

**AGEING AND PENSIONS IN EUROPE:  
A QUANTITATIVE ASSESSMENT OF SOME REFORM  
OPTIONS**

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\* The views represented in this paper are those of the author and should not be attributed to the European Commission.

## 1. INTRODUCTION

There is widespread consensus on the extent of the ageing problem in Europe, which is a result of the baby-boom in the early post-war period, the subsequent fall in fertility rates from the end of the 1960s and increasing life expectancy. This will begin to affect public finances significantly as the baby-boom generation reaches retirement age over the next few decades. The impact of these developments on public finances and pension systems is a particular issue of concern and debate in all Member States, but the effects of ageing will be far more widespread in the economy and society generally. Ageing will pose challenges for budgetary, labour and financial market policies as well as for overall economic performance. The need for a comprehensive reform strategy to cope with all these challenges is largely acknowledged.

This paper aims to address issues related to dealing with the demographic changes likely to occur in Europe over the next 50 years. Two possible strategies are analysed, namely a reform of the pension system or alternatively an increase in labour force participation. The two reform options analysed in this paper are first a gradual reduction in the replacement ratio and second an increase in the retirement age. Concerning the size of parametric reforms, the paper draws on recent work of the Economic Policy Committee and the OECD which has compiled pension projections in individual member states. The analysis focuses on the effects in some key economic variables, namely, economic growth, the sustainability of public finances and the income distribution between the working-age population and pensioners. The results presented in this paper are based on a dynamic equilibrium modelling exercise. The model used is an extension of DG ECFIN's macroeconomic model QUEST II. The model is calibrated on an EU15 and US data set including EUROSTAT demographic projections up to 2050.

The paper is structured as follows: First the key features of the model are presented. Section 3.1 describes the models baseline growth and pension expenditure projections for the EU15 as a whole to 2050, in order to underline the size of the demographic challenge to be faced over the period. Section 3.2 presents the effects of various parametric reform efforts such as lowering the replacement ratio or increasing retirement age. The paper ends with some concluding remarks.

## 2. KEY MODEL FEATURES

An EU15 aggregate version of DG ECFINs QUEST Model has been used for the scenarios. Concerning the medium and long run, the model can be characterised as a neoclassical growth model. One important modification has been made for the purpose of the ageing scenarios: In order to capture intergenerational issues the private household sector of the model has been disaggregated into working age population and retiree households, along the lines suggested by Gertler (1999). This is a generalisation to the Blanchard/Yaari life cycle framework which constitutes the standard specification in QUEST. The Gertler model can also be interpreted as a generalisation of simple overlapping generation models by allowing for realistic average lengths of life, work and retirement.

**Population Dynamics:** In the model individuals have finite lives and they go through three distinct stages of life: youth (0 - 20 years), work (21years - retirement age), and retirement (retirement age+1 - expected end of life). The number of children in period  $t$  is given by  $N_t^y$ . Each period  $bN_t^y$  children are born and average duration in childhood is  $1/(1-\lambda^y)$  where  $\lambda^y$  is the fraction of young people turning age 21. Child population dynamics is given by

$$N_{t+1}^y = bN_t^y + (1-\lambda^y)N_t^y. \quad (1)$$

The working age population in period  $t$  is given by  $N^w$ . Each period  $\lambda^y N^y$  children enter the working age population cohort. The mean duration of staying in this cohort is  $1/(1-\lambda^w)$  where  $\lambda^w$  is the fraction of the population in working age which goes into retirement within the current period. Thus the population of working age evolves over time as follows

$$N_{t+1}^w = \lambda_t^y N_t^y + (1 - \lambda_t^w) N_t^w. \quad (2)$$

There are  $N^r$  pensioners at date  $t$ . they are joined by  $\lambda^w N^w$  new retirees, while a fraction  $(1-\lambda^r)$  incumbent retirees survive to the next period. This gives the following law of motion for the retiree population

$$N_{t+1}^r = \lambda_t^w N_t^w + (1 - \lambda_t^r) N_t^r \quad (3)$$

**Households:** Consumption of retirees and workers is proportional (up to variations in real interest rates) to financial and human wealth as implied by an intertemporal CES utility function. Retiree consumption is given by:

$$C_t^r = ar(A_t^r + S_t^r) \quad (4)$$

Where  $A^r$  is financial wealth held by pensioners and  $S^r$  represents the present discounted value of pensions

$$S_t^r = \sum_{j=0}^{\infty} (1 + r_{t+j} + \lambda_{t+j}^r)^{-j} rep_{t+j} w_{t+j} (1 - tl_{t+j} - ssc_{t+j}) part_{t+j}^r N_{t+j}^r. \quad (5)$$

Notice, the finiteness of a pensioner's life is taken care of by including the probability of death in the discount rate. The higher discount rate results from a perfect annuities market (like in Yaari (1965) and Blanchard (1985)). The annuities market works as follows: each retiree turns over his wealth to a mutual fund which invests the proceeds. Those retirees which survive to the next period receive the total return, while those who die do not receive anything. Therefore the gross return of a retiree, surviving to the next period on his financial wealth is  $1 + r + \lambda^r$ . Pensions are proportional to net wages at rate  $rep_t$ , where  $tl$  is the labour tax rate and  $ssc$  is the rate of social security contributions. Only those retirees who have participated in the labour force are entitled to a pension, where the average participation rate of retirees is given by  $(part_t^r)$

Each member of the working age population<sup>1</sup> also consumes a fraction of financial ( $A^w$ ) and human wealth ( $H$ ) net of labour taxes and pension contributions. A third element entering the consumption and savings decision of workers is the value of social security payments workers can expect once they retire ( $S^w$ ).

$$C_t^w = aw(A_t^w + H_t + S_t^w) \quad (6)$$

$$\text{with } S_t^w = \sum_{j=0}^{\infty} (1 + r)^{-j} prob(ret_{t+j}) \frac{ar}{aw} \hat{S}_{t+j}^r \quad (7)$$

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<sup>1</sup> This includes consumption of children.

