PENSIONS UNDER AGEING POPULATIONS AND THE EU STABILITY AND GROWTH PACT

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This paper explores how the Stability and Growth Pact (SGP) may cope with the future costs of population ageing in the European Union. Clearly, population ageing has forced countries to reform their pension systems, and will continue to do so, both by reducing the generosity of pension arrangements and by switching to funding rather than relying on pure pay-as-you go pension provision. We study how such reforms affect the room for adhering to the SGP, but also how the SGP may induce or hamper the incentives for reform. We will refer to recent literature on ageing and pensions and on the SGP. We also calibrate a simple model for addressing intergenerational equity and discuss its implications for the SGP.

1 Introduction

This paper addresses the link between two major macroeconomic policy issues in Europe: (1) coping with rising public expenditures caused by population ageing, and (2) the adherence to the EU's fiscal rules, notably to the provisions on public finances in the Stability and Growth Pact (SGP) as revised in 2005. The analysis is concerned with the long-term sustainability of public finances. As this can, however, be achieved through many different combinations of spending and revenue policies over time, we narrow the focus and consider those policies that treat subsequent generations equally, taking into account not only their fertility and longevity, but also their tax payments and the benefits they receive from the public pension system and other expenditure programmes. Our benchmark calibration suggests that adhering to this principle requires the average EU government to run substantial surpluses for at least two future generations. Therefore, the SGP's current medium term objectives do not seem sufficiently ambitious. We further find that (partial) privatisation easily leads to a conflict with the SGP's reference values for deficits and debt.

The paper is structured as follows. Section 2 discusses the demographic and ageing-related public spending projections for the EU-25. It also discusses the content and implementation of the SGP, both before and after its recent reform, including the use of the expenditure projections for assessing long-term fiscal sustainability. As the implicit pension liabilities and intergenerational

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A previous version of this paper was partly prepared while Roel Beetsma stayed at the European Commission under the DG ECFIN Visiting Fellows Programme in January-February, 2007 (contract number 299/2006/SI2.452.980), and subsequently published as Beetsma and Oksanen (2007). Roel Beetsma thanks the Commission for the stimulating research environment.

We thank for helpful comments three anonymous referees, Torben Andersen, Jan-Marc Berk, Marco Buti, Antoine Deruennes, Willem Heeringa, Clemens Kool, Joao Nogueira Martins, Lucio Pench, Rick van der Ploeg, Andras Simonovits and Salvador Valdés-Prieto, Ed Westerhout as well as participants at a seminar at the European Commission, a Netspar panel meeting and the participants at the 2008 Banca d'Italia Workshop on Fiscal Indicators.

equity are not explicitly addressed in the SGP, Section 3 sets up a model to provide numerical illustrations of public debt, deficits and implicit liabilities under different pension and fiscal arrangements. It pays attention to a transition towards (partial) funding of pensions that might be required for intergenerational equity. Technicalities are kept to a minimum, while the Appendix, available at http://www1.fee.uva.nl/toe/content/people/beetsma.shtm, presents the full model. Section 4 discusses the implications of the analysis for pension reforms and the SGP, while Section 5 concludes the paper.

2 The SGP and ageing-related public expenditures

2.1 The original SGP

While monetary policy in the euro area is delegated to the ECB, fiscal policy remains in the hands of the national authorities, who should (according to the Treaty agreed upon in Maastricht in 1991) comply with the principle of sound public finances. To ensure this compliance, the Treaty prohibits central bank financing to governments, their privileged access to other financial institutions and the bail-out of debts of any public entity with the help of the European Community or its Member States. A bailout of a Member State in severe budgetary trouble by raising inflation to erode the real burden of its debt is also excluded by setting price stability as the primary objective of the ECB. This arsenal of measures geared to preventing divergences from sound public finances was complemented with an Excessive Deficit Procedure (EDP) with reference values for deficits (3 per cent of GDP) and debt (60 per cent of GDP) that can ultimately lead to the payment of fines by a Member State that does not correct its Excessive Deficit before the deadline imposed by the EU Council. Nevertheless, some countries (notably Germany) believed that all this would still not be sufficient guarantee for the ECB to be able to operate independently and achieve price stability. This fear resulted in the SGP in 1997.[1]

One part of the SGP, the regulation "on speeding up and clarifying the implementation of the excessive deficit procedure", makes the Treaty-based EDP operational by specifying the time schedule and various criteria applied in the procedure (the "corrective arm"). The other part, the regulation "on the strengthening of surveillance of budgetary positions and the surveillance and coordination of economic policies", aims at preventing excessive deficits by requiring countries to strive for a budget that is close to balance or in surplus in the medium run (the "preventive arm"). The safety margin below the 3 per cent of GDP deficit aims at allowing the automatic stabilizers to do their work, unless the economy falls into a very severe recession. As part of this regulation, euro area members must submit a "Stability Programme" every year, in which they set out their budgetary path and the underpinning measures for the coming years. The other EU countries submit similar "Convergence Programmes". The Commission assesses the programmes and provides recommendations, after which the ECOFIN Council gives its opinion.

2.2 The revised SGP

The revision of the SGP was agreed upon at the ECOFIN Council and endorsed by the European Council in March 2005, after the SGP had been put on hold at the end of 2003 as a result

[1] For more details, see Eichengreen and Wyplosz (1998); Fischer *et al.* (2006) classify the various proposals to amend the Pact; prominent examples are Wyplosz (2005), von Hagen (2002), Fatás *et al.* (2003), Fitoussi (2002), Blanchard and Giavazzi (2004). The proposals that focus on long-term sustainability are especially relevant for the present paper: Pisani-Ferry (2002), Calmfors and Corsetti (2004) and Buiter and Grafe (2004).

of the failure to follow its formal procedure in the case of the Excessive Deficits of Germany and France.[2] The revision comprises several improvements and clarifications to the text on short- and medium-term budget management in order to discourage pro-cyclical fiscal behaviour. Specifically, budgetary adjustment should be judged in terms of its implications for the cyclically adjusted balance, net of one-off items and temporary measures. The revision also allows the deadlines for correcting Excessive Deficits to be revised and extended if unexpected adverse economic events occur. Public debt and sustainability receive greater emphasis. This is also the case for structural reforms, including pension reforms "to safeguard the sustainability of public finances in the long run, to promote growth and to avoid imposing excessive burdens on future generations" (European Council, 2005).

In operational terms the medium term objective (MTO) for budget balance at the end of the Stability and Converge Programme period was made country-specific, subject to possible revision in the case of major structural reforms and in any case in every four years. For countries that already have adopted the euro or participate in ERM-II, the MTO ranges from a minimum of –1 per cent of GDP for low-debt and high-potential-growth countries to budget balance or surplus for high-debt or low-potential-growth countries (ECOFIN Council, 2005). As long as a country has not reached its MTO, it should achieve an annual reduction in its cyclically adjusted deficit, net of one-off and temporary measures, of at least 0.5 per cent of GDP. The short-run costs of structural reforms, in general, are explicitly recognized for the definition of the adjustment path to the MTO.

These MTOs were first agreed upon in 2006, but it was explicitly noted that they were set for a transition period until the "criteria and modalities for taking into account implicit liabilities (related to increasing expenditures in the light of ageing populations) are appropriately established and agreed by the Council" (ECOFIN Council, 2005). Even though more time was needed, useful groundwork had already taken place in the context of producing commonly agreed long-term projections for public expenditures.

