure is covered by revenues. However, this transition option first leads to deficit, pension expenditure minus revenue peaking at 4% of the wage bill in 2040, and the balance is reached only in 2060s when all DB rights have ceased and the population has reached a steady path. Amplified by the interest on the accumulating debt, the debt is then 131% of the wage bill. The average subsidy over 2001-2068 required to maintain balance is 1% of the wage bill. Thus, this option is not financially sustainable. The reason is that the previously accumulated DB pension rights are more costly than the new NDC rights, as they do not respond to the shrinking labour force and increasing time spent in retirement. As the contribution rate is now fixed, it does not respond the way it would have done in a DB PAYG system.

A second negative feature of this scenario is that for a long time after 2001 people do not have much of an incentive to postpone retirement. After 2001, working an extra year only increases the pension by about the same amount as in the old DB system, or the implicit tax rate on the extra effort is about 70% (see section 2.6). The incentives for later retirement will only emerge very slowly as the NDC component grows. Thus, an increase

Table 3.2. Transition to NDC**Assumptions:**

- fertility declines to 1.7 in 1981; longevity increases gradually from 78 in 2000 to 83 in 2050
- interest rate $r = wb + 1.5\%$
- contributions fixed at 27%
- notional interest rate (nir) set to follow wage bill growth

Scenarios:

- 1: Retirement age 60; previous DB rights respected, all move to NDC in 2001.
- 2: Retirement age 60; employees born before 1951 stay in DB; others move in 2001 to NDC with DB rights transformed to initial entries in their NDC accounts.
- 3: Retirement age increases gradually to 63 by 2010; transition to NDC like in Scenario 2 (**Figure 3.2**).

Second pillar: contribution fixed at 4%; two options for the interest rate on second pillar assets, $r = wb + 1.5\%$ and $r = wb + 3\%$. The second pillar is combined with each of the NDC pillar variants. The last line shows total average pensions from each variant in the new steady state.

NDC pillar	Scenario		
	1	2	3
Retirement age	60	60	63
Nr of groups	1	2	2
First NDC entry pensions	0+	54.1	72.7
Av pension in nss	36.1	36.1	44.7
Assets or Debt (-) in 2068	-131	-11	39
Av subsidy 2001-2068 for sust	1.1	0.1	-0.3
Imp. Pens. Debt in nss	642	642	642
Second pillar, return $wb+1.5\%$			
Av. pension in nss*	8.5	8.5	10.5
Assets in nss*	157	157	157
Total average pension in nss*	44.6	44.6	55.2
Second pillar, return $wb+3\%$			
Av. pension in nss*	13.7	13.7	17.1
Assets in nss*	207	207	210
Total average pension in nss*	49.8	49.8	61.8

All figures except fertility are expressed as percentage of the wage bill.

Rough approximation for figures expressed as percentage of GDP obtained by multiplying by 0.4.

nss = new steady state.

in the retirement age and the consequent strengthening of the system's finances are not very likely.

Transforming accumulated DB rights to NDC accounts

Encountering these problems, the transition to NDC has been implemented following a rule whereby accrued pension rights of those born before a given year are retroactively transformed to NDC rights, while the oldest workers are kept in the old DB system. There can also be a group in between, with part of accrued rights kept in the DB system and part transformed to NDC rights.¹²

In Scenario 2 (Table 3.2) we assume that in the 2001 reform workers born before 1951 stay in the old system. Still assuming retirement at 60 years, they will all have retired by 2011. The accrued pension rights of those born in 1951 and after are transformed to initial entries in their NDC accounts.

Both over the transition period on average and in the long run, this option leads to equality of pension expenditure and revenue, and to the level of pensions outlined above. The first NDC pensions in 2011 are 54% of the wage rate, thus markedly lower than the last DB entry pensions of 60% still paid in 2010 to the last cohort in the old system. Under our stylised assumptions this can be regarded as fair as the latter group initiated the reduced fertility. In practise, fertility never declines suddenly, and the transition rule can be made smoother than is the case here by following, for example, the Swedish model explained above.

Increasing retirement age

In addition to setting the transition rules for safeguarding the balance of the newly established NDC system, there is another potential source for improved finances, namely an increase in retirement age. Although under the basic rules of the NDC system it leads in the long run to an equal increase in pension expenditure and contribution revenue, it also has an additional effect: pension expenditure first decreases transitionally, while contributions increase, thus producing a surplus.

To show this effect, we assume that the retirement age increases gradually from 60 in 2000 to 63 in 2010. Although here this is merely an assumption, we also make explicit the parallel assumptions on the incentives to postpone retirement, i.e. the additional pension rights accrued by working longer.

The workers transferred to the NDC system will have a certain financial incentive to postpone their retirement as they will earn interest on their newly created pension account

¹² In the Swedish reform implemented in 1999, people born before 1938 stayed in the old system, those born in 1954 or after were fully shifted to the NDC, and those in between received a pension calculated with moving proportions from both systems, see Palmer, 2000, p. 19.

As another example, in the Latvian NDC reform implemented in 1996, the notional initial capital was arbitrarily based on the number of service years before 1996 and the monthly average contribution wage in 1996-99. Several changes have since been adopted to eliminate the effects of particular factors like unemployment or non-reporting by employers on individual accounts (Vanovska, 2002).

from the outset. We assume that those incentives are sufficient for them to work the assumed three extra years.

The assumption concerning the older workers who stay in the old DB system is less straightforward. If by working one extra year, they only earn the standard 1.5 percentage points increase to their replacement rate, the implicit tax is about 70% (see Section 2.6 above). An actuarially fair compensation would be roughly a 5 percentage point increase in the replacement rate for an extra year at work. Were they given this, they would earn a 75% replacement rate after having worked until 63. This would be costly for the system. As an alleviating factor, it is often considered that tightening eligibility to disability pensions might help towards an increase in the effective retirement age without major costs. There is no need to take any firm view on what the real options are, but for a first approximation, we make a *moderate* assumption that one third of the increase in the retirement age is remunerated by the standard accrual rate of 1.5%, and two thirds must give an actuarially fair compensation. (This assumption is not the most decisive component for the results in this section as in 2001 only $\frac{1}{4}$ of the work force is under DB, and this proportion declines to zero in 2013).

Note that here we are also simply assuming that there would be demand for this additional labour. The questions about the conditions for this (required training and the cost of it etc.) are beyond the present paper.

In Scenario 3 we assume (as above in Scenario 2) that the previously earned pension rights are transformed to NDC accounts. This scenario first leads to a surplus of revenue over pension expenditure, peaking at 3.3% of the wage bill in 2011 (see Figure 3.2). Later, deficits also occur, but on average over 2001-2068 the surplus is 0.3%. The entry replacement rate for the DB pensions increases to 71.5% in 2010, and the first NDC entry pensions in 2014 are 73% of the wage rate. Later, as the system reaches a steady path, entry pensions are 48%, and the average pensions 45%. These replacement rates are about eight percentage points higher than in the previous case with the retirement age maintained at 60. Given the notional rate of interest, this difference is the actuarially determined compensation for working for three extra years.

Second pillar attached to an NDC reform

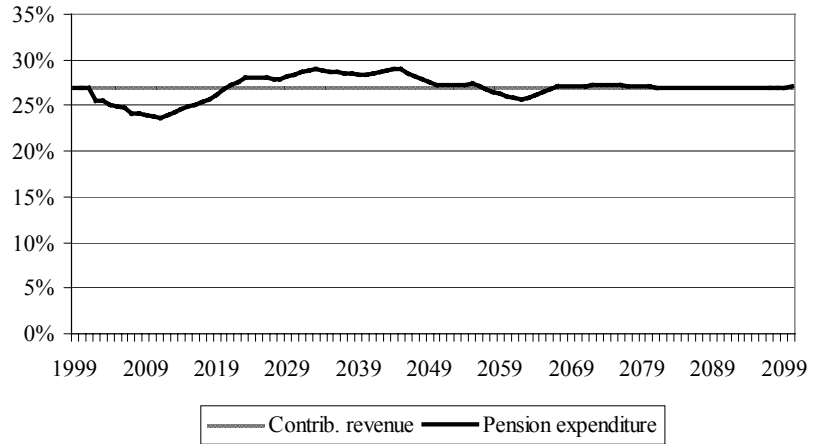
NDC reforms are in most cases accompanied by the introduction of a fully funded second pillar for those transferred to the new system. The motivation is to add to future pension levels as the NDC reform reduces them, depending on the assumption on the retirement age, to 36-45%. A mandatory second pillar opened for private management is attached to most NDC reforms so far, but our illustration would be equally valid for a public sector managed arrangement (and also for a third pillar, were people to voluntarily choose to save the amount of money assumed below). The essential difference between the NDC pillar and the accompanying fully funded pillar is that in the former, the internal rate of interest is the wage bill growth, while in the latter the rate of return on assets is determined by the market.

In Table 3.2 we assume that on top of the 27% contribution to the NDC system, a contribution of 4% of wages is paid to a fund, which is assumed to earn the market rate of interest ($r = wb + 1.5$) on its capital and to deliver annuities as people retire.

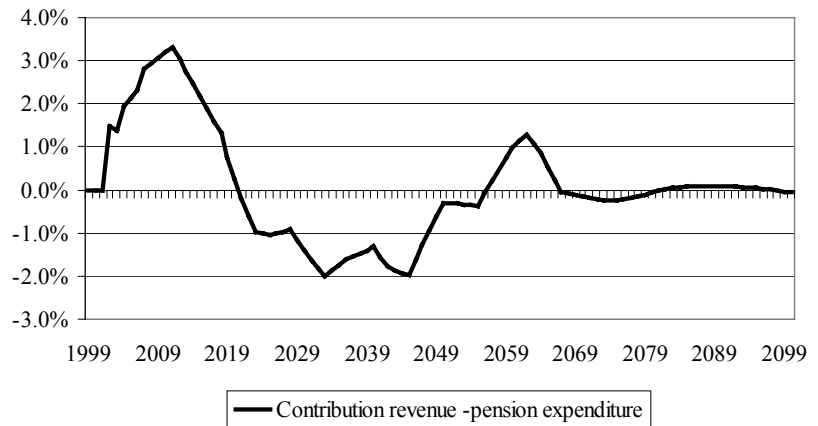
Figure 3.2. Transition to NDC

Retirement age increases gradually to 63 by 201; employees born before 1951 stay in DB, others move in 2001 to NDC with DB rights transformed to initial entries in their NDC account (Scenario 4 in Table 3.2).