$S^w$  is the capitalised value of future pensions the worker can expect after retiring. This expression is composed of two terms, namely  $prob(ret_{t+j})$  which represents the probability that the worker retires in  $t+j$  and  $\hat{S}_{t+j}^r$ , the present discounted value of pensions of the average worker he can expect when he retires in  $t+j$ . Worker households evaluate future pensions with the ratio of the marginal propensity to consume in retirement and in work<sup>2</sup>. This reflects the value to a worker of being able to consume today from wealth to be received in retirement.

At each moment of time the sum of  $S^r$  and  $S^w$ <sup>3</sup> constitute the unfunded liabilities of the PAYG system. They are endogenously calculated by the model together with time paths of the interest rate and wages, given the future evolution of the retirement age, life expectancy, the participation rate and the replacement ratio.

**Firms:** The corporate sector in each region operates under perfect competition. Output is produced with a constant returns to scale Cobb Douglas production function

$$Y_t = F(K_t, L_t) \Gamma_t = K_t^{1-\alpha} L_t^\alpha (e^{\pi})^\alpha \quad (9)$$

Capital stock changes according to the rate of fixed capital formation  $J_t$  and the rate of geometric depreciation

$$K_t = J_t + (1 - \delta)K_{t-1}. \quad (10)$$

Total investment expenditures are equal to investment purchases plus the cost of installation. The unit installation costs are assumed to be a linear function of the investment to capital ratio with a parameter  $\phi$ . Total investment expenditure is therefore given by

$$I_t = J_t \left( 1 + \frac{\phi}{2} \left( \frac{J_t}{K_t} \right) \right). \quad (11)$$

In order to facilitate aggregation we interpret  $I$  as the physical requirement of a composite investment good. This composite good is composed of domestic and imported brands. These brands are combined using a CES technology which is identical to the CES sub-utility function of consumers. Workers are leaving firms at rate  $s$ . In order to recruit new workers the firm has to open up job vacancies  $O_t$  and advertise actively. The recruitment costs for each vacancy is  $v_t$  and it is assumed that it evolves proportional to the nominal wage rate at rate  $v_0$ . It is assumed that firms can fill existing vacancies within one period. Employment thus changes according to the following equation

$$L_t = O_t + (1 - s)L_{t-1}. \quad (12)$$

The corporate sector in country  $i$  maximises the net present value of its cash flow

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<sup>2</sup> This ratio is close to 2.

<sup>3</sup> Corrected for the marginal propensity to consume differential in order to obtain the pure financial burden without utility evaluation.

$$V_t = E_t \sum_{j=0}^{\infty} \prod_{k=0}^j (1+r_{t+k})^{-1} \{ (1-t_c) [Y_{t+j} - w_{t+j} L_{t+j} - v_{t+j} O_{t+j}] - (I_{t+j}^d + e_{t+j} I_{t+j}^f) \} \quad (13)$$

subject to the technology, the adjustment cost, the capital accumulation and the employment adjustment constraint. Define with  $\lambda^k$  and  $\lambda^l$  the multipliers associated with the constraint on capital and labour respectively. Differentiating the objective function with respect to  $K_{t+j}$ ,  $J_{t+j}^d$ ,  $J_{t+j}^f$ ,  $L_{t+j}$  and  $O_{t+j}$  ( $j=0,1,\dots$ ), gives the following system of stochastic Euler equations (subject to the transversality condition)

$$(1-t_c)(1-\alpha) \frac{Y_{t+j}}{K_{t+j}} = (r_{t+j} + \delta) \lambda_{t+j}^k - \frac{\phi}{2} \left( \frac{J_{t+j}}{K_{t+j}} \right)^2 - E_{t+j} [\lambda_{t+j+1}^k - \lambda_{t+j}^k] \quad (14)$$

$$\left( \phi \frac{J_{t+j}}{K_{t+j}} + 1 \right) p_t^c = \lambda_{t+j}^k \quad (15)$$

$$\left( \frac{1-\xi}{\xi} \right)^\sigma \left( \frac{I_t^d}{I_t^f} \right) = e_t^\sigma \quad (16)$$

$$(1-t_c) \alpha \frac{Y_{t+j}}{L_{t+j}} = (r_{t+j} + s) \lambda_{t+j}^l + (1-t_c) w_{t+j} - E_{t+j} [\lambda_{t+j+1}^l - \lambda_{t+j}^l] \quad (17)$$

$$\lambda_{t+j}^l = v_{t+j} (1-t_c) \quad (18)$$

Equation (14) is the equation of motion of the marginal shadow value of capital  $\lambda^k$ . Equation (15) is the first order condition for total investment and it implies that the cost of a marginal unit of capital, including both its purchase and adjustment costs, must equal the shadow value of capital  $\lambda^k$ . The cost of capital includes both the pure rental price and adjustment costs. Equation (16) determines the optimal choice of domestic and foreign investment goods as a function of the relative price. Equations (17) and (18) define the law of motion of the shadow value of labour and show that labour demand is a positive function of output and negative function of total labour costs. Because it is costly for firms to fill existing vacancies, total labour costs are the sum of pure wage costs and vacancy costs. It will be assumed in our analysis that vacancy costs are proportional to wages at rate  $v_0$ .