2.3 Demography and ageing-related expenditure projections

Pensions are largely unfunded in most EU countries.[3] In the EU, thus far only the Netherlands, Denmark and the United Kingdom have featured a substantial funded pension pillar. If strictly applied, a pure PAYG pension system implies that contributions into the system exactly match the pension payments. Such a system thus affects neither the government's deficit nor its debt. However, the consequence of increasing expenditure under a pure PAYG system is that over

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[2] Apart from the fact that in many Member States deficits exceeded 3 per cent, there was a particular issue that triggered the crisis in implementing the SGP in 2003. It was the question as to what should happen when the Member State in Excessive Deficit implemented the recommendations it received, but exogenous factors turned out to be more unfavourable than expected and the deficit therefore does not decline. This was especially relevant for Germany in 2003. The Commission took the view that it was legally obliged to recommend moving to the next stage of the procedure (*i.e.*, one step closer to potential sanctions), while Germany, supported by France, wanted to return to the previous recommendations and revise them (Korkman, 2005, p. 117). This dispute caused a deadlock in the Council, as the required qualified majority was not found under the correct legal procedure to any decision. In the subsequent ruling the Court of Justice of the European Communities (2004) considered (among other things) that the recommendations could indeed be modified later by the Council, but that this would require a fresh recommendation from the Commission (paragraph 92). After this clarification to the original SGP, the possibility of repeating the steps was made explicit in the revised SGP.

[3] Economic Policy Committee and European Commission (2006a), pp. 52-56, provides an overview of European pension systems; Economic Policy Committee and European Commission (2006b), pp. 28-31, contains a scheme of the pension reforms in the EU. See also Whiteford and Whitehouse (2006). In Finland, the statutory pension system is 20-25 per cent funded, and consists of investments mainly in assets other than Finnish government bonds. It is classified within the general government accounts; consequently (e.g. in 2006), while gross public debt was 39 per cent, net debt was negative, at –24 per cent of GDP (Ministry of Finance of Finland, 2007).

the coming decades PAYG pension contributions (or other taxes) have to increase substantially. This raises some questions about the negative consequences of such tax hikes, including lower labour supply, tax evasion using various legal means and outright non-compliance with the tax rules.

These negative consequences of escalating ageing-related expenditures and the potentially serious impact on the government's deficit and debt were commonly recognised towards the end of 1990s. To prepare the ground for the necessary reforms, serious work on projecting these expenditures was started at the EU level in 1999, leading to the first comprehensive report in 2001 followed by the second one in 2006 (Economic Policy Committee and European Commission, 2001 and 2006a-b). The latter provides projections for population ageing-related public expenditures in the EU Member States (EU-25 at the time) from 2004 to 2050 (henceforth referred to as "EPC projections"). They are based on demographic projections, a commonly agreed-upon set of macroeconomic assumptions regarding the labour force, productivity growth and real interest rates, and the policies or policy rules prevailing in 2005.

In 2004, EU-25 pension expenditures were on average 10.6 per cent of GDP, ranging from 4.7 per cent of GDP in Ireland to 14.2 per cent in Italy. The average increase in the EU-25 by 2050 is a relatively modest 2.2 percentage points of GDP. This is much less than the increase in the old-age dependency ratio which (other things equal) would imply an 8.1 percentage points increase in expenditure. The countervailing factors are a projected increase in the employment rate of prime-age workers and in the retirement age, and, notably, a decrease in the average pension relative to the average wage. The projected average expenditure increase of 2.2 percentage points of GDP also conceals large differences among the Member States, from a 5.9 percentage points decrease in Poland to a 12.9 percentage points increase in Cyprus.

Health care and long-term care expenditures are projected to rise, on average, at roughly the same relative speed as the pensions. The dispersion across countries is smaller than for pensions, presumably partly because a common methodology was applied to projecting these costs. Hence, the true uncertainty concerning potential divergence across countries is potentially larger than for pension expenditures.

Based on ageing-related expenditure projections, and taking into account current deficit and debt ratios, European Commission (2006, pp. 86-87) classifies the EU Member States into three groups with respect to risks to the sustainability of public finances: (1) "high-risk": the Czech Republic, Greece, Cyprus, Hungary, Portugal and Slovenia, where the projected increase in pension expenditure ranges from 5.6 to 12.9 percentage points of GDP; (2) "medium-risk": Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, Malta, Slovakia and the UK, where the projected increase ranges from zero to 7.4 percentage points of GDP; and (3) "low risk": Denmark, Estonia, Latvia, Lithuania, the Netherlands, Austria, Poland, Finland and Sweden, where the projected change ranges from a decrease by 5.9 per cent to an increase of 3.5 percentage points of GDP, due to legislated and implemented reforms.

The EPC projections should be regarded with considerable caution. For example, the significant decreases in projected expenditures, notably in Poland, Estonia and Malta, and the very small increase for Italy, follow from the policy rules in force in 2005. There is serious doubt, however, about the political sustainability of those rules (and possibly also their interpretation). This doubt mainly concerns the indexation of pensions: the rule that is formally in place (e.g. price indexation only) and, therefore, assumed for the projection, may not be politically sustainable. Poland is an illustrative example: in 2005 the indexation rule was changed to inflation only, abolishing the partial indexation to real wages. In line with the common methodology, the projections were based on this new rule, implying a significant reduction in projected replacement rates. However, the original the original indexation rule was restored in 2007 (Republic of Poland,

2008). As even the restored rule can be regarded as conflicting with the basic principles of the Polish Notional Defined Contribution system, one may reasonably expect further changes to the indexation rule or occasional increases in pension payouts.

The EPC projections do show, however, that ageing-related public expenditures pose a severe challenge to almost all EU Member States. The illustrations below refer to EU-average numbers; for further applications, we recommend looking carefully into the EPC projection for each Member State separately and considering all relevant details.

2.4 The revised SGP and pension system reforms

In anticipation of the rising costs of ageing, and to share more evenly among the generations the costs of providing old-age pensions, countries have started to introduce both systemic and parametric pension reforms. Regardless of whether pension reform is systemic or parametric, to the extent that it permanently reduces projected expenditure it alleviates the concerns of long-term sustainability. However, a reform that replaces part of the public pension system by a private-sector-managed, fully funded tier will trigger a reduction in pension contributions paid to the first pillar at a time when the pensions of the current retirees still need to be financed. A stock of assets will be built up in the newly established funded pillar, but this will not be part of the government accounts as, according to the decision by Eurostat (2004), funded defined-contribution schemes should be recorded as part of the private sector.[4] To cope with the reform, the government may issue debt, making some of the implicit pension debt explicit. The problem here, however, is that the public deficit and debt increase, while the fall in implicit liabilities due to the reduction of future pension payments from the PAYG pillar is not recognised in the national accounts relevant for assessment of compliance with the SGP.[5]

The revision of the SGP addresses this potential conflict between the transition to a (partially) funded pension system outside the government accounts and the SGP rules. With regard to the preventive arm, it prescribes that the "Member States implementing such reforms should be allowed to deviate from the adjustment path towards the MTO, or from the MTO itself. The deviation from the MTO should reflect the net cost of the reform to the publicly managed pillar, provided the deviation remains temporary and an appropriate safety margin to the reference value is preserved" (European Council, 2005).

In the corrective arm, the leeway is specified prescribing that (regressive) "consideration to the net cost of the reform will be given for the initial five years after a Member State has introduced a mandatory fully-funded system", so that during the five years "100, 80, 60, 40 and 20 per cent of the net cost of the reform to the publicly managed pillar" will be taken into account (European Council, 2005; for a detailed presentation, see European Commission, 2007).

Note that while the allowed deviations from (the path to) the MTO and the reference deficit level as a share of the cost are falling over time and restricted to five years only, transition under pension reforms typically lasts for decades.

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[4] This decision by Eurostat concerned the defined-contribution, funded pension systems that may be managed by the government. It considered that the fund's assets are ultimately owned by the participants, who bear the risk associated with the return on the assets. These systems should therefore be classified in the private sector. With regard to the defined-benefit schemes, an important criterion is the degree of funding. The Dutch occupational defined-benefit system is classified in the private sector (as it is fully funded), while the Finnish partially mandatory defined-benefit system falls within the general government (as the degree of funding is only about a quarter).

[5] Tabellini (2003) makes this point. Oksanen (2004) presents a numerical illustration of the effect of partial privatisation on the public deficit and debt.