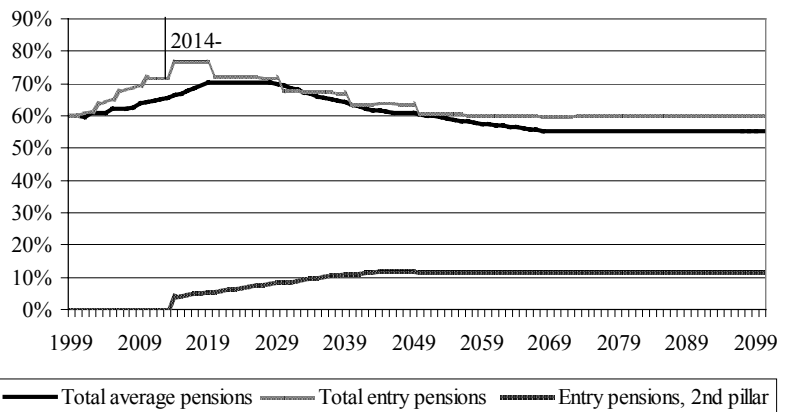
As retirement age increases, contribution revenue first exceeds pension expenditure, and a surplus is produced.



Then, the balance reverses, but ultimately the system reaches the long run balance.



Entry replacement rates in the first pillar rise initially to above 70%, but then decline leading together with the second pillar to total entry pensions of 60% and total average pension of 55%.



Total entry pensions: DB until 2013 and NDC 2014- plus 2nd pillar pensions.

In the early years, the financial surplus in the second pillar is of course more than 4% of the wage bill which it covers (contributions plus interest revenue), and the fund grows to a permanent size of 157% of the wage bill. The average pensions provided by this pillar to those who have contributed to it over their whole career are 8.5% or 10.5% of wages, depending on whether people worked for a total of 40 or 43 years.

As another assumption on the interest rate, a 3 p.p. premium over wage bill growth is presented in Table 3.2. Compared to the previous cases this gives a more than 6 p.p. higher replacement rate, and restores the level of total pension to above 60%, which was the level before the effects of the assumed ageing.

Figure 3.2 illustrates the NDC scenario 3 combined with the second pillar, assuming the rate of return to be $wb+1.5$. The first NDC entry pensions in 2014 are 73% of the wage rate, and then they decline, and together with the second pillar produce a total average pension of 55% as the system matures.

As a conclusion, a three year increase in the effective retirement age would guarantee a financial balance for the new NDC system. This is perhaps not an unlikely scenario as we assume that people will earn a higher pension by working longer. Should they accept to pay an additional 4% contribution to a funded pillar, their average pensions would be 55% of average wages, somewhat lower than the 60% in the original DB system before ageing put a strain pension financing.

The financial balance of the NDC system depends, however, on the retirement age, and therefore on the behaviour of workers, and of employers as providers of jobs. This makes the financial sustainability of the NDC reform uncertain. Thus, while such a reform is very interesting, it is not a panacea, and many details and problems are confronted in implementing it.

To enlarge the palette for pension reforms, we look again into the DB system provisionally described in Sections 3.1-3.2 above, and introduce to it further, so-called parametric reforms, namely a change in the indexation rules or a decrease in accrual rates, and an increase in the retirement age, along the lines of the NDC system above.

4. Further reforms to the pre-funded DB system

Considerations on pre-funding a DB system in Section 3.1 led to the conclusion that contribution rates should immediately be considerably increased in order to share the burden in an equitable manner across successive generations. The illustrations were based on the assumption of preserving benefits at the level in 2000, including the replacement rate and the retirement age.

Having studied how changes to these two variables take place and how they are coped with under a transition to an NDC system, it seems worthwhile to take another look at possible further reforms to a DB system, which would make the required increase in the contribution rates more moderate.

4.1. Indexation to prices or decrease of accrual rate

In Section 3.1 we assumed that pensions are indexed to the wage rate as they have been until recently or still are in many countries. Lately, however, shifting from wages to prices has been implemented in a few EU Member States and elsewhere. The effect of this change in indexation can be calculated as follows: if the real wage rate is assumed to increase by 1.75% p.a. and time in retirement to reach 23 years after the projected longevity increase, this shift in the indexation rule decreases pension expenditure by 17% in the long term, to 37.0% of the wage bill. Entry pensions are still 60%, but average pensions are 50% of wages. The pension of an 83 year old would be 32% lower than in the case of wage indexation.

This shift in the indexation rule has the perverse effect that the decrease in pension expenditure as a percentage of the wage bill is the smaller the lower the growth of productivity in the economy, while the need for a downward adjustment might be even more important in the case of low growth.

Secondly, a change in the public pensions indexation rule has a marked effect because it affects pensions retroactively in the sense that even pensions in payment are reduced as compared to original expectations based on wage indexation. Yet, this has been politically acceptable as indexation is commonly not understood to be a part of acquired rights in DB systems, untouchable by policy measures. However, the lack of a firm rule may later lead to decisions to increase pensions to restore their relative level. This may become more likely as pensioners will represent an increasing proportion of voters.

For these reasons we consider an alternative policy measure, namely decreasing the accrual rate. A decrease of the accrual rate from 1.5% to 1.25% and maintaining the indexation to wages, reduces the replacement rate to 50%, and pension expenditure to 37.4% of the wage bill in the long run. The effect is then almost exactly the same as for the shift in the indexation rule if the real wage increase is 1.75%. The advantage of accrual rate reduction is that its effect is the same even if the wage rate change turns out to be other than 1.75%.

Although the long-run effects of these alternative measures are the same, their short- and medium-run effects differ. If the accrual rates are reduced only for the accumulation of new rights with no retroactive effect, the indexation change has a bigger downward effect in the first decades. The difference peaks in 2014 at 3.1% of the wage bill.

4.2. Increasing retirement age

Taking as the reference the pre-funded DB system with the retirement age at 60 (Scenario 4 in Table 3.1), reproduced as Scenario 1 in Table 4.1, we now assume a gradual increase in the retirement age to 63 by 2010. Secondly, we assume that from 2001, the accumulation of pension rights until the age of 60 is decreased to 1.25% a year while indexation to wages is maintained. One alternative option could be to shift from indexation to prices without cutting the standard accrual rate, but it is not treated here in order to limit the number of cases to be analysed. For the additional accrual over the years from 60-62 spent at work, we take the *moderate* assumption (as in section 3.3) that one third of the increase in the retirement age is remunerated by the standard accrual rate of 1.25% and two thirds give an actuarially fair compensation of 4.8%.

These assumptions lead to the entry replacement rate peaking in 2010 at 69%. These figures are influenced by the accrual rate of 1.5% until 2000 and increased years at work. Later, the replacement rate approaches 61%, almost the same as until 2000 (Scenario 2 in Table 4.1). Pension expenditure settles at 36.8% in the long term.

The same principles for fairness as in Section 3.1 above are now applied to determine the contribution rate from 2001 onwards. Earlier we made it increase gradually until 2020, reflecting both fertility and longevity. Now, as we assume that people work extra years, so that the ratio between years at work and in retirement increases, and as they are not fully actuarially compensated for this, there is no simple rule for the pace of adjusting the contribution rate to reflect longevity change. As a rule of thumb, we assume that the new permanent contribution rate will be reached by 2010, and that two-thirds of the increase takes place in 2001. The result is that for financial sustainability the contribution rate should be increased from 27% in 2000 to 30.4% in 2001 and to 32.0% by 2010 (Figure 4.1 and Scenario 2 in Table 4.1).

The surplus of revenue over pension expenditure peaks in 2011 at 8.9% of the wage bill, and the overall surplus in the late 2020s at 12.6%. The fund increases to 313% of the wage bill.

As a conclusion, a combination of postponing retirement by three years, increasing the contribution rate from 27% to 32%, and adjusting the accrual rate downwards for the standard years, and upwards for working from 60-62, renders the DB PAYG system sustainable under the projected ageing.

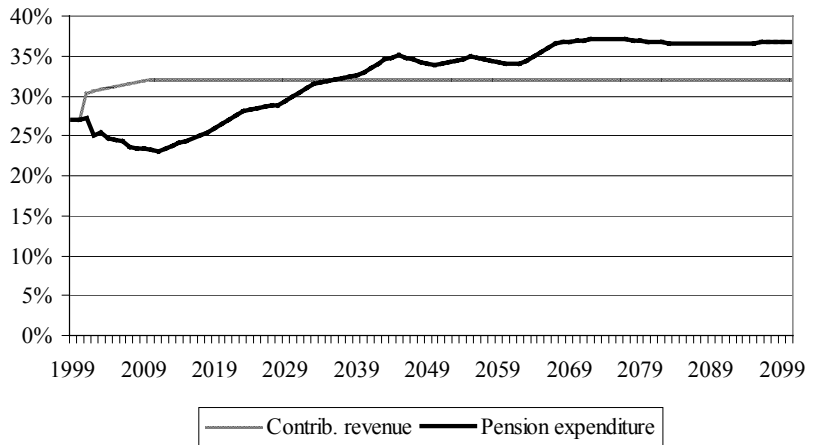
The assumption on the additional compensation for working extra years is a crucial one, more crucial here than in the NDC exercise, where only the oldest employees stayed in the DB system. In Box 2, Table 4.1, we report three additional scenarios to show the sensitivity of the results in this respect.