**Labour Market:** Unlike in the goods market we assume imperfect competition in the labour market in both countries. Here we follow closely the search model discussed in Pissarides (1990). The basic incentive for search activities in the labour market by both workers and firms are the profit opportunities in present value terms which are associated with a successful job match for both parties. In the case of households, this is given by the difference between the present value of labour income a household can earn in the case of a successful current job match, versus the net present value of labour income in the presence of a failure, given by  $(H^l - H^u)$ .

Here we observe that the human capital of employed and unemployed households which we denote with  $H^l$  and  $H^u$  respectively is given by two arbitrage equations. The return from the human capital of an employed worker consists of three components: the current net wage rate, the expected capital loss from a job separation given by  $s(H^l - H^u)$ , where  $s$  is an exogenous separation rate, and the expected capital gain from an expected change in  $H^l$ .

$$(\pi + r_t) H_{t,z}^l = (1-t_l) w_t + s(H_{t,z}^u - H_{t,z}^l) + E_t [\Delta H_{t+1,z}^l] \quad (19)$$

Corresponding to this equation we can write an arbitrage equation for the human capital of an unemployed household as

$$(\pi + r_t)H_{t,z}^u = z_t + p(\cdot)(H_{t,z}^l - H_{t,z}^u) + E_t[\Delta H_{t+1,z}^u] \quad \text{where } p(\cdot) = O_t/(1 - L_t) \quad (20)$$

The return in this case consists of unemployment benefits, the expected capital gain from finding a job with probability  $p(\cdot)$ , and a capital gain from any expected change of  $H^u$  itself. Since we make the assumption that firms can fill vacancies within one period the probability of finding a job is equal to the ratio between vacancies and the number of unemployed workers. For the firm, the return from a successful job match is given by  $\lambda^l$ .

We assume that each firm employs many workers and is large enough to eliminate all uncertainty about the flow of labour. Both parties also know about the profit opportunities of the other players. Wages are determined by an implicit bargain at the individual level, *i.e.* the firm engages in Nash bargains with each individual worker by taking the wage of all other employees as given. Thus wage contracts are set such as to maximise the product

$$\underset{\{w_t\}}{\text{Max}} (H_t^l - H_t^u)^\beta (\lambda_t^l)^{(1-\beta)} \quad (21)$$

This agreement is based on the relative bargaining position of the two parties. The bargaining strength of workers is characterised by the parameter  $\beta$  ( $0 \leq \beta \leq 1$ ) which determines the fraction of the total return from a successful job match going to workers. Maximising (26) with respect to  $w_t$  yields the familiar sharing rule for the division of the surplus where the fraction of the total surplus from a job match going to the worker depends on his bargaining strength

$$H_{t,z}^l - H_{t,z}^u = \beta (H_{t,z}^l - H_{t,z}^u + \lambda_t^l). \quad (22)$$

Using this sharing rule the following wage equation can be derived

$$w_t = (1 - \beta) \frac{z_t}{(1 - t_l)} + \beta \left( \alpha \frac{Y_t}{L_t} + v_t \frac{\Delta L_t + sL_{t-1}}{1 - L_t} \right). \quad (23)$$

According to this rule, wage costs are a weighted average of the reservation wage and labour productivity plus an additional mark-up term that depends positively on labour market tightness. From this wage rule together with the labour demand equation it can easily be seen that, the gross wage rate is set by workers and firms in such a way as to guarantee a certain mark-up of net wages over unemployment benefits. The mark-up will generally depend on economic conditions such as the unemployment rate for example but also on structural characteristics of the labour market such as adjustment costs for labour, the bargaining strength of trade unions etc<sup>4</sup>.

The government pays unemployment benefits and consumes domestic and foreign goods ( $G_t^d, G_t^f$ ). It finances these expenditures by labour income and company taxes, indirect taxes on consumption and lump-sum taxes. The tax rates on wages ( $t_l$ ) and corporate income ( $t_c$ ) as well as the consumption tax rate ( $t_v$ ) are assumed to be constant. Alternatively, the government can issue debt. Thus the government budget constraint is given by

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<sup>4</sup> It should be pointed out that this formulation is not restricted to union bargaining models but is a feature of many labour market models. Search models and efficiency wage models of the labour market imply similar wage rules. For an exposition see, for example, Pissarides (1995).

$$B_{t+1} = (1 + r_t)B_t + (1 - L_t)z_t + G_t^d + e_t G_t^f + T_t - t_l w_t L_t - t_c (Y_t - w_t L_t - v_t O_t) - t_v (C_t^d + e_t C_t^f) \quad (24a)$$

The government also manages the PAYG system. Given the replacement rate, the rate of pension contributions ( $ssc$ ) are set each period in such a way that

$$ssc_t w_t L_t = rep_t w_t (1 - tl_t - ssc_t) part_t^r N_t^r \quad (24b)$$

Lump sum transfers are adjusted proportionally to the gap between the debt to GDP ratio and its target level  $b_0$  according to the following rule

$$\Delta T = -\psi_1 \left( \frac{B_t}{Y_t} - b_0 \right) - \psi_2 \left( \frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} \right). \quad (25)$$