2.5 *Intergenerational equity*

For a few years now, the EU has used the commonly agreed projections for ageing-related expenditures to construct a quantitative indicator for long-term stability of public finances along the lines of Buiter (1985). The indicator is based on the constant tax rate that would fulfil the intertemporal budget constraint (ITBC) of the government, given the projected expenditures and the need to service the current debt. This tax rate is compared to the current tax rate, and the difference between the two is called the "sustainability gap".[6]

However, for a given projected expenditure increase an infinite number of tax-rate paths exist that fulfil the ITBC of the government, while there are no convincing reasons why the scenario with a constant tax rate should be chosen as the (dominant) benchmark (as is done when calculating the sustainability gap). There are several arguments for looking at a broader range of scenarios. First, the constant tax rate (or permanent balance rule by Buiter, 1985) was partially motivated by tax smoothing (*i.e.*, minimising over time the distortions caused by taxes). While this is a relevant consideration, it should not be the only one. Subsequent generations generally differ from each other with regard to their fertility, longevity, retirement age and pension benefits. Hence, to achieve intergenerational equity, one might envisage that they also pay different pension contributions and other taxes (Sinn, 2000 and 2004). Second, an increase in the tax rate can always be replaced by a reduction in non-ageing-related expenditures. This further weakens the case for constant tax rates. Finally, the expenditure projection based on current policies should not dominate the modalities for setting the MTOs, as for many EU Member States emphasis should obviously be put on designing reforms that reduce these expenditures (e.g. European Council, 2005); in the process of designing a comprehensive policy package one could make alternative calculations for the MTOs conditional upon several reform options.

It is clear, as is also acknowledged by the European Commission (2006, p. 21-22), that the SGP incorporates intergenerational equity neither explicitly nor systematically. One reason for this is that distributional issues are a matter of political preferences expressed and implemented at the national level – taking actions affecting the fundamental principles of national social security is even explicitly excluded from the competence of the European Union (EU Treaty article 137; this is maintained in the Reform Treaty of 2007, which is pending for ratification). Another reason is the lack of data: since the EPC projections do not provide data by age cohort, they do not allow for a link between the costs and benefits of subsequent generations.

These or other considerations should not, however, be regarded as decisive obstacles to examining pensions and their financing from the angle of intergenerational burden sharing. Analysis and policy at the EU level, however, still lack an overall framework that encompasses the relevant demographic and economic factors as well as the policy parameters for ageing-related expenditures and their financing (including systemic pension reforms). Below we set up a simple model and use numerical illustrations to explore compliance with the SGP of different policies dealing with future ageing costs, including those aimed at intergenerational equity.

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[6] See European Commission (2006); see also Buiter and Grafe (2004). The gap derived from an infinite-horizon calculation is now more prominent, while a gap derived from a calculation until 2050 has also been used. The Board of Trustees of the US Social Security system (Board of Trustees, 2007) uses the same method.

3 The intergenerational distribution of costs under alternative fiscal rules

This section addresses explicitly the consequences, under population ageing, of different fiscal and pension arrangements for public deficits, public debt, implicit liabilities and the balance of contributions and benefits per generation. The former two variables are of particular importance for assessing to what extent the arrangements comply with the SGP. The balance of contributions and benefits per cohort is the key for assessing the size of potential economic distortions and the intergenerational distribution of the ageing burden. We illustrate the consequences of a fall in fertility and a rise in life expectancy.

3.1 Description of the pension model

The model that underlies the illustration is (with a slightly different notation) adapted from Oksanen (2005 and 2006) and presented in more detail in the Appendix. In the model workers (or employers on their behalf) contribute to the pension system. Their per person fertility is *f* children. The retirees receive a public pension (and do not pay pension contributions or, for simplicity, other taxes). The pensions can be partly (or fully) financed out of current workers' contributions or they can be partly (or fully) financed out of the assets accumulated from contributions in the past. The two extreme cases are a pure PAYG system and a fully funded system. The discounted pension benefits to be received by the current workers are termed the "implicit pension debt" (*IPD*, also called "accrued-to-reference-date liability") of the public sector.

The consolidated public sector (government plus the pension system) owns (net) financial assets A_t in period t (public debt amounts to negative assets). Further, all taxes are levied on the wage bill.[7] The consolidated public sector budget constraint is:

$$c_t w_t L_t + (\rho_t - 1) A_{t-1} = \pi_{t-1} w_t R_t + A_t - A_{t-1} \tag{1}$$

where c_t is the tax rate, w_t is the (gross) wage rate,[8] L_t is the "effective" labour supply of workers in period t, ρ_t is the financial market interest-rate factor (the interest rate is ρ_t–1), π_{t-1} is the pension accrual rate and R_t is the "effective" number of elderly. Here, $L_t = l_t \tilde{L}_t$, where $\tilde{L}_t$ is the number of new entrants to the labour force in period t, and l_t is the number of years spent in work in period t, divided by the number of years spent in work in period 0. We thus compare the labour input of a worker in each period with that in a single reference period. Further, since periods refer to generations here, and as the number of years during which a pension benefit is received generally differs from the number of years that individuals pay contributions to the pension system, we define σ_t as the number of years spent in retirement in period t divided by the number of years spent working in period t–1, *i.e.* $R_t = \sigma_t L_{t-1}$. Finally, $\rho_t = (1+g_t)(1+\mu_t)$, where $1+g_t = \frac{w_t}{w_{t-1}} \frac{L_t}{L_{t-1}}$ is the wage-bill growth factor, and $\mu_t > 0$ is an exogenous mark-up of the financial market interest-rate factor on the wage-bill growth factor. Hence, μ_t is not influenced by

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[7] For convenience, we label all primary revenues of the public sector as "taxes", even though in our model they consist mostly of pension contributions. The reason is that primary revenues also include the taxes collected (from wages) to service the initial explicit debt of the government.

[8] From now on, "wage" stands for "gross wage", that is, the wage before pension contributions are paid.

the demographic shocks considered below.[9] The accrual rate as a share of the wage net of contributions, π^n_{t-1}, is set by policy. Using π^n_{t-1}, one then derives the appropriate accrual rate π_{t-1} as a share of the gross wage w_t (for the details of the calculation, see the Appendix).

Dividing by the total wage bill in period t, we can rewrite (1) as follows:

$$c_t = \pi_{t-1}\,(l_{t-1}/l_t)(\sigma_t/f_{t-1}) + a_t - (1+\mu_t)\,a_{t-1} \tag{2}$$

where f_{t-1} is the fertility rate in period t–1 (hence, $\tilde{L}_t = f_{t-1}\,\tilde{L}_{t-1}$) and $a_t = A_t/(w_t L_t)$ are (net) assets as a share of the wage bill. Note that (2) is an identity that follows from the public budget constraint.

3.1.1 Pure PAYG and constant debt ratio

We first spell out the policy rule that keeps the financial position of the public sector unchanged (*i.e.*, assets as a share of the total wage bill are kept constant at a level $\bar{a} = a_0$ = the initial assets as a share of GDP). This implies the following tax rate:

$$c_t^{pcd} = \pi_{t-1}\,(l_{t-1}/l_t)(\sigma_t/f_{t-1}) - \mu_t\,\bar{a} \tag{3}$$

where superscript "pcd" is used to indicate "PAYG with constant debt". A reduction in the pension accrual rate, an increase in the length of the working life, a reduction in the number of years in retirement relative to working life length and an increase in the fertility rate all imply a lower tax rate. The total tax rate consists of a component that covers the pension outlays and a second component that captures the cost of debt servicing so that a_t is kept constant. This implies that (under the assumption of positive wage bill growth) the budget balance is in surplus (deficit) if government net assets are positive (negative).

3.1.2 A new policy rule: actuarial neutrality across generations

Next, we introduce a policy rule such that in each period, for any demographic characteristics and pension benefit parameters pertaining to current workers and interest mark-up projected for the next period, the tax rate is set at the constant level that is financially sustainable under the hypothetical situation that no changes to these factors will occur in the future. This rule essentially stipulates that from now onwards, (hypothetical) identical generations will be treated identically by the government. Note that we do not assume that these factors will remain unchanged indefinitely. Instead, our rule amounts to a particular choice for the tax rate in this period. If and when one or more of these factors change, the same principle as just defined is applied again. We show now how this simple principle implies a formula for setting the tax rate as a function of the demographic variables, pension policy parameters and the interest mark-up.