Figure 4.1. Pre-funded DB system: standard accrual rate reduced and retirement age increased

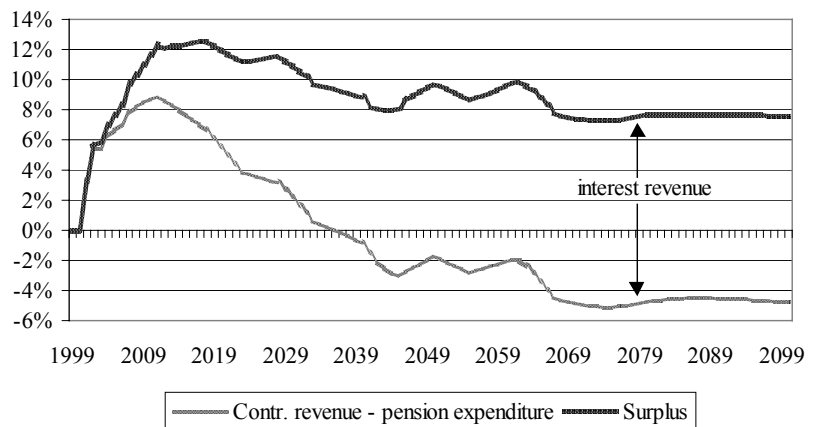
Accrual rate 1.25% per year; retirement age increases gradually to 63 by 2010; accrual rate for years 60-62 provides moderate compensation; contributions increased in 2001 by 2/3 of the total increase to steady state level by 2010 (Scenario 2 in Table 4.1).

As retirement age increases, pension expenditure falls initially even below the previous level.

This, and an increase in the contribution rate produce a comfortable surplus...



... so that in the more distant future, the burden is considerably eased by the interest revenue



... coming from a fund which grows to over 300% of the wage bill.

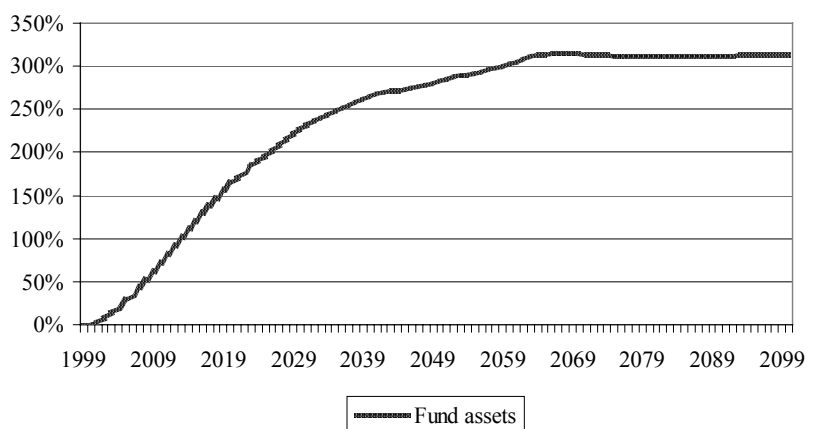


Table 4.1. Further reforms to the pre-funded Defined Benefit system**Assumptions:**

- fertility declines to 1.7 in 1981; longevity increases gradually from 78 in 2000 to 83 in 2050
- pensions indexed to wages
- interest rate $r = wb + 1.5\%$
- real wage growth 1.75% and inflation 1.5% (relevant only for surplus or deficit figures)

Scenarios:

- 1: Retirement age 60; accrual rate 1.5% per year; contributions increased in 2001 and further to 2020 to correspond to the fertility decline and longevity increase (as Scenario 4 in Table 3.1 and **Figure 3.1**).
- 2: Retirement age increases gradually to 63 by 2010; standard accrual rate 1.25% per year; accrual rate for years 60-62 provides moderate compensation; contributions increased in 2001 by 2/3 of the total increase to steady state level by 2010 (**Figure 4.1**).
- 3: Like Scenario 2 but accrual rate for years 60-62 provides full compensation.
- 4: Like Scenario 2 but accrual rate for years 60-62 provides low compensation.
- 5: Two groups: (1) workers born before 1951 maintain original DB rights and get moderately compensated for years 60-62 at work; contribution rate maintained at 27%; (2) workers born 1951 or after: DB accrual rate reduced to 1.25% per year retroactively from 1981; moderately compensated for years 60-62 at work; new contribution rate effective from 2001.

	Scenario				
	1	2	3	4	5
Retirement age	60	63	63	63	63
Accrual rate 2001-, standard	1.5	1.25	1.25	1.25	1.5/1.25
Accrual rate for 60-62 year old	-	moder.	full comp.	low comp.	moder.
Entry repl. rate peak (2010-14)	-	69.3	72.9	65.7	71.6/63.4
Av repl. rate in nss	60	60.8	64.4	56.0	60.8
Pension expenditure in nss	44.8	36.8	39.0	33.9	36.9
Contribution rate in nss	38.4	32.0	33.6	29.9	31.6
Surplus, max	16.1	12.6	14.0	10.6	12.8
Year of peak surplus	2020	2018	2011	2018	2028
Surplus in nss	10.5	7.6	8.5	6.5	8.3
Fund in nss	427	313	348	265	340
Imp. Pens. Debt in nss	1066	874	924	800	873
IPD - fund in nss	639	561	576	535	533
Degree of funding, %	40.1	35.8	37.7	33.1	38.9

Under the assumption of stationary population IPD was 645%. Assuming ageing, retirement age at 63 and the original standard accrual rate of 1.5% without any adjustment for later years at work, IPD would be 927% in nss.

All figures except fertility and degree of funding are expressed as percentage of the wage bill.

Rough approximation for figures expressed as percentage of GDP obtained by multiplying by 0.4.

nss = new steady state.

Box 2. Outcomes of the reforms with varying compensation for later retirement

In Scenario 2 in Table 4.1 a moderate compensation for postponing retirement until the age of 63 was assumed. In Scenario 3 a full actuarial compensation is assumed to be necessary. In this case the entry replacement rate peaks at 73%, the contribution rate needs to be increased to 33.6%, and the fund reaches 348% of the wage bill.

In Scenario 4 it is assumed that the effective retirement age can be increased by one year without any compensation at all (reducing disability pensions), the second additional year is compensated only by the standard accrual rate of 1.25%, and only the third needs the full actuarial compensation. In this case the entry replacement rate peaks at 66%, the permanent contribution rate is 29.9%, and the fund reaches 265% of the wage bill.

Scenario 5 is inspired by the NDC reform: here too employees could be divided into two groups according to whether they (on average) had the previous or current fertility rate. Assuming a decision takes effect in 2001 such that those born in 1950 or before maintain the accrual rate of 1.5%, while the rate for those born in 1951 or after is retroactively reduced to 1.25% for pension rights earned since 1981 to reflect their low fertility. Both groups receive the moderate compensation for increasing the retirement age. The first group continues to pay the old contribution rate of 27%. Now that the differentiation is made in the accrual rates, we simply assume that the required rise to the contribution rate paid by the second group is implemented immediately in 2001.

In this case the new constant contribution rate to guarantee sustainability is 31.6%, i.e. not much lower than the 32.0% in the corresponding case with no retroactive effect. The fund reaches 340% of the wage bill. After the increase in retirement age the pensions for the first group are 71.6% while those for the second are 63.8%. This, and the higher contributions paid by the second group, form one possible combination leading to a fair and financially sustainable path, in response to the challenge of the decline in fertility and increase in longevity.

4.3. Partial privatisation of a pre-funded DB system

The pre-funded DB system without retirement age increase illustrated in Section 3.1 required a contribution rate of 38% for sustainability. If retirement age increases by three years, as assumed in Section 4.2 above, the required contribution rate varies between 30% and 33% depending on the assumption on accrual rates, both for the normal career years and for the extra ones after the age of 60.

The size of the fund in the steady state to be reached in about 60 years varies in these examples between 265% and 348% of the wage bill, or between 100% and 140% of GDP.

In the case of a NDC system it was argued that establishing a fully-funded second pillar might be advisable to top up the low NDC pensions in future. We illustrated an example with a 4% contribution to the second pillar, on top of the 27% to the NDC system.

In the examples of a pre-funded DB system above, in the case that the retirement age increases by three years, the replacement rates are maintained around 60% even in the long run, while the contribution rates are 30-32%, or of the same order of magnitude as in the NDC plus the 4% to the second pillar.

Thus, the argument for privatisation in the reformed, public sector managed DB system has to be different than in the NDC system. Here it stems from the management of funds accumulated in the DB system. First and foremost, it is essential for the whole purpose of funding that these funds are not used for government consumption, because in such a case the savings in the pension system would not be transferred to the future generations. This requirement is met if government consumption and transfers other than pensions are financed from general tax revenue. However, this leaves many options for placing the pension system surplus. If the government has a high initial debt, it may use the pension system surplus for its amortisation.¹³ Also, a special public sector pension fund could be established, which would place the funds in a wide range of assets. Furthermore, a public-private-sector partnership can be established for the same purpose.¹⁴

In addition to these options, under which the funds would be managed by the public sector, management can be fully or partially shifted to the private sector for political, institutional or economic reasons, not to be discussed here. This could be done by diverting part of the contributions to the privately managed second pillar, and reducing correspondingly the accrual of DB benefits in the public pillar, as shown in the stationary population case in Section 2.4.

As an illustration, we start with the basic mono-pillar case, Scenario 1 in Table 4.1 shown in Figure 3.2 above, where retirement age is maintained at 60 and the contribution rate is increased to 38.4% by 2020. This scenario is financially sustainable and results in a fund of 427% of the wage bill. This case is reproduced as Scenario 1 in Table 4.2, which reports results for privatisation.