The government fixes its consumption as a share of GDP at rate  $g_0$  and consumes domestic and foreign goods by maximising the same CES sub-utility function as consumers. Government consumption of domestic and foreign goods is thus determined by the following equation

$$\left( \frac{1 - \xi}{\xi} \right)^\sigma \left( \frac{G_t^d}{G_t^f} \right) = e_t^\sigma. \quad (26)$$

**Equilibrium:** The market clearing conditions for the goods market in country 1 and 2 are

$$Y_{1t} = C_{1t}^d + C_{2t}^f + I_{1t}^d + I_{2t}^f + G_{1t}^d + G_{2t}^f \quad (27)$$

$$Y_{2t} = C_{2t}^d + C_{1t}^f + I_{2t}^d + I_{1t}^f + G_{2t}^d + G_{1t}^f. \quad (28)$$

All bonds and equity supplied by the domestic government and the corporate sector are held by domestic households. The market clearing condition for internationally traded bonds is

$$F_{1t} + F_{2t} = 0. \quad (29)$$

Output prices in both countries serve as numéraire. The competitive equilibrium of this economy consists of a sequence of prices  $(r_t, r_t^*, e_t)$  and allocations  $(C_{it}^d, C_{it}^f, I_{it}^d, I_{it}^f, G_{it}^d, G_{it}^f, K_{it}, F_{it}, B_{it})$  that satisfy the first order conditions of households and firms, the budget constraints of households, governments and firms and goods and bond market equilibrium conditions. Real wages ( $w_{it}$ ) are determined by the wage contracting rule (23) and firms set employment optimally according to the first order condition (17-18). The labour market equilibrium can coexist with involuntary unemployment. Furthermore, the evolution of the economy is subject to initial conditions  $(K_{i0}, L_{i0}, F_{i0}, B_{i0})$  and a sequence of fiscal instruments  $(t_r, t_l, t_c, t_v, b_0, g_0)$  as well as a rule that ensures sustainability of government debt. Interest rates, wages and the exchange rate also ensure that an intertemporal equilibrium condition holds between national saving and investment in both countries. Technical details concerning model solution can be found in Roeger and In't Veld (1999).

## Model Calibration

In order to assess some basic predictions of the model against observed correlation patterns we calibrate the model for two regions, namely the US and Europe (EU15). To select parameter values we largely follow standard procedures, i.e. we base these values on evidence from growth observations and some microeconomic evidence. In cases where this is not possible parameters are chosen close to those of existing studies. The rate of time preference  $\theta$  is set equal to 0.01, which implies a steady state annual rate of interest equal to 4%. The probability of death  $\pi$  is set to 0.0035, which corresponds to a life expectancy of 70 years. The output elasticity of labour is set equal to the average wage share. The depreciation rate is set to 2% per quarter which corresponds to the mean rate in our data set over the sample period. The adjustment cost parameter is more difficult to pin down on the basis of information on first moments only. It has, however, been noticed before (see, for example, Mendoza (1991)) that the parameter  $\phi$  has a crucial effect on the volatility of investment. It is therefore set in such a way as to make investment about 3 times as volatile in the US and twice as volatile in Europe. With respect to the separation rate  $s$  we draw on information provided by Layard et al. (1990) from data on gross labour market flows. According to their figures the inflow rate into unemployment fluctuates narrowly around two per cent for the reported European countries per quarter. For the US they obtain an estimate of 6.6% per quarter. Our assumption that vacancies can be filled within a quarter is based on studies on vacancy duration. A study by van Ours and Ridder (1992) reports average vacancy durations of 45 days for the Dutch economy. Similar estimates can be found for Germany (see Erdmann (1990)). Blanchard and Diamond (1989) report durations of less than one month for the US. The parameter  $\beta$  referred to as the bargaining strength of workers is set to .5. This implies that all relevant differences between the two parties are captured by the two terms  $(H_t^l - H_t^u)$  and  $\lambda_t^l$  (see Binmore, Rubinstein and Wolinsky (1986) for a discussion of the symmetry axiom).

**Table 1. Parameter Values**

	Europe	US	
Utility Function:			
$\theta$	0.01	0.01	Rate of time preference
$\sigma$	1.0	1.0	Import price elasticity
$\xi$	0.9	0.9	Share of domestic goods
Technology:			
$\alpha$	0.65	0.65	Output elasticity of labour
$\delta$	0.02	0.02	Depreciation rate
$\phi$	8.0	5.0	Adjustment cost parameter (investment)
Labour market:			
$s$	0.015	0.066	Separation rate
$\beta$	0.5	0.5	Bargaining strength of workers
$z_0$	0.40	0.20	Replacement ratio
$v_0$	0.13	0.09	Vacancy cost (as share of wages)
Fiscal Parameters			
$t_p$	29%	35%	Effective Corporate Tax Rate
$t_l$	41%	27%	Effective Labour Tax Rate
$t_c$	14%	4%	Effective Consumption Tax Rate

$t_r$	0	0	Taxes on Interest Income
$g_0$	21%	20%	Government Consumption (% of GDP)
$\psi_1$	0.025	0.025	Debt targeting rate
TR/Y	19%	9%	Government Transfers (% of GDP)

The level of unemployment compensation determines the reservation wage. Unfortunately, internationally comparable figures on unemployment compensation are not easy to obtain, since countries do not only differ with respect to the replacement ratio but also with respect to benefit duration and coverage. To cover all these different aspects, Layard et al. (1990) have calculated expenditures on benefits per unemployed person as a per cent of output per worker for major OECD countries for the year 1987. According to these figures the ratio within Europe is highest for Denmark (42%) and lowest for Italy (4%) and no calculations are presented for Portugal and Greece. The European average is slightly below 20%. We therefore assume that unemployment benefits amount to roughly 40% of gross wages. The figures for the US suggests that the US replacement ratio is about half the European level. Given the fact that all other parameters have been chosen, the parameter  $vc_0$  can be selected such that the model replicates the steady state unemployment rate in both countries.