Where applicable, a superscript t indicates that the variable is based on the information available in period t. For example, μ_t^t denotes the interest mark-up in period t known in period t,

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[9] Note that for setting up the accounting framework, the expression for the interest rate is merely an identity; for the main results below, however, we need to assume that μ_t is exogenous.

while μ_{t+1}^{t} denotes the interest mark-up projected for period t+1 under the information available in period t.[10]

We define θ as the *IPD* as a share of the total wage bill. For the burden from the past (period t–1) and given the (known) parameter values in period t, it is:

$$\theta_{t-1}^{t} = \frac{IPD_{t-1}^{t}}{w_{t-1}L_{t-1}^{t-1}} = \frac{\pi_{t-1}\left(l_{t-1}^{t-1} / l_{t}^{t}\right)\sigma_{t}^{t}}{\left(1+\mu_{t}^{t}\right)f_{t-1}} \tag{4}$$

while for period t, given the known parameter values and those projected for t+1, it is:

$$\theta_{t}^{t} = \frac{IPD_{t}^{t}}{w_{t}L_{t}^{t}} = \frac{\pi_{t}\sigma_{t+1}^{t}}{\left(1+\mu_{t+1}^{t}\right)f_{t}} \tag{5}$$

Higher fertility f and longer working life l raise the total wage bill and, hence, reduce the *IPD* as a share of the wage bill. An increase in the pension accrual rate π or a (projected) increase in number of years in retirement relative to the length of the working life σ naturally raises it. An increase in the interest rate mark-up implies heavier discounting of future liabilities and thus has a depressing effect on θ.

Using the expressions above, the tax rate implied by the new policy rule is found as (see the Appendix):

$$c_{t}^{a} = \mu_{t+1}^{t}\left[\left(\frac{1+\mu_{t}^{t}}{1+\mu_{t+1}^{t}}\right)\left(\theta_{t-1}^{t} - a_{t-1}\right)\right] + \theta_{t}^{t}. \tag{6}$$

Hence, each generation of workers first contributes to share the burden stemming from the past decisions on pensions and other expenditures and revenues by paying the interest mark-up on the sum of the implicit pension liabilities and the explicit public debt (possibly corrected for a change in the mark-up – see the first term on the right-hand side) – and then pays the full present value of its own future pensions (the second term). An increase in the length of the working life $l_{t}^{t} > l_{t-1}^{t-1}$ implies that the *IPD* accumulated in the past is shouldered by more labour input, which implies a reduction in the contribution rate (notice that $\theta_{t-1}^{t} = \left(l_{t-1}^{t-1} / l_{t}^{t}\right)\theta_{t-1}^{t-1}$).

Now that we have shown these implications of our policy rule we label it as actuarial neutrality across generations: the burden of initial explicit and implicit debt is shared equally between the current and future generations and each generation covers the actuarial value its own future pensions. Like any actuarial calculation the implementation of the rule is partly based on fixed policy parameters (e.g. the pension accrual rate and retirement age) and partly on projected values (longevity and interest rate).

The expression for the tax rate in equation (6) is a general formula under actuarial neutrality. It is valid for any changes, permanent or temporary, in the demography, retirement age, generosity of pensions and interest-rate margin in the subsequent periods. Under this rule, the balance of

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[10] For clarity, we also attach a superscript to the length of the working life variable, l_{t}^{t}, to indicate that it is the value known in period t when the tax rate for workers in that period is determined. Variable θ below also carries a superscript as for each period it has both *ex ante* and *ex post* value; for a detailed explanation of our rule see the Appendix.

pension contributions and benefits of each generation is fully separated from the characteristics and pension policy choices of other generations starting from the moment at which this rule was first implemented. This result is quite robust, as it allows, for example, for a change in the (projected) interest-rate margin as long as the latter does not depend on the other factors in the formula.[11]

We emphasize that this rule is not based on a welfare evaluation across generations. This is an advantage: we do not need to compare welfare across generations with different fertility, longevity and retirement age – this would be difficult if not impossible. Yet, according to the rule, identical generations are treated equally by the government in terms of present values of payments to and benefits from the public coffer, and the rule then implies how the policy parameters need to be changed when successive generations differ in some respect. We view the rule and its implications as a natural benchmark for a neutral treatment of different generations by the government. It contrasts with pure PAYG pension financing, which generally produces systematic redistribution across generations.

Under our rule, furthermore, the sum of explicit public debt (-a) and implicit liabilities as a share of the wage bill (labelled the "total debt ratio") evolves as follows:

$$\theta_t^t - a_t = \frac{1+\mu_t^t}{1+\mu_{t+1}^t}\left[\left(l_{t-1}^{t-1}/l_t^t\right)\theta_{t-1}^{t-1} - a_{t-1}\right] \tag{7}$$

This equation thus implies that the total debt ratio remains constant if $\mu_t^t = \mu_{t+1}^t$ and $l_{t-1}^{t-1} = l_t^t$. An increase in the length of the working life or an increase in the interest mark-up implies a reduction in the total debt. Ceteris paribus, higher implicit liabilities (a higher θ_t^t) require higher pension contributions, which implies an offsetting reduction in the public debt. Note that (7) is applicable under any initial degree of funding, which then evolves as a function of factors in the formula for c_t^a. In particular, if the system were initially fully funded, it would remain so under the actuarial neutrality rule.

3.2 The calibration

Our numerical example is largely based on the following stylized calibration taken from Oksanen (2005). The unit period corresponds to 30 years, which is roughly the average childbearing age of women in Europe. It is also roughly the average age difference between a retired person (70) and a worker (40). Throughout, we assume that the annual growth rate of the nominal wage per worker is 3.28 per cent, which stems from a unit real-wage growth rate of 1.75 per cent and an inflation rate of 1.5 per cent *per annum*. The interest-rate mark-up over the growth of the total wage bill equals 1.5 percentage points *per annum*.

The economy starts in period 0 in a steady state in which people work for 40 years and spend 18 years in retirement (hence, σ_t = 0.45). These numbers are thus used to scale pension contributions and pensions to correspond to realistic numbers, although the formal model works with the 30-year period. Fertility, moreover, initially preserves a constant population. Further, the

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[11] To assess the plausibility of this assumption, note that under elementary growth theory the interest rate should fall with a declining rate of growth of the economy and with increasing capital intensity. In the model here this is indeed the case: for given μ_t^t and μ_{t+1}^t, the interest rate decreases with a fall of the wage bill growth rate.

unit pension is initially set at 55 per cent of the wage after pension contributions (*i.e.*, $\pi^n_{t-1} = 0.55$, see the Appendix), so as to make the initial numbers comparable with those for 2004 in the EPC projections. Initial public debt is 60 per cent of annual GDP.

Period 1 includes both a 20 per cent fall in fertility (roughly corresponding to a fall from 2.1 children per woman, which is needed for full replacement, to 1.7, which is close to the current average in Europe) and an increase in longevity by three years (this corresponds to one year for each ten-year period). Period 2 shows a further increase in longevity by three years. This allows us to match quite closely the assumptions on the increase in longevity in the EPC projections for the EU average (an increase in life expectancy (at birth) for males (6.3 years) and for females (5.1 years) from 2004 to 2050).

3.3 The numerical results

We show the time paths of the most relevant variables under pure PAYG and various policies under actuarial neutrality. We consider two possible policy measures to contain the rising ageing burden: an increase in the retirement age and a reduction of the replacement rate; the tax rate is then residually determined by these measures and the policy rule implemented. For the case of actuarial neutrality we also consider a (partial) privatisation of the public pension pillar, where the latter is partly replaced by a mandatory, funded private pillar. Most numbers are expressed in percentages of GDP, assuming for simplicity that the total wage bill (including pension contributions) is a constant 60 per cent of GDP.