¹³ This could be the case for Belgium, where amortisation of public debt of 100% of GDP within 40-60 years could be a scenario resembling accumulation of public pension reserves in another country which starts with a debt position close to zero.

¹⁴ If in such a case the system is a DB one, it is classified in national accounts under the general government as is the case e.g. in Finland; this is relevant for public finances monitoring under EMU.

Let's now assume that from 2001 onwards 4 percentage points of the contributions are diverted to a newly created, privately managed and fully funded second pillar. The standard assumption of the interest rate, $r = wb + 1.5$, holds for both pillars.

If the accrual rates in the DB first pillar are reduced only pro rata, i.e. in proportion to the decline in contributions paid to the first pillar, the result is an unsustainable path, even though the mono-pillar starting point was sustainable. The reason is the same as explained for the stationary population case in Section 2.4 above: although in this case the system first runs a surplus (due to the increase in retirement age and a small increase in the contribution rate), at a certain point in time the difference between the pension expenditure and contributions in the first pillar exceeds a critical level, and as the rate of interest is assumed to be above the rate of growth of the wage bill, assets are run down and debt explodes. Viewed from another angle, the system breaks down because introduction of the second pillar generates an addition to the replacement rate (a 3-percentage points increase in this case), while the total contribution payments remain the same, therefore rendering the system unsustainable.

Achieving a sustainable system requires a more than pro rata reduction of accrual rates in the first pillar (or an increase in the contribution rate or a transfer from somewhere). Reducing the accrual rates so that the total replacement rate remains at the level of the mono-pillar, the first pillar remains sustainable, and the main effect of the privatisation is that in the long run it shifts a fund of 159% of the wage bill from the public pillar to the second. The total of funds in the two pillars is the same as in the mono-pillar as the first pillar maintains a fund of 262%. This and other features are reported as Scenario 2 in Table 4.2 and illustrated in Figure 4.2. The first pillar does not counter a deficit at any point in time as the 4 p.p. of contributions diverted to the second pillar is less than the increase in the contribution rate in 2001. Later, contribution revenue for the first pillar is less than pension expenditure, but the revenue from assets accumulated in the first decades more than covers this. The first pillar remains sustainable, with the said assets amounting to about 70% of GDP.¹⁵

As said above, the mono-pillar case underlying this exercise may not be a commonly preferred option as the total contribution rate is 38%. For another illustration, we start with the mono-pillar case, Scenario 2 in Table 4.1 shown in Figure 4.1 above, where retirement age increases to 63, rendering it sufficient that the contribution rate increases only to 32% by 2010. It is financially sustainable and results in a fund of 313% of the wage bill. It is reproduced as Scenario 3 in Table 4.2.

Diverting a 4 p.p. contribution into a second pillar and reducing again the accrual rate in the first pillar to maintain sustainability (reported as Scenario 4 in Table 4.2) still maintains the first pillar in surplus throughout the scenario (apart from a small deficit in 2001). The permanent level of funds reaches 153% of the wage bill. The pattern is very similar to the previous case (Figure 4.2), except that both expenditure and contributions are lower, thanks to the three year increase in the retirement age.

¹⁵ Were the assumed uniform interest rate higher (lower), accumulation of assets in the second pillar and the corresponding reduction in the first pillar assets would be larger (smaller) so that total amount assets are unaffected. The surplus in the first pillar would also change, as would division of the total replacement rate between the two pillars.

Table 4.2. Partial privatisation of a pre-funded Defined Benefit system**Assumptions:**

- fertility declines to 1.7 in 1981; longevity increases gradually from 78 in 2000 to 83 in 2050
- pensions indexed to wages
- interest rate in the first pillar $r = wb + 1.5\%$
- real wage growth 1.75% and inflation 1.5% (relevant only for the surplus and deficit figures)

Scenarios:

- 1: Retirement age 60; mono-pillar, accrual rate 1.5% per year; contributions adjusted for intergenerational fairness (same as Scenario 1 in Table 4.1 and **Figure 3.1**).
- 2: 4 percentage points of contributions in Scenario 1 diverted to the second pillar from 2001 onwards; second pillar rate of return $wb + 1.5\%$ (**Figure 4.2**), or $= wb + 3\%$.
- 3: Retirement age increases gradually to 63 by 2010; mono-pillar, standard accrual rate 1.25% per year; working at 60-62 moderately compensated; contributions adjusted for intergenerational fairness (same as Scenario 2 in Table 4.1).
- 4: 4 percentage points of contributions in Scenario 3 diverted to the second pillar from 2001 onwards; second pillar rate of return $wb + 1.5\%$, or $= wb + 3\%$.
- 5: 8 percentage points of contributions in Scenario 3 diverted to the second pillar from 2001 onwards; second pillar rate of return $wb + 1.5\%$ (**Figure 4.3**), or $= wb + 3\%$.

	Retirement age 60		Retirement age 63		
	1	2	3	4	5
Accrual rate 2001-, standard	1.5	1.3	1.25	1.0	0.8
Entry repl. rate peak in 2010	-	-	69.3	66.2	62.9
Av repl. rate in nss	60	51.4	60.8	50.3	39.6
Pension expenditure in nss	44.8	38.5	36.8	30.3	24.0
Contribution rate in nss	38.4	34.5	32.0	28.0	24.1
Surplus, max	16.1	10	12.6	6.7	..
Year of peak surplus	2020	2020	2018	2017	..
Surplus in nss	10.5	6.4	7.6	3.7	-0.1
Fund in nss	427	262	313	153	-7
Imp. Pens. Debt in nss	1066	750	874	732	578
IPD - fund in nss	639	488	561	579	585
Degree of funding in 1st pillar, %	40.1	34.9	35.8	20.9	-1.2
Second pillar, return = $wb + 1.5\%$					
Av 2nd pillar pension in nss*	-	8.6	-	10.6	21.2
2nd pillar assets in nss*	-	159	-	159	318
Total average pension in nss*	60.0	60.0	60.8	60.9	60.8
Degree of funding in entire sys., %	40.1	46.3	35.8	35.0	34.7
Second pillar, return = $wb + 3\%$					
Av 2nd pillar pension in nss*	-	13.8	-	17.2	34.4
2nd pillar assets in nss*	-	211	-	213	425
Total average pension in nss*	60.0	65.3	60.8	67.5	74.1
Degree of funding in entire sys., %	40.1	49.2	35.8	38.7	41.7

All figures except fertility and degree of funding are expressed as percentage of the wage bill.

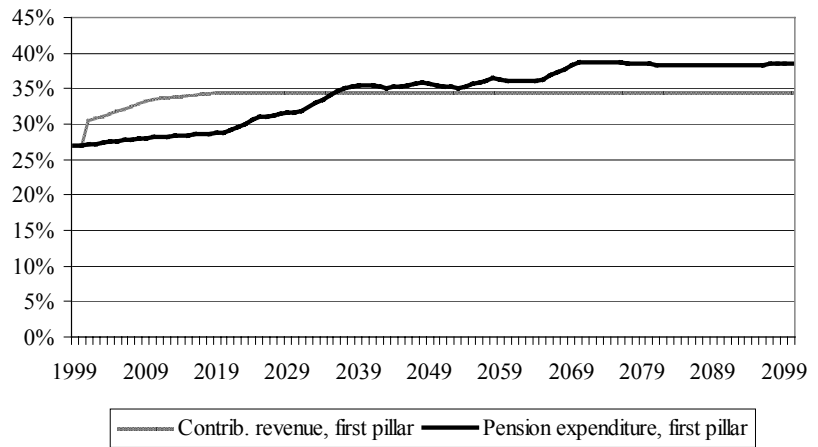
Rough approximation for figures expressed as percentage of GDP obtained by multiplying by 0.4.

nss = new steady state.

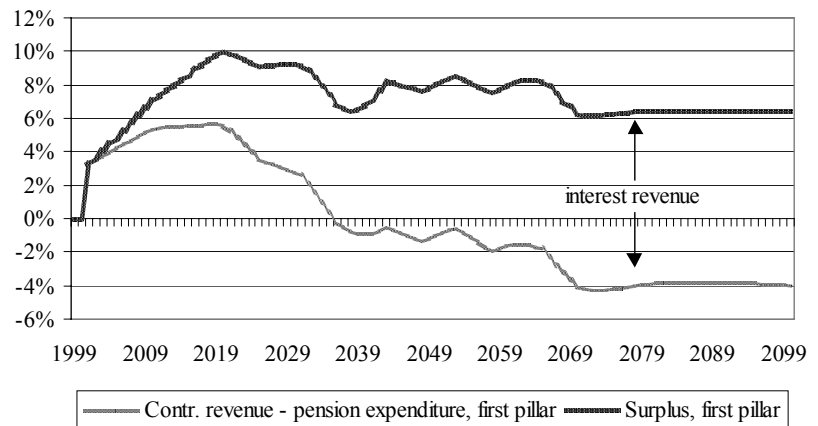
Figure 4.2. Partial privatisation of the pre-funded DB system: retirement age 60

4 percentage points of contributions diverted to the second pillar from 2001 onwards; second pillar rate of return = $wb + 1.5\%$ (Scenario 2 in Table 4.2).

As 4 percentage points of contributions are diverted to the second pillar, contributions to the first pillar still exceed pension expenditure ...



... maintaining a significant surplus and accumulating significant reserves in the first pillar ...



... and resulting in a first pillar fund of more than 250% of the wage bill, while the second pillar funds rise to 160%.