We set the price elasticity of imports in both regions equal to one. A value in this neighbourhood can often be found in empirical studies on import and export equations. The share of imports in total GDP is set to 10% in both regions, which is the mean value over the period 1975 to 1992 for the US and the extra EU trade. Finally, the labour and wage tax rates are taken from Mendoza *et al.* (1994).

### **3. EMPIRICAL ASSESSMENT OF SELECTED PENSION REFORM OPTIONS**

#### **3.1 DESCRIPTION OF BASELINE GROWTH AND PENSION EXPENDITURE SCENARIO FOR 2000-2050**

In order to provide an appropriate reference framework for the pension reform simulations, it is important to describe the key assumptions on which the models baseline scenario is based and the impact of these assumptions in terms of the overall growth, pension expenditure and income distribution effects of ageing populations.

In terms of the assumptions used, the demographic context for the baseline scenario is provided by Eurostats population projections to 2050, which were specially prepared in 2000 for the EPC for their ageing analysis. According to these projections, the dependency ratio will rise from currently .24 to .49 in 2050. In terms of future labour force developments, the baseline assumes that participation rates will stay at their 2000 levels over the next 50 years and that there are no further reductions in the effective retirement age which is consequently predicted to remain at close to 60 over the period.

The model also makes important assumptions regarding the generosity of the pension system. In this regard, in calculating pension expenditure as a % of GDP, it is well known that the key determinants are the old age dependency ratio and the generosity of the pension system, as

measured by the pension income replacement ratio relative to wages in employment. Because of the many difficulties in calculating this replacement ratio it was decided to work back from the pension expenditure figures for 2000 provided by the Member States in the EPC's Working Group. Using the EPC's expenditure to GDP ratio for the EU as a whole of around 10 1/2% in 2000 and using the models old age dependency ratio would imply a net replacement ratio (NRR) for the EU of about 74% in 2000 which is equivalent to a gross replacement ratio of 54%. This 20% points difference between the gross and net concepts reflects the much higher taxation levels on workers compared with pensioners, with the NRR of the EU as a whole assumed in the baseline to stay at its 2000 level of 74% for the next 50 years.

What are the economic and budgetary implications of these demographic and pension generosity assumptions over the simulation period. As shown in Graph 1, the models baseline scenario assumes a fall in the level of GDP in the EU over this period of 19%<sup>5</sup>, with pension expenditure as a % of GDP rising by 7% points to 17 1/2% of GDP. This rise in pension expenditure is due uniquely to the rise in the old age dependency ratio since the generosity of the system is kept constant at its 2000 level. In terms of the burden of ageing on workers, the doubling in the old age dependency ratio is forecast to increase the taxation burden significantly, with social security contributions (as a % of wages) needing to rise from 16% in 2000 to nearly 27% in 2050 in order to meet the pension expenditure obligations operating under the PAYG system. Given the dramatic deterioration in the financing costs of the public pension system, as represented by the nearly 70% increase in the rate of SSC's paid by workers and the equivalent hike in pension expenditure commitments of governments to 17 1/2% of GDP, it is not surprising to find that the overall implicit debt of the PAYG system rises dramatically over the period from a figure of about 180% in 2000 to 280% in 2050.

Table 2: **Baseline scenario**

	<b>Growth</b>	<b>Budgetary Impact</b>		<b>Income Distribution</b>	
	<b>GDP per capita*</b>	<b>Social security contributions (% of Wages)</b>	<b>Pension expenditure (% of GDP)</b>	<b>Working age population consumption*</b>	<b>Pensioners consumption*</b>
<b>2000</b>	0	16.1	10.5	0	0
<b>2030</b>	-12.0	22.9	15.0	-11.9	-15.5
<b>2050</b>	-19.0	26.9	17.6	-19.5	-19.6

*Source:* Commission services.

\* Compared with a technical scenario where no "ageing" is assumed i.e. the population trends evident in the most recent decades are simply extrapolated forward.

As well as the growth and budgetary implications of ageing, the baseline also contains important information in terms of the evolution of the internal rates of returns of both the PAYG and funded systems over the coming decades (this is discussed in more detail later on in the section).

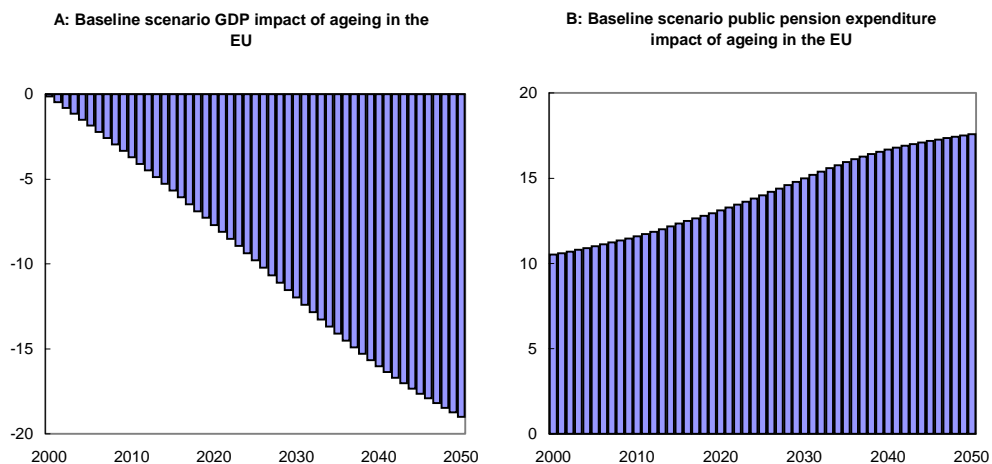
- With regard to the PAYG system, while real wages are expected to rise slightly, reflecting changes in relative factor endowments, the growth in the wage bill is expected to decline due to the demographically induced fall in the number of people employed.