Table 1 displays the time paths of the tax rate and pension expenditures, the public debt, the *IPD*, the total debt and the budget surplus (all as shares of GDP) under the pure PAYG rule. A negative value for the budget surplus/GDP ratio thus indicates a public deficit. Throughout, the debt and the budget surplus are expressed as ratios of annual GDP (see the Appendix; a new steady state is always achieved in period 3; the period-4 numbers are reported merely to confirm this; budget balances and public debt levels that violate the Stability and Growth pact are indicated with boldface characters). Table 2 reports the figures corresponding to Table 1 under actuarial neutrality, while Table 3 illustrates a partial privatisation of the public pension system under actuarial neutrality.

Panel 1 of Table 1 shows the results for the baseline PAYG scenario in which no policy changes are undertaken. The reduction in fertility and the two-step rise in longevity produce an increase in pension expenditure from an initial level of 11.9 per cent of GDP to a new steady-state level of 17.5 per cent of GDP. Taxes (the bulk of which consist of pension contributions) as a share of the total wage cost ("wage" for short) rise from the initial 21.7 to 31.1 per cent in the new steady state. Given that the generosity of the pension benefits is untouched, the *IPD* rises as a share of GDP. This rise is produced both by the additional years in retirement and the fall in fertility. Permanently lower fertility means that the *IPD* as a share of GDP increases because the growth of the wage bill is permanently reduced implying that a given amount of future pension outlays is discounted at the lower rate. Naturally, an increase in the retirement age alleviates the rise in pension expenditures and the tax rate. In period 1 the tax rate falls because the contribution period has increased while the rise in longevity has not yet materialized (because it concerns those working in period 1 and thus the longevity rise materializes in period 2). In panel 2.1 we consider a reduction in the pension accrual rate π^n_{t-1} as a share of the wage net of pension contributions from 55 to 48 per cent. In panel 2.2 this is combined with a "moderate" increase in the retirement age

Table 1

Public Finances and Pensions under Pure PAYG

Period	0	1	2	3	4	change
1 PAYG – Baseline: Net Accrual Rate 55 per cent; Fixed Retirement Age						
Pension exp/GDP *(percent)*	11.9	11.9	15.9	17.5	17.5	5.6
Tax rate	21.7	21.7	28.4	31.1	31.1	9.4
Public debt/GDP *(percent)*	60.0	60.0	60.0	60.0	60.0	0.0
IPD/GDP *(percent)*	228.5	305.4	336.3	336.3	336.3	107.8
Total debt/GDP *(percent)*	288.5	365.4	396.3	396.3	396.3	107.8
Budget surplus/GDP *(percent)*	–1.9	–1.9	–1.5	–1.5	–1.5	0.4
2.1 PAYG – Target Net Replacement Rate 48 per cent; Fixed Retirement Age						
Pension exp/GDP *(percent)*	11.9	11.9	14.4	15.9	15.9	4.0
Tax rate	21.7	21.7	25.8	28.3	28.3	6.6
Public debt/GDP *(percent)*	60.0	60.0	60.0	60.0	60.0	0.0
IPD/GDP *(percent)*	228.5	275.9	304.8	304.8	304.8	76.3
Total debt/GDP *(percent)*	288.5	335.9	364.8	364.8	364.8	76.3
Budget surplus/GDP *(percent)*	–1.9	–1.9	–1.5	–1.5	–1.5	0.4
2.2 PAYG – Target Net Replacement Rate 48 per cent; Increase in Working Life (40-41-42)						
Pension exp/GDP *(percent)*	11.9	11.7	13.3	14.3	14.3	2.4
Tax rate	21.7	21.3	24.1	25.8	25.8	4.1
Public debt/GDP *(percent)*	60.0	60.0	60.0	60.0	60.0	0.0
IPD/GDP *(percent)*	228.5	255.9	275.4	275.4	275.4	46.9
Total debt/GDP *(percent)*	288.5	315.9	335.4	335.4	335.4	46.9
Budget surplus/GDP *(percent)*	–1.9	–2.0	–1.5	–1.5	–1.5	0.4

Notes: (1) The tax rate consists mainly of pension contributions and is expressed as a percentage of the total wage cost. (2) The final column "change" gives the percentage point change from period 0 to the new steady state, except for the budget surplus/GDP ratio, where it gives the percentage point change from period 0 to the lowest or highest level.

such that the working life in period 1 rises to 41 years and in period 2 to 42 years, *i.e.*, it rises by one-third of the increase in life expectancy (Beetsma and Oksanen, 2007, provides results also for a larger increase in retirement age for this and other tables, respectively). The budget surplus is practically unaffected in all these cases. Moreover, the projected pension expenditure in panel 2.2 roughly corresponds to the EPC projection for EU-15.

Table 2

Public Finances and Pensions under Actuarial Neutrality

Period	**0**	**1**	**2**	**3**	**4**	**change**
1 Actuarial Neutrality – Baseline: Net Accrual Rate 55 per cent; Fixed Retirement Age						
Pension exp/GDP *(percent)*	11.9	11.9	16.3	18.2	18.2	6.3
Tax rate	21.7	26.4	28.4	28.4	28.4	6.7
Public debt/GDP *(percent)*	60.0	–25.1	–60.5	–60.5	–60.5	–120.5
IPD/GDP *(percent)*	228.5	313.5	349.0	349.0	349.0	120.5
Total debt/GDP *(percent)*	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP *(percent)*	–1.9	2.5	2.3	1.5	1.5	4.4
2.1 Actuarial Neutrality – Accrual Rate Reduced to 48 per cent; Fixed Retirement Age						
Pension exp/GDP *(percent)*	11.9	11.9	14.6	16.3	16.3	4.4
Tax rate	21.7	24.6	26.4	26.4	26.4	4.7
Public debt/GDP *(percent)*	60.0	8.1	–24.4	–24.4	–24.4	–84.4
IPD/GDP *(percent)*	228.5	280.3	312.9	312.9	312.9	84.4
Total debt/GDP *(percent)*	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP *(percent)*	–1.9	0.8	1.3	0.6	0.6	3.2
2.2 Actuarial Neutrality – Accrual Rate Reduced to 48 per cent; Increase in Working Life (40-41-42)						
Pension exp/GDP *(percent)*	11.9	11.6	13.4	14.6	14.6	2.7
Tax rate	21.7	23.5	24.3	24.3	24.3	2.6
Public debt/GDP *(percent)*	60.0	18.8	–4.3	–4.3	–4.3	–64.3
IPD/GDP *(percent)*	228.5	264.1	280.9	280.9	280.9	52.4
Total debt/GDP *(percent)*	288.5	282.9	276.6	276.6	276.6	–11.9
Budget surplus/GDP *(percent)*	–1.9	0.2	0.6	0.1	0.1	2.5

Notes: see Table 1.

Table 2 illustrates actuarial neutrality as an alternative policy rule.[12] The baseline assumes no

[12] We can compare actuarial neutrality to the generational accounts developed by Kotlikoff and others (e.g. Kotlikoff, 2002) that aim at revealing intergenerational imbalances by projecting public expenditure by generation under prevailing policies and calculating the net tax payments of current and future generations. We can also compare actuarial neutrality with Musgrave's (1986) "fixed relative position" rule for determining a fair pension formula, referred to in recent discussions, e.g. by Esping-Andersen *et al.* (2002). Pensions are thus indexed to the wage rate after pension contributions, while a pure PAYG system is strictly preserved. Although the indexation rule is the same as in the illustrations here, the Musgrave rule deviates from actuarial neutrality, and under population ageing leads to an increasing burden for future generations.

change in the generosity of the benefits or in the retirement age. The fall in fertility (via a reduction in the discount rate) and the rise in life expectancy both raise the *IPD* as a share of GDP. In anticipation of this increase, taxes already rise in period 1 (the system now moves to partial funding). Hence, the rise in the implicit debt ratio is followed by an equivalent reduction in the (explicit) public debt ratio (or increase in the public asset ratio), and the deficit turns into a surplus from period 1 onwards in all panels. The surplus is largest in period 1, when the population is affected by two shocks simultaneously (the rise in workers' life expectancy and the fall in the fertility rate). A reduction in the accrual rate (panel 2.1) produces a smaller implicit debt/GDP ratio, thereby requiring smaller surpluses than under the baseline. This effect is further strengthened when the reduction in the accrual rate is combined with an increase in the retirement age. The expenditure increase of 2.7 percentage points of GDP in panel 2.2 in Table 2 roughly corresponds to the EPC projection for the EU.