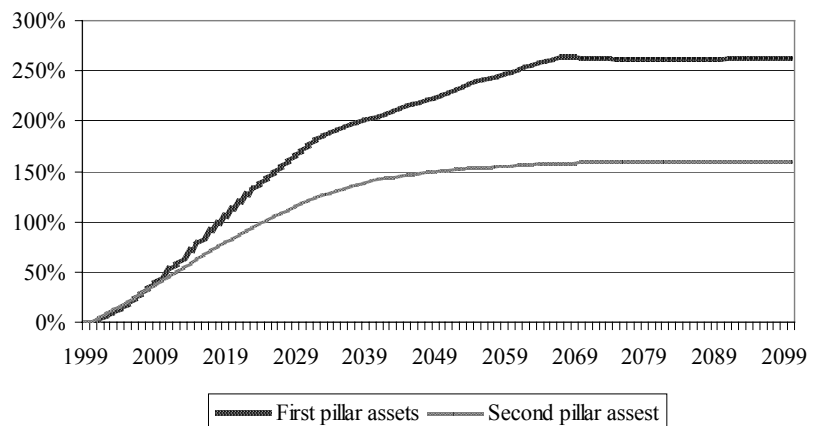
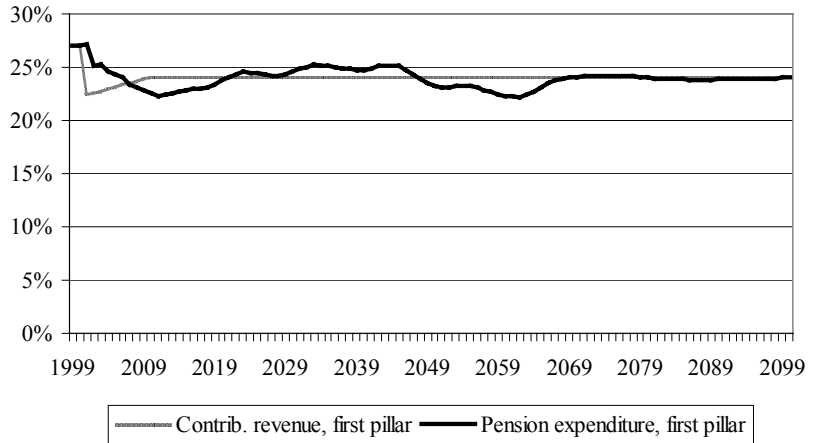


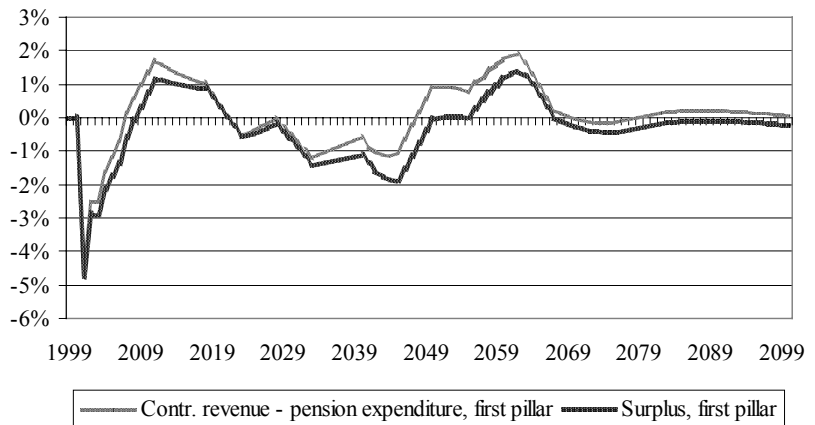
Figure 4.3. Partial privatisation of the pre-funded DB system: retirement age 63

8 percentage points of contributions in Scenario 3 diverted to the second pillar from 2001 onwards; second pillar rate of return = $wb + 1.5\%$ (Scenario 5 in Table 4.2).

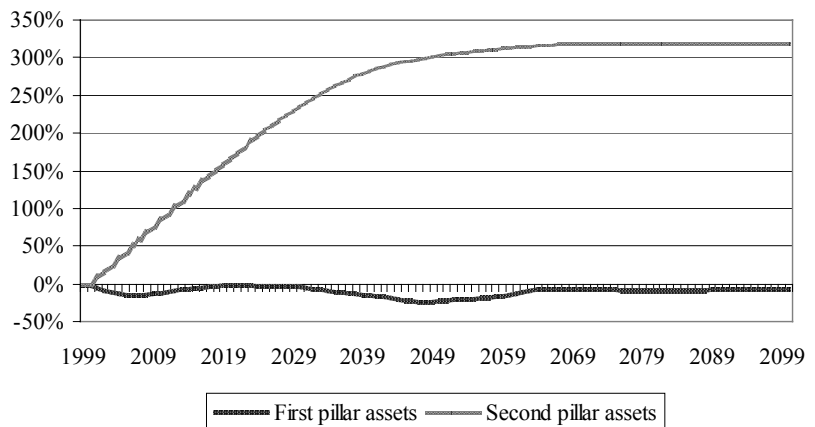
Diverting 8 percentage points of contributions to the second pillar reduces first pillar revenue to the level of expenditure in the long run ...



... maintaining a balance close to zero in the long run, while a significant deficit occurs in the first decade, as it is assumed that the retirement increases only gradually, helping to restore the balance only after a decade.



No reserves are accumulated in the first pillar, but the second pillar funds grow to more than 300% of the wage bill.



The remaining surplus in the first pillar in these two cases means that an even bigger shift to the second pillar is possible. In the case of retirement age of 63, diverting 8 percentage points of contributions to the second pillar leads to a balance in the first pillar in the long run (Scenario 5 in Table 4.2 and Figure 4.3). In this way the assets are transferred from the first pillar to the second, which acquires a permanent fund of 318% of the wage bill, but the problem of at least a temporary deficit arises. A deficit of about 5% of the wage bill (2% of GDP) appears immediately in 2001, decreasing to almost zero by 2010, thanks to the increase in the retirement age adding to revenue. After 2010 the balance fluctuates around zero.

In this last scenario, the degree of privatisation, or the amount of contributions to be diverted to the second pillar, was chosen so that no funds were left to the first pillar. A larger privatisation, again with the principle that the accrual rates in the first pillar are reduced so that the total replacement rate is maintained, would lead to debt accumulation in the first pillar. This could still be a sustainable path where deficit and debt each converge to some proportion of the size of the economy, following the principle illustrated in Chapter 2 with Figure 2.2.

As a separate issue, the effect of an alternative assumption on the rate of return on second pillar funds is reported at the bottom of Table 4.2, combined with any of the privatisation scenarios. Should this rate be 3 p.p. above the wage bill growth instead of the standard assumption of 1.5 p.p., the effects on the total replacement rate and on the permanent level of funds are noticeably higher.

The degree of funding, i.e. the ratio between accumulated funds and liabilities, is also reported in Table 4.2. In the mono-pillar case with retirement age at 60 this degree increases to 40%, and up to 50% if the system is partially privatised. As mentioned above, this case represents a useful reference, but is probably not a commonly preferred option due to its very high contribution rates. In the case of a retirement age increase to 63, the figures could more realistically be policy targets as the contribution rate sufficient for financial sustainability and intergenerational fairness is 32%. The resulting degree of funding varies in the range of 35-40% after 60 years, when full adjustment has taken place. About 2/3 of the accumulation of funds should take place in 30 years.

The implications of pension system privatisation for public finance targets will be discussed in Chapter 6 below.

5. Comparison between DB and NDC reforms and full funding

The DB system reform outlined above is based on the following factors:

- (1) an increase in contribution rates so that current workers, taking the declined fertility and increased longevity into account, pay a fair share of the intergenerational burden of pensions, and
- (2) a decrease in the standard accrual rate so that base line pensions decrease by 17%, and an increase in the accrual rates for older workers to provide an incentive for an increase in the retirement age.

The results differ to a certain extent depending on the degree of retroactivity of the change to the accrual rate, which can be argued by taking into account that most current workers already belong to cohorts with a declined fertility. In all cases analysed where we assume a three-year increase in retirement age, the contribution rate is increased from its initial level of 27% to 30-33%, and the permanent fund created is 100-150% of GDP. These scenarios compare favourably with the base case, in which a contribution rate of 38% is necessary to cover the cost of maintaining the replacement rate at the initial level of 60% and the retirement age at 60.

The reformed DB system can then be partially privatised if it is considered more advisable to trust the management of the funds to the privately managed institutions. In this case, however, in the first pillar, benefits compared to contributions have to be reduced, which reduces the actuarial fairness in this pillar, and may further reduce its acceptability as a vehicle for implementing an intergenerational contract. This happens at the expense of the full actuarial fairness in the newly created second pillar.

Privatisation may also cause a deficit in the first pillar, the size of which depends primarily on the proportion of the system to be privatised and on the pace of implementing the reform and changes in retirement age.

In *the NDC reform*, replacement rates are automatically adjusted so that in the long run, fixed contributions cover pension expenditure. If the retirement age does not increase, a deficit occurs in the first decades, and the system is unsustainable unless transfers are made from the general budget or benefits are specifically adjusted to make the transition affordable.

The transition to the NDC system can be implemented so that workers born after a given year are transferred to the new system so that they receive an initial fund based on their work history. In this case they earn more pension rights by working extra years, hence an increase in retirement age may take place. If the retirement age increases by three years, financial sustainability is safeguarded as the system runs a surplus.

As the average replacement rates decline to about 45% even if the retirement age increases to 63, a second pillar may be established. It would not draw resources from the NDC pillar, thus avoiding the possibly problematic interaction between the two pillars, which appears in the DB system. The size of the second pillar to complement the NDC system can then also be more freely chosen.

We have illustrated the effects of a *permanent change in fertility*. If fertility changes again, an adjustment is needed to the contribution rates or benefits in the DB system to

re-establish sustainability. In the NDC system equality of contributions and pension expenditure is guaranteed in the long run, but adjustment is needed for balancing the system in the short run so that it does not start accumulating unlimited debt.