<sup>5</sup> This result is very similar to that reported in the "1999 Review" based on Eurostat's 1996 population projections for the period 2000-2050. This similarity in terms of the GDP loss associated with ageing is not that surprising however given that, while individual EU country population projections have in some cases changed quite significantly between the 1996 and 2000 Eurostat exercises, the population projections for the EU15 as a whole have remained very similar, in terms of both the overall population total and its decomposition into the various age cohorts.

- As regards the return on funded schemes, the real interest rate is expected to decline over the period but not significantly, with rates of return only falling from 5 1/2% to 5 1/4%. With regard to the real interest rate, it is important to underline that movements in the latter reflect developments in terms of both the supply and demand for funds, with overall national savings as a % of GDP forecast to decline in the baseline due to falls in private savings<sup>6</sup>, but with the demand for savings also falling due to the expected decline in GDP growth rates. In overall terms therefore it is projected that the rate of return differential enjoyed by funded schemes compared with the PAYG system over the last number of decades is likely to persist over the simulation horizon to 2050, with a differential in favour of funding of the order of 3 1/4 to 3 1/2 percentage points predicted by the model over the coming decades.

Finally in terms of income distribution, the baseline scenario to 2050 assumes that the working age population and pensioners will both be affected to the same extent by the ageing phenomenon.

Graph 1: Baseline scenario 2000-2050



Source: Commission services.

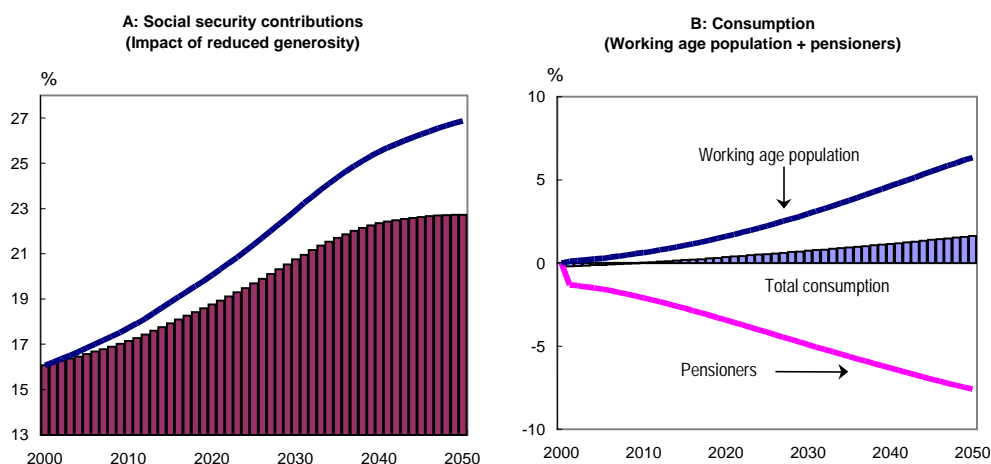
## 3.2 ASSESSMENT OF PARAMETRIC REFORMS

### ***Reductions in generosity (replacement rate) achieved via a partial shift from wage to price indexation***

Here we ask the question by how much key economic variables would be affected by reducing the generosity of the pension system. A recent survey of the Economic Policy Committee (EPC) among member states finance ministries (reference) suggests that on average a reduction of the of the pension expenditure to GDP ratio of about 2.5% points in 2050 will be achieved via a reduction in the benefit ratio. In order to reduce the increase in pension expenditure by 2 1/2% points, as suggested in the EPC's simulations for the next 50 years, EU governments according to the model would have to cut the net replacement rate (NRR) of the system from its present level of 74% down to 58% in 2050.

<sup>6</sup> The consumption to GDP ratio rises in the baseline due to the higher marginal propensity to consume (MPC) of retirees, with the share of retirees in the overall population rising steadily throughout the period. This lower propensity to save on behalf of the elderly is an important factor in preventing a large decline in real interest rates.

Graph 2: Cut in pension generosity



Source: Commission services.

This NRR figure of 58% would still be considered by many commentators to be generous and of course only reflects the proportion of retirement income coming from the public PAYG system since it does not include private pension provision<sup>7</sup>. In the present simulation, the reduction in generosity assumed by the EPC could be achieved in a large number of ways including cutting benefits directly, changes in the eligibility criteria, such as the number of years needed for full pension entitlement, or by changes to the rules applied with regard to indexation. For simplicity it is assumed that all of the decrease in generosity, to a NRR of 58%, is achieved through a movement on behalf of public pension schemes towards some form of price indexation. As an additional simulation showed, however, this drop of 16% points in the NRR is not equivalent to a shift to full price indexation. Full price indexation would in fact result in the net replacement rate falling to 45% which therefore implies that relative to our baseline assumption of no change in the NRR over the next 50 years, that the present "reform" efforts in terms of the generosity of the PAYG system are equivalent to the introduction of a "hybrid" form of indexation, hybrid in the sense that Governments may not wish to go for full price indexation but instead may have decided to partially retain the link between pensions and wage developments.