All actuarially neutral scenarios clearly show that as long as the demographic change is permanent, the financial position of the government should also change permanently. Depleting the public assets once the ageing process has ended is therefore excluded, unless pension accrual is drastically reduced.

Table 3 considers the latter option induced by a partial privatisation (possibly in combination with other measures) in which implicit pension debt is swapped for (explicit) public debt. The partial privatisation is implemented with a one-third reduction in the accrual rate expressed as a share of the gross wage rate. Under actuarial neutrality taxes paid to the government fall immediately (the contributions to the newly established private second pillar come on top of these taxes). Obviously, as accrued pension rights are respected, public pension expenditure falls only gradually. Comparing the new steady state with period 0, the public debt/GDP ratio falls only slightly (panel 1). In period 1 it exceeds the 60 per cent limit of the SGP, while the deficit ratio in that period remains just marginally below the 3 per cent limit. Adding to this a reduction in the accrual rate leads to a further swap of debt in panels 2.1-2.2, where the deficit ratio violates the SGP in period 1 and so does the debt ratio from period 1 onwards.

A complete privatisation under actuarial neutrality would make all implicit debt explicit, leading to a gross violation of the SGP limits (for details, see Beetsma and Oksanen, 2007, Table 5). This scenario is not mentioned here as a realistic one, but to note that a reform that shifts mandatory pensions entirely to private sector has a severe effect on the public finance figures, even though total pensions and taxes are not affected at all.

3.4 Other ageing-related expenditure

In order to obtain a picture of the overall budgetary consequences of ageing, one can extend the above approach to pensions also to other ageing-related expenditures. The most important categories are the health care and long-term care expenditures. In 2004, they were respectively 6.4 and 0.9 per cent of GDP in the EU-15, while their projected increase by 2050 amounts to 1.6 and 0.7 per cent of GDP, respectively. Although we have employed these numbers in our calculations, they are highly uncertain, and the conclusions derived from them are only tentative, requiring a substantial amount of further work (e.g. Chapters 4-5 in Economic Policy Committee and the European Commission, 2006a).

Who benefits from these expenditures and who provides the financing? A stylised fact is that roughly half of health care costs benefit the working-age population (including their children), while the other half benefit the elderly, particularly those approaching their final years of life. As

Table 3

Public Finances and Pensions under Actuarial Neutrality: One-third Privatisation

Period	**0**	**1**	**2**	**3**	**4**	**change**
1 Actuarial Neutrality – 55 per cent Accrual Rate; Fixed Retirement Age						
Pension exp/GDP *(percent)*	11.9	11.9	10.9	12.1	12.1	0.2
Tax rate	21.7	20.6	21.9	21.9	21.9	0.2
Public debt/GDP *(percent)*	60.0	**79.4**	55.8	55.8	55.8	–4.2
IPD/GDP *(percent)*	228.5	209.0	232.7	232.7	232.7	4.2
Total debt/GDP *(percent)*	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP *(percent)*	–1.9	–2.9	–0.8	–1.4	–1.4	–1.0
2.1 Actuarial Neutrality – Accrual Rate Reduced to 48 per cent; Fixed Retirement Age						
Pension exp/GDP *(percent)*	11.9	11.9	9.7	10.9	10.9	–1.0
Tax rate	21.7	19.4	20.6	20.6	20.6	–1.1
Public debt/GDP *(percent)*	60.0	**101.6**	**79.9**	**79.9**	**79.9**	19.9
IPD/GDP *(percent)*	228.5	186.9	208.6	208.6	208.6	–19.9
Total debt/GDP *(percent)*	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP *(percent)*	–1.9	**–4.0**	–1.5	–2.0	–2.0	–2.1
2.2 Actuarial Neutrality – Accrual Rate Reduced to 48 per cent; Increase in Working Life (40-41-42)						
Pension exp/GDP *(percent)*	11.9	11.6	9.0	9.8	9.8	–2.1
Tax rate	21.7	18.6	19.1	19.1	19.1	–2.6
Public debt/GDP *(percent)*	60.0	**106.8**	**91.4**	**91.4**	**91.4**	31.4
IPD/GDP *(percent)*	228.5	176.1	187.3	187.3	187.3	–41.2
Total debt/GDP *(percent)*	288.5	282.9	278.7	278.7	278.7	–9.8
Budget surplus/GDP *(percent)*	–1.9	**–4.4**	–2.0	–2.2	–2.2	–2.5

Notes: see Table 1.

the bulk of public expenditure on long-term care is related to the elderly, we simply assume that they consume all of it.

An estimate must then be made of how an increase in longevity affects the volume of health care facilities and long-term care services to be used by the elderly. One extreme assumption is that it increases proportionally with the number of people over, say, 60 years of age. The opposite

extreme is that an increase in longevity raises these expenditures hardly at all, as the bulk of these are concentrated in the last few years before death.

As for the financing, we note that public health and long-term care expenditures are normally covered by tax revenues that are paid also by the elderly. The way in which these expenditures are financed thus differs significantly from that of pension outlays, which are typically covered by pension contributions paid by workers, but not by pensioners.

Fortunately, the framework described above is derived from a more general model that we can apply also to other ageing-related expenditure items. One assumption that we need to make concerns the ratio between the level of taxable income of the elderly and that of the workers. We set this at 60 per cent, keeping in mind the level of pensions as compared to wages in Europe (see the Appendix for the details).

We make the following assumptions: the system is initially (until period 0) in the steady state, initial public debt is set at zero,[13] and health care and long-term care spending for the elderly are financed out of current taxes.

Again, we spell out the effects of ageing on expenditures, on taxes on wages and income of the elderly, on debt and on the deficit. Because taxes would mechanically follow expenditures, we do not present the results for full financing from current taxes (the analogue to the pure PAYG pension system). Instead, the results discussed below are all based on the same new rule as for pensions: after any change, the tax rate is set at a level that is financially sustainable as long as there is no new shock, and *mutatis mutandis,* revised when such a shock arrives. We also compute for each period the implicit debt, which is defined as the capital value of these expenditures benefiting the elderly in the following period.

Note that the policy rule does not in all cases result in perfect actuarial neutrality, as it did for pensions. The reason is the assumption that the same tax rate is applied to the incomes of both workers and pensioners. For example, if the working-age generation were to start consuming a higher amount of health care services than the previous generation did, then policymakers should immediately increase the tax rate. The current elderly will then also pay higher taxes, although they would get nothing in return. Thus, under these assumptions the succeeding generations cannot be treated completely separately.

We consider one scenario (Table 4). It assumes that the time spent as a net user of these services increases by two years in both periods 1 and 2, while longevity increases by three plus three years, leading to a "moderate increase" in the ratio of the elderly to net contributors. In addition, we assume for periods 1 and 2 a pro rata 4 per cent increase in expenditures for both the younger generation and the elderly for each 30-year period. The implied expenditure increase of 2.3 percentage points of GDP roughly corresponds to the EPC projection for the EU average. Our assumptions imply a stepwise frontloading of tax collection leading to an eventual reduction of the public debt by 35 per cent of GDP and a budget surplus of 1.4 per cent of GDP in period 1 and 0.9 per cent in the new steady state. Government debt falls because the tax rate immediately jumps to a higher level as soon as the projected expenditure is recognised, while the spending increase will materialise only later.[14]

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[13] This is assumed without loss of generality as the outcomes for the public budget under this calibration will later be combined with those obtained above for the pension model. The consolidated public sector then starts with 60 per cent initial debt, the reference value in the Treaty and the SGP.