Longevity change, if not followed by a proportional increase in retirement age, requires an adjustment to the contribution rate or benefits in a DB system. An NDC system adjusts the replacement rates automatically.

The two systems differ with regard to the link between the burden of pensions, size of the labour force and labour productivity. The primary channel between these variables is the replacement rate. In a DB system where pensions are indexed to wages, replacement rate depends only on the accrual rates (and a possible fixed component) and retirement age. Pension contributions then depend on the size of the labour force, which in the scenarios above only depend on fertility (in reality it also depends on unemployment, participation rate and migration). However, assuming indexation to wages, the replacement rate does not depend directly on labour productivity under the conventional assumption that labour productivity and wages move together. Labour productivity has an effect only if pensions are not indexed to wages but e.g. to prices.

In an NDC system the replacement rate is determined by the rate of change in the labour force via the increase in the wage bill (as this is set as the notional interest rate). Thus, average fertility and retirement age affect the return on the notional accounts, and the retirement age decision of the individual then determines his/her level of pension. Replacement rate does not depend on labour productivity as it is indexed to wages via the wage bill. Neither is there any case for an indexation rule change as the capitalised value of the pension is given, and alternative indexation rules for pensions in payment only determine the ratio between entry and average pensions.

In addition to these features, the DB and NDC reforms may differ with regard to *actuarial fairness across different types of beneficiaries*. Although this aspect is not properly treated in the present paper, it is still useful to make a few comments.

The NDC system is actuarially fair in the sense that individual accounts are remunerated with the administratively set interest rate, which in a sustainable NDC is the change in the wage bill covered by it. It may differ from the full actuarial rule across genders or any other groups with characteristics known to have an impact on life expectancy.

Actuarial fairness can take many degrees in a DB system. A flat rate pension not linked to any contribution payments is not actuarial at all, while a system where pension rights are accrued by working and paying pension contributions and where the pension is determined on the basis of the whole working career wage, can have exactly the same properties as a NDC system. If an individual can choose his retirement age, then the accrual rates for the years in that interval must be set with a view to providing sufficient incentives to stay longer at work. If reforms to this effect are made in a DB system, then some of the desired properties of a NDC system can be achieved.

Portability of pension rights when workers move between countries is another issue not properly dealt with here, but we can briefly note the differences between the two main systems in this regard. An NDC system is more suitable for transfer as it includes individual accounts as a genuine feature. In a DB system the clarity of the value of the accumulated pension rights depends on the clarity of the rules of the system as a whole, and on its sustainability. Even when the expected pension of an individual is clearly

defined, contributions paid by the individual might not correspond to rules, which would render the system sustainable. It then becomes unclear as to what the fair capitalised value of the rights should be. It helps if the rules of the DB system are first reviewed and adequately changed so that sustainability and fairness of the system is guaranteed, and the value of individual rights then determined.

While a comparison of the outlined reforms with a *fully funded system* (or with a transition to it) may indeed be interesting, we disregard a more detailed assessment for the following reasons:

- (1) a FF system providing the level of benefits assumed initially in 2000 would have funds equal to 645% of the wage bill, and maintaining the set contribution level and assuming a retirement age 63, the funds would be 680% in the new steady state after the assumed ageing. These figures represent nearly 300% of GDP, thus, the FF funds would have claims on more than half of the total capital stock in a typical EU country.
- (2) A shift to 100% funding would lay an unfair burden on some generations. The examples illustrated above are based on fairness, and they lead to a degree of funding of 30-40% (funds as a percent of implicit pension debt). By implication, under the prevailing assumptions on ageing, more funding would be unfair for some while benefiting others.

Regardless of these aspects, it should be noted that the replacement rate in relation to contribution payments also declines in a hypothetical FF system if the interest rate declines with ageing, as is generally assumed. With our standard assumption $r = wb + 1.5\%$, the replacement rate would decline from 60% to 46%, i.e. by the same amount as in the NDC system (as the factor behind is the same, namely the decline in the labour force). In this case a 100% FF system is as vulnerable to ageing as an NDC. Correspondingly, should the real interest rate decline by less than the rate of decrease of the labour force, as might be the case in an open economy interacting with other countries where ageing is less rapid, the result would be more favourable to funding.

Also, a higher return on funded assets than the assumed $wb + 1.5\%$ would render the results more favourable to full funding, as under any degree of funding, in the sense that a lower contribution rate would be sufficient for given benefits. Whether this possible higher return would indicate higher total welfare in the economy as a whole or merely a shift of income between different sources and recipients is a topic for a further study.

6. Effects of pensions and ageing on public finance targets

6.1. Effects of ageing on public expenditure and tax revenue

Before showing how the results of the actuarial calculations can be transformed to targets for public finance, it is worthwhile to discuss some other items under public sector budgets, which possibly depend on ageing.

Health and long-term care are known to depend on the age structure of the population, as a considerable part of public sector financed health care is provided to people over 65 years of age. A rough estimate for this expenditure in EU-15 is 3% of GDP. This old-age related expenditure should increase proportionally less than the share of people at age over 65 years because people will remain in better health longer than before. However, even if this is taken into account, and no increase in this expenditure per person is assumed, this old-age related expenditure will, by 2050, still increase by at least one per cent of GDP (or 2½% of the wage bill). This is the pure effect of ageing on these expenditure items, though not a forecast, which must also take the effects of other factors into account.

The principle of intergenerational fairness could be applied to the increase in this expenditure by modifying the approach developed in Chapter 3. As for DB pensions, it can be considered that it is more fair if the generation which initiated the ageing of the population by reducing the fertility rate pays part of their own expected health care expenditure beforehand. Thus for the next 20-30 years, an extra tax revenue of about ¾ % of GDP should be collected.¹⁶

A decrease in expenditure on childcare, child allowances and education due to the decline in the number of children is often suggested (e.g. in the so-called intergenerational accounts) as a factor partially compensating the increase in age-related public expenditure. This observation is valid – if unit costs are assumed to be constant – but it does not mean that the reduction in expenditure should reduce the need for pre-funding for old age pensions. The reason is that under normal assumptions, a reduction in these expenditures leads to reduced taxes benefiting all age cohorts directly, including those who initiated the decline in fertility.

In a pure PAYG system ageing will have effects on *tax revenue*. Assume that pension contributions are tax-deductible and regular income tax is paid on pensions. Then, a contribution rate increase causes a decline in tax revenue, while the increase in tax revenue due to larger pension income occurs only later. Furthermore, if income taxation is progressive, the average tax rate on pensions is lower than that on wages. Therefore, the loss in tax revenue is permanent. This also holds, even earlier, under a transition to partial funding – irrespective of whether this takes place within the public sector or beyond, or whether additional saving for pensions is mandatory or voluntary. This simply follows from the tax deductibility of pension contributions.

¹⁶ It is not necessary to create a special fund for it, but its use for amortising government debt and therefore reducing interest expenditure in future, is one sufficient arrangement to achieve the goal of intergenerational fairness for sharing this burden. Note that for these expenditures there is no mechanism which would correspond to increasing the retirement age to alleviate this burden.

We do not, however, pursue this issue further as initial conditions and taxation system details differ widely from one country to another. For preliminary results it is sufficient to note that a loss in tax revenue may result in many cases, although its size represents only a proportion of the increase in public pension expenditure.¹⁷

These remarks on the possible effects of ageing on public expenditure and tax revenue, other than those operating within the public pension system proper, lead to the following conclusion: all these factors taken together would require some additional surplus in the public sector finances over the rest of the working career of the generation which initiated the decline in fertility (i.e. roughly speaking over the next 20 years in EU-15). The most important of the public finance items pointing in this direction is health expenditure, and the other factors may add to it. However, we leave a more detailed assessment of these factors for further studies and confine the treatment below to the pension system.

6.2. Targets for public finance

Disregarding the dependency on ageing of public finance items other than pensions, the results derived in Chapters 3-4 for a sustainable and intergenerationally fair pension scenario can be translated into targets for public sector balance in a relatively straightforward manner.

Pre-funded DB system

The scenarios in Chapter 4 indicate in each case the surplus (or deficit in the case of privatisation) in the public pension system implied by the assumed ageing and the rules set for the pre-funded DB system. To translate this into a target for general government balance only requires an underlying benchmark for the balance of the other public sector revenue and expenditure.

A benchmark for the balance of these other items, which is sufficient for a preliminary analysis, is a balance which would maintain the government debt/GDP -ratio as constant. This happens if the nominal debt grows at the same rate as the nominal GDP, i.e. the deficit is the product of the nominal economic growth rate and government debt. Government debt should be defined as net debt if the government owns or acquires financial assets.

Let's assume that initially government net debt is 50% of GDP, as it was for EU-15 on average in 2001. Real GDP growth under the assumptions in this paper is around 1.6%¹⁸ and we assume 1.5% inflation, implying a nominal growth of 3.1%. Thus, the benchmark deficit is 1.6% of GDP ($=0.031*50\%$). For a country with 100% initial net

¹⁷ The effects may go both ways. What was said above does not apply to a country which has already moved to an important degree of funding before the base year for the tax projection. In such a country, the effect of ageing on tax revenue is henceforth positive as the tax revenue foregone was already counted before the base year for the comparison. This is the case in Denmark and The Netherlands. An example of a factor which aggravates loss in tax revenue would be a system of special tax incentives for voluntary pension savings.

¹⁸ This varies a little from one case to another, but this is the figure over 2001-2030 based on the assumption of real wage rate growth of 1.75%, retirement age increase and reduction in the size of the younger cohorts due to decline in fertility.