What are the budgetary, economic and income distribution consequences of such a significant decline in the net replacement ratio. In terms of the budgetary consequences, would a move from a system assuming 100% real wage indexation to a hybrid wage/price system or more dramatically a move to full price indexation lead to a stabilisation of the pension system in terms of social security contributions (SSC's). In terms of SSC's, a move to a hybrid index would have the effect that the increase in SSC's as a % of wages will be about 4% points less in 2050 than in the baseline scenario, whereas even with full price indexation while SSC's will fall by 8% points relative to the baseline, there would still be an increase in contributions from 16% to 18 ½% of wages. Consequently, while the budgetary gains are significant, stabilisation of the EU's PAYG pension system would not appear to be achievable solely by shifting from a system which is 100% indexed to wages to one based exclusively on prices.

<sup>7</sup> Figures published in 2000 by the European Commission's Directorate General for the Internal Market (DG Markt) suggest that PAYG pensions represent roughly 88% of all pensions in the EU, although the country variation is quite large, especially for countries such as the UK and the Netherlands which have a much higher proportion of private pension provision compared with the EU average and in fact have levels closer to those of the US. This indicative breakdown of pensions into public and private provision is corroborated by recently published OECD figures for a number of EU Member States (see OECD 2001c).

In addition, as one can see from Table 3, a decline in the generosity of the PAYG pension system, equivalent to a move to a hybrid indexation system, will have an insignificant impact in terms of living standards, with the fall in the replacement ratio only marginally offsetting the GDP loss associated with ageing. The 2% increase in GDP relative to the no reform baseline comes from labour and capital. Because of the decline of social security contributions employment increases by about 1%. Such an employment response would be consistent with recent estimates on the effect of taxation on unemployment by Daveri and Tabellini (2000). Not included in the employment response are changes participation possibly induced by a reduction in pension generosity. Private provision for retirement and thus savings will increase, which in turn leads to more capital accumulation. However, only about a fifth of the 26% increase in total financial assets is invested domestically. Thus the contribution from capital to GDP does not exceed 1%. Though the savings rate increases it will not be sufficient to stabilise the standard of living of pensioners. Pensioners consumption is expected to fall by over 7 ½% over the period.

Table 3: Cut in pension generosity

	Growth	Budgetary Impact		Income Distribution	
	GDP per capita (% Diff. from baseline)	Social security contributions (% of Wages)	Pension expenditure (% of GDP)	Working age population consumption (% Diff. from baseline)	Pensioners consumption (% Diff. from baseline)
2000	0	16.1	10.5	0	0
2030	+1.1	20.7	13.6	+3.0	-4.9
2050	+2.1	22.7	14.9	+6.4	-7.6

Source: Commission services.

### ***Increase in retirement age***

In this retirement simulation, the effective retirement age, which is presently close to 60 in the EU, is brought back up to the average statutory retirement age of 65 gradually over the next 10 years. Part of the rationale for this simulation is the fact that since the 1960's there has been an enormous deterioration in the so-called passivity ratio which measures the number of years worked relative to the number of years spent in retirement. In the 1960's the passivity ratio was over 4 ¼<sup>8</sup> but by 2000 this ratio had fallen to less than 3 due to increases in life expectancy and falls in the effective retirement age to less than 60.

As graph 3a shows, by bringing back the retirement age to 65, the passivity ratio is expected to improve over the next 10 years but to deteriorate again over subsequent decades. This pattern of change over the next 5 decades is driven by two essential factors : firstly, the projected improvement in participation rates and structural unemployment assumed in the EPC's scenario which will impact strongly only in the period up to 2010 and secondly, the ongoing increase in life expectancy over the period as a whole. Under the retirement simulation the number of years spent in work rises to the 1960's level of 45 which unfortunately is still insufficient to stabilise the passivity ratio. The latter objective can only be achieved if governments were to link the retirement age to changes in life expectancy.

<sup>8</sup> In other words workers spent 4 ¼ years in employment for every 1 year spent in retirement.

Table 4: Increase in effective retirement age to 65

	Growth	Budgetary Impact		Income Distribution	
	GDP per capita (% Diff. from baseline)	Social security contributions (% of Wages)	Pension expenditure (% of GDP)	Working age population consumption (% Diff. from baseline)	Pensioners consumption (% Diff. from baseline)
2000	0	16.1	10.5	0	0
2030	8.7	18.3	12.0	+5.2	+13.8
2050	13.1	20.5	13.4	+10.8	+16.3*

*Source:* Commission services.

\* Given that pensioners do not receive any additional pension entitlements from working five extra years, this higher level of consumption relative to workers simply reflects the fact that life cycle consumers will have a shorter period over which to consume their accumulated lifetime wealth.

From the graphs shown for the retirement simulation, it is clear that an increase in the effective retirement age (ERA) to the statutory age has major benefits in terms of growth and budgetary sustainability, as well as being relatively favourable with regard to income distribution.