[14] In itself this effect reduces spending in period 1 relative to period 0. It virtually cancels against the effect of the exogenous spending trend, implying that the overall spending/GDP ratios of periods 0 and 1 are almost equal.

Table 4

General Model Applied to Health Care and Long-term Care Expenditure

Period	**0**	**1**	**2**	**3**	**4**	**change**
Moderate Increase Elderly/Net Contributors Ratio and 4 per cent Increase in Expenditure per 30 Years						
Expenditure/GDP *(percent)*	7.3	7.3	9.1	9.6	9.6	2.3
Tax rate	10.0	11.3	11.5	11.5	11.5	1.5
Public debt/GDP *(percent)*	0.0	–27.4	–34.8	–34.8	–34.8	–34.8
Net ID/GDP *(percent)*	52.8	76.4	82.0	82.0	82.0	29.2
Total debt/GDP *(percent)*	52.8	49.0	47.2	47.2	47.2	–5.6
Budget surplus/GDP *(percent)*	0.0	1.4	1.0	0.9	0.9	1.4

Notes: ID = implicit debt. Further, see Table 1.

Table 5

Overall Financial Implications of Ageing

Period	**0**	**1**	**2**	**3**	**4**	**change**
Expenditure/GDP *(percent)*	19.2	18.9	22.5	24.3	24.3	5.1
Tax rate	31.7	34.8	35.7	35.7	35.7	4.0
Public debt/GDP *(percent)*	60.0	–8.6	–39.2	–39.2	–39.2	–99.2
Net ID/GDP *(percent)*	281.3	340.5	362.9	362.9	362.9	81.6
Total debt/GDP *(percent)*	341.3	331.9	323.8	323.8	323.8	–17.5
Budget surplus/GDP *(percent)*	–1.9	1.6	1.6	1.0	1.0	3.5

Notes: see Tables 1 and 4.

The full consequences of ageing for the public budget under the policy rule introduced in this paper can be calculated by summing the budgetary effects associated with the pension outlays and those associated with health care and long-term care expenditures reported in Table 4. Table 5 provides an example, combining pensions under actuarial neutrality, a moderate retirement-age increase and a net accrual rate reduction to 48 per cent (panel 2.2 in Table 2) and our scenario for health care and long-term care expenditures. The total debt ratio declines relatively little. The conventionally measured government deficit moves from the initial 1.9 per cent of GDP deficit to a surplus of 1.6 per cent over 60 years, while explicit debt declines by 100 per cent of GDP over two generations. These are large numbers that deserve careful assessment.

3.5 Limitations and extensions of our framework

Our analysis obviously makes a number of simplifying assumptions. First, our results are based on a model in which successive generations follow one another after each 30-year period (*i.e.*, all members of a given generation are born at the same instant). Reality is quite different, and we can only interpret the results representing neutrality for an average-aged worker and an average-aged retiree. As the same tax rate is set for all workers in a given year, and as the demographic change is gradual, there is no way to reach perfect actuarial neutrality for every yearly age cohort. Our results can be generalised for annual data, however, and the unavoidable deviations from perfect neutrality could be estimated (for an application see Oksanen, 2003).

Another extension involves addressing the consequences of forecasting errors. For example, suppose that the actual longevity increase for the next period turns out to have been underestimated – something that has frequently happened in reality. Under PAYG, the tax rate on workers in the next period rises to cover the larger amount of pension outlays. Explicit debt remains constant and the consequences of the mistake are thus borne by the workers in the period in which it materializes. Under actuarial neutrality, the increase in the tax rate caused by the mistake is limited to the interest on the unexpected increase in the total public debt. The consequences of the mistake are thus spread out over all working generations as of the period when the forecasting error is discovered.[15] This is an intrinsic feature of an actuarially neutral system: it implicitly allows for intergenerational risk-sharing by spreading the costs of unexpected longevity shocks over all current and future workers, while it, by construction, also takes care of generational neutrality with respect to an expected longevity increase.

As mentioned above our rule can be applied to the average-aged worker having 30 years to become an average-aged retiree. Hence, the result is mainly determined by known factors and the projections of future demographic variables and the interest rate over the next 30 years. Those projections gradually change over time and our rule can be continually updated to take these changes into account. Thus, the effects of the uncertainty about demographic and economic projections further into the future are kept under control.

Finally, we have ignored public investment. This is reasonable if we can assume that the public capital stock is properly maintained and expanded in line with economic growth. However, if major investment projects are undertaken or planned, they should be recognised as part of the net assets to be left to future generations. The same should be the case for government disinvestment (*i.e.*, the sale of its real assets).

4 Implications of *actuarial neutrality* for pension reforms and the SGP

4.1 Implications for designing pension reforms

Our framework highlights the *IPD* and makes the distinction between pension rights accrued to date and those to be accrued in future. Accrued rights are assumed to be well defined and respected. This does not correspond to reality. If a pension reform plan is presented without due

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[15] This is seen from equations (4)–(6) above: an error in the longevity estimate for period t means that its realised value σ_t^t in equation (4) is different from its value σ_t^{t-1} projected in t–1. σ_t^t in equation (4) enters the tax rate equation (6) via θ_{t-1}^t in the first term for the interest on the total debt. For example, if longevity was underestimated, all workers from t onwards will shoulder the same additional burden caused by the forecasting error that made the workers in period t–1 pay too low taxes.

assurances, the elderly, who have already accrued most of their pension rights, may fear that they will lose these rights and therefore block an otherwise sensible reform plan. Distinguishing accrued rights from those to be accrued in the future may help here. If an agreement is reached on the accrued rights, then current pensioners and older workers may be able to lift their concerns and accept reforms that set new rules for (less generous) future rights and their financing. The agreed reform option (for example a partial privatisation as studied above) could then gradually replace the old system. The advantages from clarifying the accrued rights could also be regarded as a responsibility of the government in order to enhance the private long-term saving decisions of individuals.[16]

4.2 Measurement and treatment of the IPD and the SGP

Obviously, the estimation of the *IPD* defined as accrued-to-date pension liabilities is a non-straightforward matter. In the 1990s there was some interest in estimating these liabilities (e.g., van den Noord and Herd, 1993), but no systematic update has taken place since then.

The *IPD* as defined here can be compared to the open-system pension liabilities, defined as the present value of projected pension expenditure minus revenue up to infinity. The sustainability gap indicator corresponds to the constant tax rate matching this liability.[17] Thus, just like the sustainability gap indicator, the projection for open-system liabilities is not sufficient for assessing intergenerational equity: it does not contain the data by age cohort, nor does it distinguish between rights accrued to reference date and those to be accrued in the future.

There is a debate as to how much effort should be put into estimating the (accrued-to-date) *IPD*, and how the latter should be related to the explicit public debt. First, under most public pension systems in Europe, implicit pension rights are not backed by explicit well-defined commitments. For example, frequently there is ambiguity about inflation indexation. Second, there is a fear that the official publication of an implicit-liabilities estimate may give those liabilities an explicit character, and thereby make it more difficult to renege on them. For this reason Coeuré and Pisani-Ferry (2005) argue quite fiercely against including implicit liabilities in their measure of the net balance position of the government. This worry could be handled by adding to the official publication of implicit liabilities a statement that the figures are based on current policy and that no legal rights can be extracted from them. Moreover, baseline figures for implicit liabilities could be complemented by projections based on alternative assumptions, for example about indexation. This would give those baseline figures a less definitive character.

These considerations will become important as the international statistical community is about to finalise its proposals to set up, in the next SNA/ESA revision, new supplementary accounts for accrued public pension liabilities (see Advisory Expert Group on National Accounts (AEG), 2007; also European Commission, 2007, Part II, Section 2.3). These figures will help in constructing actuarially neutral benchmarks for public pension policy.[18]

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[16] The political economy of pension reform is studied in Razin *et al.* (2002) and Galasso (2006).