Figure 6.1. Targets for government balance under alternative reforms of the DB system, % of GDP

Scenarios: (same as in Table 4.2)

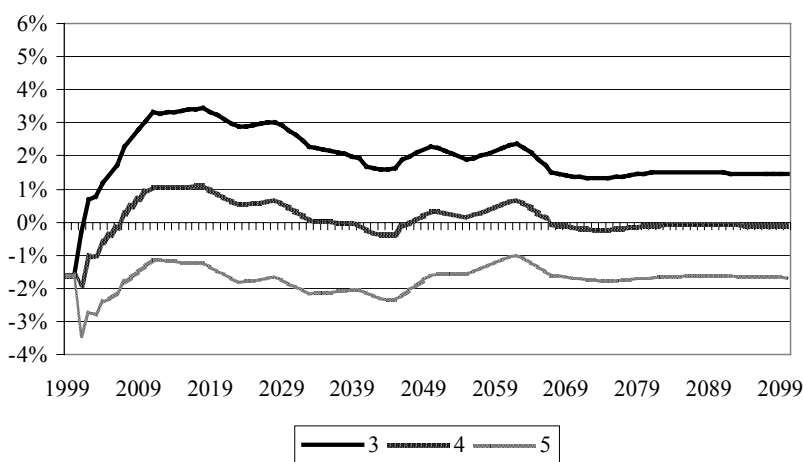
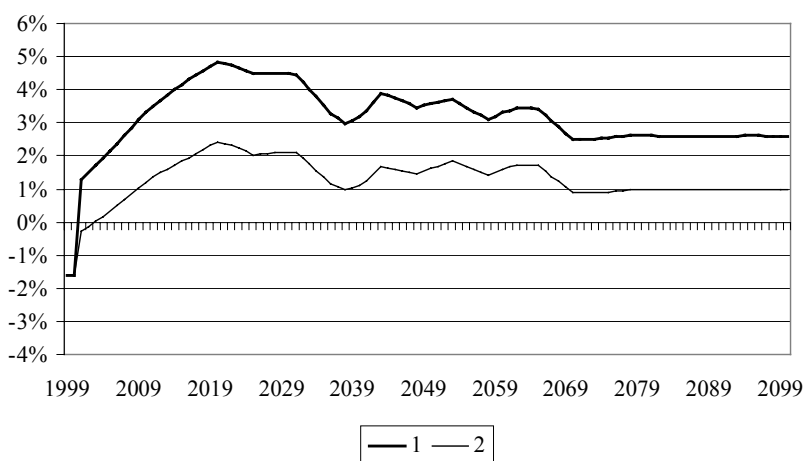
- 1: pre-funded mono-pillar base case, retirement age 60, accrual rate 1.5% per year.
- 2: 4 percentage points of contributions in mono-pillar base case diverted to the second pillar (Figure 4.2).
- 3: mono-pillar further reformed, standard accrual rate reduced; retirement age increases to 63.
- 4: 4 percentage points of contributions in reformed mono-pillar diverted to the second pillar.
- 5: 8 percentage point of contributions in reformed mono-pillar directed to the second pillar (Figure 4.3).

Without an increase in retirement age the target for general government balance should increase to 4½% of GDP by 2020. This requires a very high contribution rate, 38%.

If the pension system is partially privatised, the target for government surplus is correspondingly lower.

If retirement age increases, the peak of the target surplus is lower, 3½% of GDP. It is achieved with a contribution rate of 32%.

If the system is partially privatised, the target for government balance reduces. It may even lead to an acceptance of a marked deficit if a large share is privatised.



debt, the benchmark deficit would correspondingly be 3.1% of GDP, and, obviously, for a country with zero debt, zero.

Figure 6.1 reproduces the surplus (or deficit) paths under the five scenarios for the pre-funded DB systems reported in Table 4.2 above, including the cases of partial privatisation. The figures are now expressed in percentages of GDP (assuming simply that the wage bill after pension contributions is 40% of GDP), deducting from them the above average EU-15 benchmark deficit for the other items in the government budgets, 1.6% of GDP.

In each case, the graphs give a target for the public sector balance in the medium term consistent with the requirements for sustainability and intergenerational fairness. This simple approach is sufficient as a preliminary finding, provided that there are no particular factors to warrant deviating from the implied target. For transition economies, which might have important public sector investment needs, an acceptable medium term target could be a larger deficit, provided that the additional debt to be accumulated would then be served in a sustainable manner.

In our basic mono-pillar case, in which the replacement rate is maintained at the initial level of 60% and the retirement age at 60, the pre-funding required for intergenerational fairness implies a general government surplus target of 2½-4½% of GDP over more than 30 years. It should be achieved by a drastic increase in contribution rate to 38%, which would lead to a net increase in government assets (or net decrease of debt) by about 170% of GDP.

The second line shows a partial privatisation by diverting 4 percentage points of contributions to a privately managed pillar. This would shift about 40% of the asset accumulation from public to private management. The target for government surplus implied by this case is about 1½% of GDP over approximately 25 years.

The third scenario presents the surplus in the mono-pillar, in which the standard accrual rate is decreased, but increasing the retirement age by three years is moderately compensated by additional pension rights. The implied surplus target is nearly as high as in the first mono-pillar case, but note that the contribution rate increase is more moderate, only to 32%. The surplus stems from the reduced expenditure and increased contribution revenue due to later retirement. The important message from this case is that the gains from the increased retirement age should be retained. If given away as lower contributions (as would happen in a pure PAYG system), the result would be an increase in contribution rate to 37%.

In this case, diverting 4 percentage points of contributions to a second pillar would shift half of the asset accumulation to the latter, and imply a 0-1% surplus target for government finances.

The last case presents a larger privatisation, diverting 8 percentage points of contributions to the second pillar. This would keep the long-term target for the public sector balance close to the initial 1.6% of GDP deficit (which is consistent with a constant debt/GDP – ratio). The particularly important feature here is that during the initial phase of privatisation, the first pillar suffers from a noticeable deficit. This raises the government deficit to above 3% of GDP, and it subsequently only reduces thanks to the increase in retirement age (which may be uncertain in real life applications). In assessing this situation one has to take into consideration the long-term projection for the deficit in the first pillar and the accumulation of public-policy-induced compulsory savings in the newly created second pillar.

The conclusion to be drawn from these scenarios is, first, that under the assumed ageing, maintaining a mono-pillar system with its benefit level and retirement age would require a target of 2½-4½% of GDP for government surplus for several decades. This sounds ambitious, but it can be clearly argued, and shows that the only fair options are reductions in replacement rates and/or an increase in retirement age. The target for government surplus is 1% of GDP lower if the retirement age increases by three years and accrual rates are adjusted so that replacement rates settle at around 60%. Remember that in this

latter case the contribution revenue is about 2½% of GDP lower than in the former one, and the surplus is generated to a great extent thanks to the increase in retirement age.

The second general conclusion is that a partial privatisation of the public pension system may cause a temporary or permanent deficit in the first pillar – and therefore in the whole public sector. It depends in which phase the system is with regard to accumulation of funds. If the system is matured and in balance, a privatisation induced deficit always appears, but if ageing requires an accumulation of funds in the pension system as a whole, partial privatisation does not necessarily lead to a deficit in the first pillar. This will depend on the pace of ageing and size and timing of privatisation.

This conclusion can also be expressed the other way round, by asking whether the sole appearance of deficit in the government budget balance should affect the size and timing of pension system privatisation, if government balances and the pension system are otherwise on a sustainable path. This may be especially relevant in cases where a deficit induced by pension privatisation is combined with deficit financed government investment due to other factors. In such cases, a reasoned assessment of government deficit should comprise the effects of pension privatisation, including the accumulation of capital in the second pillar.

Transition to an NDC system

The key feature of a transition to a well-designed NDC is that in the (very) long run, pension expenditure is covered by contribution revenue. The deficit may occur, however, in the transitional period when the previously accumulated rights appear as expenditure which exceeds the contributions fixed by the NDC reform. If the transition is made slowly by maintaining all pre-reform rights in the DB system, and if retirement age remains constant, the excess of pension expenditure over contributions is, over a long period, of the order of 1% of GDP. If pre-reform rights are transformed to initial entries in NDC accounts, the system is close to balance. If retirement age increases by three years, for example, the financial position first fluctuates from positive to negative, resulting in close to balance, and settles down to long-term balance as pension expenditure equals contribution revenue.

The projected deficit in the first case needs to be covered by a transfer from other government budget sources, in addition to the typical transfers to cover the non-contribution periods (maternity leave etc.), as in an NDC system the contributions paid from wages normally cover only old age pensions.

All this leads to a simple rule for public finance targets under a NDC pension reform: the benchmark deficit of 1.6% of GDP should be the target balance for the public sector as a whole, including the first pillar NDC pension system. Taxes, therefore, need to be increased (or other expenditures decreased) to continuously cover the possible deficit in the NDC pension system.

Figure 6.2. Surplus or deficit (-) in government finances other than pensions under alternative transition paths to an NDC system, % of GDP

Scenarios:

- 1: Retirement age 60; previous DB rights respected, all move to NDC in 2001.
- 2: Retirement age 60; employees born before 1951 stay in DB; others move in 2001 to NDC with DB rights transformed to initial entries in their NDC accounts.
- 3: Retirement age increases gradually to 63 by 2010; transition to NDC like in Scenario 2 (Figure 3.2).

To maintain the overall deficit of the general government at 1.6% of GDP (consistent with maintaining the debt/GDP ratio at 50%) requires, in most cases, a surplus in budgets other than the public pension system. Its size depends on the rules for transition and on changes in the retirement age.

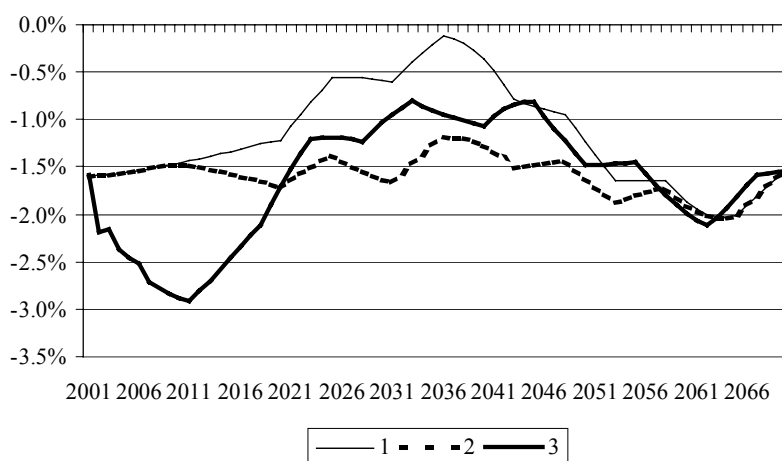


Figure 6.2 illustrates the implications of this principle under each NCD scenario in Chapter 3. For the public sector as a whole to have a deficit of 1.6% of GDP it is required that in the most demanding case, the rest of the public sector should run a balanced budget, while small deficits will not undermine sustainability in cases where retirement age increase brings savings to the pension system.¹⁹

Thus, the whole logic for setting public finance targets under a transition to a NDC is quite different from the case of the reformed DB system. The underlying reason is the firm commitment induced by the NDC reform that replacement rates decrease so that the fixed contribution rate covers the pension expenditure when the system matures.

Budget financing

We have spoken of the public pension system – or rather, old age pensions - isolated from the rest of the public sector, though this need not always be the case. Some

¹⁹ In a case where there are specially identified sources transferred to the NDC pillar as a “demographic reserve fund”, as it is called in some applications, the result may be that the public sector as a whole runs a deficit drawing from the previously accumulated public pension funds. This means that government net debt is deliberately increased. If the funds to be used for this purpose are limited, and once they are fully exploited, measures are taken to fill the possible remaining deficit in the NDC pensions by raising taxes (or reducing other expenditures), sustainability is maintained. In terms of intergenerational fairness, depleting previously accumulated funds might raise some questions. In each case the answer would depend on which generation(s) accumulated the funds.

proportion of the expenditure might regularly be covered from the general budget, and only a little imagination is needed to adapt the above results to fit such a case.

If the expenditure side of the DB system is first modelled, our alternative scenarios give the target for public sector surplus regardless of the division of the revenues between pension contributions and transfers from other government budget sources. Thus, a time path for a government surplus target can be derived. In some cases special pension reserve funds are created to earmark part of tax revenue for future pension expenditure.

7. Macroeconomic aspects related to the pension reform scenarios

Generalisation of the results

Although the pension system model used in this paper covers only the pension system proper, the results can be applied quite generally. The robustness of most results stems from the assumption that pensions are indexed to (average) wages (or to the wage bill in the NDC scenarios, in which case they are additionally indexed to the number of employees). This may be a reasonably good approximation of reality as it is often an institutionally prescribed feature of a pension system, or may mimic the results of political decisions which keep pensions roughly proportional to wages. A powerful consequence of this is that most results depend neither on the assumed underlying rate of growth of real GDP nor on inflation.

Most results above concern distribution of income between successive generations, which takes place in the form of pension contributions paid out of total wage costs and pension benefits. The benchmark rule to assess this redistribution was that successive generations with the same fertility and longevity should pay and receive the same amounts as percentages of their wages – and consequently, these amounts should differ if fertility or longevity differ across generations.

The one exceptional variable which always depends on the rate of growth of the economy, real and nominal, and on the interest rate, is the surplus (or deficit) in the pension system and hence, in the public sector as a whole. This stems from the national accounts definitions for government deficit, and holds even if the real rate of interest is fixed by assumption. The model used here can be easily used to run sensitivity tests for this particular, most important economic policy indicator.

Another exception is the scenario where the pension indexation rule is changed from wage to price indexation. In this case the rate of growth of real wages matters for the change in distribution of income.

The interest rate assumption is important for the scenarios. Again, however, the results are rather general as what counts for most results is only the assumption on the difference between the interest rate and rate of growth of the wage bill. Our base line assumption is a difference of 1.5 percentage points between the two. With the assumption of 1.75% real wage growth and the assumption on fertility affecting the size of the labour force, the real rate of interest declines from its initial 3.3% to 2.4-2.5%. These are conventionally assumed interest rates for government bonds. Sensitivity tests would show that different assumptions within a reasonable range would not change the overall conclusions.

Pension funding and aggregate saving

Accumulation of pension funds is an additional component to saving in accounting terms, but the effect on aggregate saving also depends on the possible effects on saving in other sectors of the economy.

Saving in other government budgets was already treated above, with the result that general government targets should be set in an appropriate manner to guarantee that saving in the pension system be an addition to total public saving. Otherwise the purpose of increased funding is not fully achieved.

However, private voluntary saving may react to more pension saving within the public sector or in the mandatory second pillar, which belongs in accounting terms to the private sector. There is no simple answer to the question of how much private voluntary saving may decrease due to more compulsory saving: if income for old age is more secure than before, there is less need for voluntary private saving. However, as individuals are liquidity constrained, and as the motives for saving are diverse etc., the consensus view is that compulsory saving is not followed by a one-to-one decrease in voluntary saving, thus, it has a positive effect on aggregate saving.

The moderate partially pre-funded or partially privatised scenarios above indicate that pension fund accumulation could realistically be 100-150% of GDP, with 2/3 accumulated in 30 years and the rest in 60 years. This is now the order of magnitude of pension funds in the few EU Member States which took that route in the 1960s (often establishing quasi-mandatory occupational schemes). If the capital/output ratio is now roughly four, it would lead to an increase to five over a long period, which is not necessarily unrealistic. In an open economy, the required internal adjustment is even less, as part of the new savings may be invested in other countries where the rate of return is higher.

In addition to the possible effect through a change in the interest rate differential discussed above, there is no major effect through saving which would modify the results of the present paper: more aggregate saving leads to higher output per employee and therefore, under our assumptions, to higher income for both workers and pensioners. The results on contribution and replacement rates and funding would still hold.

Furthermore, even in an extreme case where private voluntary savings decrease by the same amount as mandatory pension saving increases, the results derived here can remain relevant and applicable. As the pension system is in any case an instrument of public policy affecting the transfer of resources across generations, making the rules clear and transparent may in itself be useful so that people can take a reasoned view both in formulating their electoral behaviour and determining their private savings, including their plans to leave bequests to their heirs.

Labour market

The analysis in the present paper has two major links to labour market issues: distortion caused by pension contributions perceived as a tax, and determination of the retirement age.

If contributions to the public pension system are perceived as a pure tax with no link to future benefits, then the labour market is distorted, creating a marked negative effect on welfare. If this holds for any increase in the contribution rate, then there is a trade-off between total future welfare and a reduction of pension benefits to comply with the given contribution rate.

This approach gives, however, an exaggerated view of drawbacks in public pensions, especially if contributions to private accounts are assumed to have no distorting effect. Apart from pure flat rate public pensions, most public schemes include an element of actuarial link between contributions and benefits. Although this link is imperfect in most cases because one of the public system objectives is to distribute income between various groups, it can be strengthened in the context of reforms. Moving to a NDC system is one such option: it is fully actuarial under its own rules, namely setting the rate of growth of

the contribution base (the wage bill) as the internal rate of return. The link between contributions and payments can also be strengthened in DB systems, making the rules for accruing pension rights clearer, or perhaps even getting them to imitate the NDC rules.

One measure to reduce labour market distortion is to reduce wage based pension contributions and revert to financing from general tax revenue. On the one hand this has the desired effect - and it might be particularly advisable for flat rate pensions - but on the other, budget financing weakens the link between contribution payments and benefits, i.e. actuarial fairness is zero for budget financed pensions. This may make it more difficult to gain political acceptance for reducing such pensions as those who suffer from the reduction would themselves hardly benefit from lower in-payments.

A more general argument along these lines is that reforming the public pension system so that it becomes financially sustainable and fair would possibly make people more confident about receiving pensions when they retire, so they would perceive the contributions less as a tax from which they would gain nothing. This would improve the perception of actuarial fairness, improve compliance and reduce labour market distortion.

Increasing the retirement age was shown to have a major impact on the sustainability of the pension system under any reform scenario. An analysis of all relevant factors necessary for such an increase is by nature beyond an actuarial model, but we attempted to provide elements for such an analysis by presenting alternative cases for compensating for extra years at work in the form of an increase in the replacement rate.

Many other retirement age increase scenarios could be presented using the method presented here. It is interesting to note that the three year increase assumed above exceeds the targets set for EU-15 at the Lisbon and Stockholm European Council meetings in 2000 and 2001, while a more ambitious target of an increase of five years was mentioned in the Barcelona European Council conclusions in March 2002.

The more general target for increasing the employment rates from 63% to 70% set in Lisbon cannot be analysed by the model used in the present study, but the assumed 3 year increase in retirement age meets more than half of that increase – the rest would depend on an increase in participation rates in other age groups.

Regarding a possible increase in the participation rate and migration, the main message of the present approach – parallel to the case of increasing the retirement age - is that the increasing revenue to the pension system should not immediately lead to lower pension contributions. This would happen in a pure PAYG system, but for intergenerational fairness the rules should be changed and the increasing revenue should be saved for the future. The reasons are: (1) the additional labour will earn pension rights which need to be met later, and (2) the transitory gain for the pension system should be used for accumulating funds which strengthen the sustainability of the system, otherwise under great pressure due to ageing.

The actuarial model as an input to more general macroeconomic models

Whatever the limitations of the actuarial model used in the present exercise, it serves to clarify key features of pension systems. This way it can provide important input to a construction of more general macroeconomic models, which are often even more simplistic in their institutional assumptions, and may thus hamper realistic and concrete analysis of pensions reform options.

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For the summary and main conclusions of this paper, please refer to the Executive Summary.

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