[17] European Commission (2006, Chapter I and Annex I), and (2007, Section 2.3); see also Buti and Nogueira Martins (2006) and Blanchet and Ouvrard (2006).

[18] The way the *IPD* enters in our policy rule should remove Franco's (1995) concern that it should not be used without qualification as a stand-alone indicator of the future pension burden (also European Commission, 2007, p. 99, and Blanchet and Ouvrard, 2006).

4.3 Implications for the Stability and Growth Pact

The newly established MTOs for the next few years, ranging from –1 per cent of GDP to balance or surplus, if persistently followed, imply a reduction in the public debt and, hence, guarantee quite safely the sustainability of the (explicit) public debt. However, the question is whether it is (politically) feasible for governments to implement those MTOs in the long run in view of the increase in ageing-related expenditures. This seemed to concern the ECOFIN Council (2006), when it noted that reaching the MTOs in the 2005 programmes based on the revised SGP guidelines would be an important step, but not a sufficient one. In particular, the Council called "for further structural reforms and/or budgetary consolidation, in line with the three-pronged strategy to ensure sustainability decided by the Stockholm European Council in 2001, *i.e.* (i) reducing debt at a fast pace; (ii) raising employment rates and productivity; and, (iii) reviewing and, where appropriate, reforming pension, health care and long-term care systems". The summary example (Table 5) based on our tax-setting rule aiming at neutrality across generations implied a reduction of 100 per cent in the government debt ratio and a 1.6 per cent surplus over a 60-year period. From this perspective, the current MTOs for the EU on average do not seem ambitious enough, given the expenditure projections used. This conclusion is strengthened by a serious risk that the expenditure projections regarding health care and long-term care will be exceeded (after all, in the past couple of decades, these expenditures have risen much faster than is now projected for the coming decades; see Economic Policy Committee and European Commission, 2006a, pp. 121 and 127).

A clear implication of our policy rule is that if the accumulation of funds for pre-funding future pensions belongs to the general government sector, this should be fully reflected in the targets for the public debt and the deficit. Otherwise, the pension-system surplus will likely be squandered by a deficit in other public policy areas.[19]

Finally, the results from the illustrations of the (partial) privatisation of the public pension system clearly indicate that a conflict with the SGP rules may arise, although how serious this becomes will depend on several factors. In our stylised examples for one-third privatisation and 60 per cent of GDP initial public debt (Table 3), there is a serious risk that the SGP will be violated.[20] Lower initial debt gives more room for adjustment. Also, the budget surplus target would be larger under a policy of frontloading taxes to finance the future increase in the costs of health care and long-term care. This would help to offset the negative effect on the budget balance of pension system privatisation.

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[19] The accumulation of funds in the public pension system should thus show up as a positive item for the budget balance and a reduction in net debt. If the public pension system is organised as a separate entity, then the question arises as to where it should invest. Some authors argue that if pension funds (private or public) invest in government bonds, they are in effect pure PAYG (e.g., Barr, 2004, p.114). Of course, this requires that the government always issues new debt (*i.e.* increases the deficit) to accommodate such investment. Whether or not this happens depends on rules and policies. From the perspective of intergenerational equity, investment by a public (private) pension fund in government debt is neutral if net public debt is reduced (kept constant) in response to this investment. Bosworth and Burtless (2004) find that this requirement has been met at the state level in the US, while in OECD countries (from 1970-2000) 60-100 per cent of public pension saving at the national level was offset by larger deficits in other budgetary accounts.

[20] Note here that the reference scenario is not a pure PAYG mono-pillar system, but a mono-pillar that is first reformed to implement actuarial neutrality. The latter would lead to a reduction of the public debt, while the one-third privatisation would turn that around to an increase (compare, for example, panels 2.2 in Tables 2 and 3, respectively).

5 Concluding remarks

This paper has explored how the Stability and Growth Pact may cope with the future costs of population ageing in the European Union. In anticipation, countries have started to, or plan to, reform their pension systems – both by reducing the generosity of pension arrangements and increasing the retirement age, and by switching from pure PAYG pension provision to pre-funding, including reduction of public debt and partial privatisation. This paper has investigated how such reforms relate to the SGP.

Although the SGP, especially after its revision in 2005, clearly aims to ease the financial burden on future generations, it does not incorporate intergenerational equity explicitly and systematically. The simple rule studied in this paper labelled as actuarial neutrality means that generations that are identical in terms of demography (longevity and fertility) and retirement age should face the same tax rate for the same level of benefits. We show that there exists a wide range of alternative pension arrangements that comply with this benchmark. Our results provide further rationale and precision for the ambitious policy line widely expressed by the European Union finance ministers (e.g. ECOFIN Council, 2006) and others. They also show that a pure PAYG rule does not, in general, comply with actuarial neutrality, but tends to shift an increasing burden to future generations.

Our results are derived from a partial equilibrium analysis that ignores the behavioural responses of private-sector agents. It is clear, however, that the demographic and pension system variables would dominate the results even if the model would comprise some endogenous private-sector reactions. Qualitatively speaking, and in terms of orders of magnitude, we would expect our results to be unaffected by such extensions.

For the many countries in which ageing-related expenditure is projected to increase considerably under current policies, emphasis should be on considering policy changes that will help contain the increase. The medium-term objective (MTO) for budget balance should then be set on the basis of the reformed rules. However, the EPC projection for a Member State close to the EU average might be a relevant starting point for setting targets for the debt and deficit. This average increase in pensions already incorporates a significant reduction in the replacement rate and an increase in retirement age, and yet, as a result of the ongoing change in the age structure of the population, expenditures increase. Our stylised example above, which mimics those figures and also takes into account the projected increase in health care expenditure (Table 5), shows that our neutrality rule then implies that the budget target should be a significant surplus for several decades. It thus does not seem sufficiently ambitious to set the MTOs under the revised SGP provisionally in the range from –1 per cent of GDP to balance or surplus.

While the revised SGP now recognises the problem with the transitional cost of (partial) privatisation of pensions, the leeway over the 3 per cent of GDP deficit ceiling is quite limited. Our results show the inevitable downside of this: a partial privatisation performed on a fully actuarially neutral basis of a reformed and sound mono-pillar pension system may not easily be accommodated under the current rules. If, for example, one-third of the *IPD* is swapped for explicit public debt, then the government budget balance should be allowed to deteriorate by 4 to 5 percentage points of GDP relative to the otherwise similar mono-pillar system. The risk of breaching the 3 per cent deficit ceiling therefore becomes imminent. Hence, while there might be sound economic reasons for privatisation (e.g., a reduction in the distortionary effects of the pension system on the labour market), it is clear that under otherwise similar policies a country that maintains a mono-pillar system can be much more comfortable with the SGP rules than a country that contemplates and implements a partial privatisation of the system. More concretely, a

significant privatisation may lead to an Excessive Deficit and prevent the Member State from adopting the euro. For this reason the reforms to establish a fully funded second pillar may be abandoned or delayed. This is hardly in the spirit of the EU budgetary rules as they were originally drafted.

A remedy to this consequence of the current rules would entail a change to the Protocol on the Excessive Deficit Procedure (EDP) annexed to the EU Treaty. When the SGP was revised in 2005, no changes were made to the Treaty, including the Protocol on the EDP, presumably because of the concern that the EDP as a budgetary anchor would be undermined. However, if serious plans for significant privatisation would be considered by some Member State, the solution could be a limited clause (requiring a unanimous decision of the EU Council) that the surplus in the second pillar be included in the government budget balance for the purposes of the EDP.

Experience with the budgetary rules as inserted in the Maastricht Treaty in 1991 and their enforcement under the SGP show that it is difficult to avoid the tension between the economic rationale behind complex issues and the simplicity required by the political process. Improving the implementation of the legal rules is therefore an ongoing process. The framework in the present paper provides some clarification regarding the issues to be tackled, and the ongoing work of pension actuaries and statisticians to gather estimates on implicit pension liabilities will greatly help in analyzing the issues and designing economically sound reforms.

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