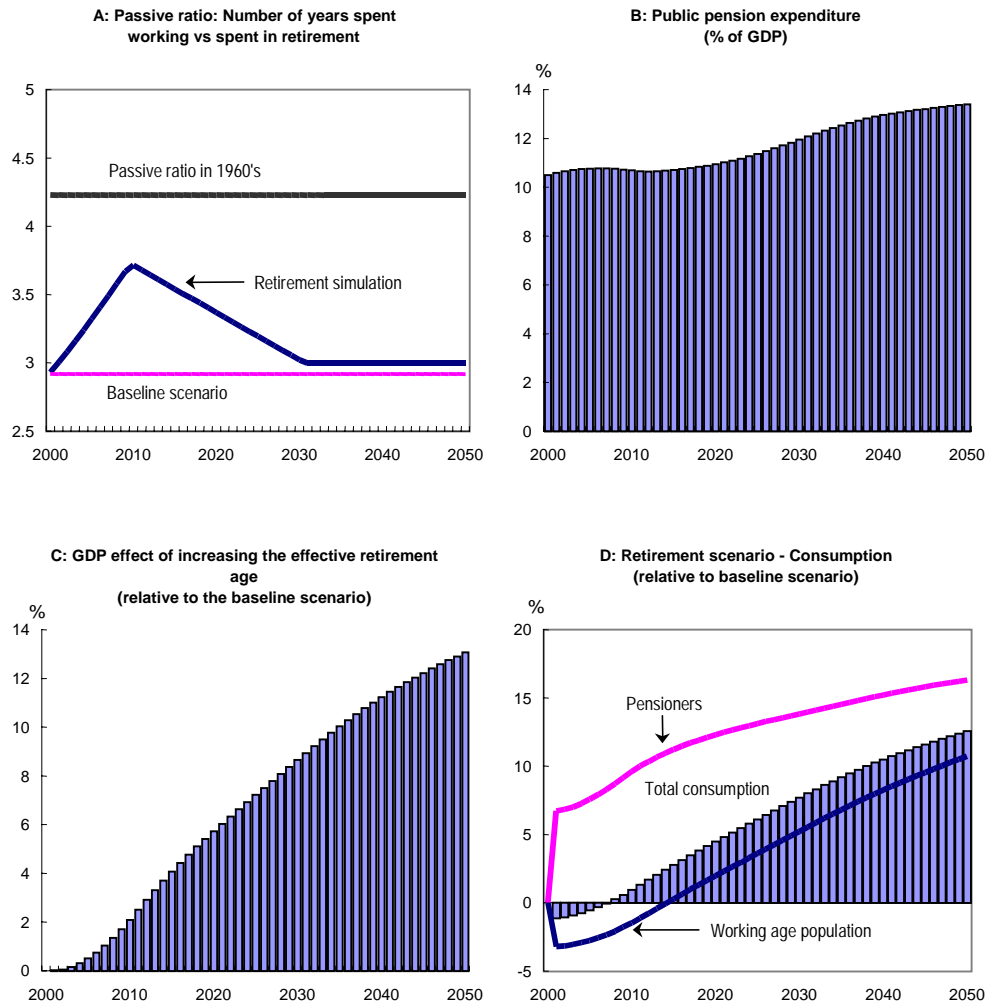
In terms of budgetary developments, the impact is quite dramatic with the increased burden on workers over the period, in terms of SSC's, being reduced to 4 ½% points versus 11% points in the baseline and with an equivalent strong improvement in terms of public expenditure on pensions which would fall by over 4% points in 2050 compared with the baseline. As a rough rule of thumb the public expenditure impact of an increase in the ERA is of the order of 1 to 1 (i.e. if workers were to work, on average, one additional year before retiring, the increase in public expenditure on pensions over the period to 2050 would be reduced by 0.84 of a % point of GDP). This strong budgetary gain is however predicated on the assumption that any additional years in employment do not yield any additional pension benefits<sup>9</sup>.

In addition to the very favourable public finance impact, the increase in the average working life also appears to simultaneously meet the other key policy objectives of boosting growth and avoiding big changes in income distribution which in the longer term could call into question the political sustainability of any pension reforms which have been set in place. In terms of GDP, the increase in the retirement age has a significant effect on the level of GDP, with the latter growing by over 13% compared with the baseline, thereby on its own going a long way towards offsetting the GDP loss associated with ageing.

Finally, as shown in graph 3D, this parametric reform is also relatively good from an income distribution perspective, with the consumption of both the working age population and pensioners rising relative to the baseline.

<sup>9</sup> This assumption is crucial since in a separate simulation based on an actuarially fair adjustment of pensions to reflect the increased number of contribution years, the budgetary gain from an additional year of work falls from 0.84% to 0.6% while the GDP gain stays roughly the same as in the main simulation. This simulation assumes that for the extra five years worked that the generosity of one's annual pension would increase by about 12% relative to what it would otherwise have been but pensioners will receive this higher pension for, on average, five years less than in the baseline scenario. Consequently, while the fiscal gain is reduced it still remains relatively substantial.

### Graph 3 Retirement scenario - increase in the effective age to the statutory level of



Source: Commission services.

## 4. SUMMARY AND CONCLUSIONS

This paper has provided a quantitative assessment of various pension reform issues. Simulations for the EU15 as a whole give an idea of the magnitude of the impact of some selected pension reforms as well as their simultaneous impact on a range of economic variables. In particular, the simulations focussed on the effects on economic growth, the sustainability of public finances and the income distribution consequences in terms of the differential impact of the various pension reforms on the working-age population and on pensioners.

In terms of parametric reforms, a number of individual and combined reform scenarios were assessed. Regarding the individual reforms, the impact of two options were analysed: namely (i) a reduction in the generosity of the PAYG pension system brought about through changes in the systems replacement ratio and (ii) an increase in the retirement age. With regard to reductions in generosity, while such a reform option provides clear budgetary gains, less success is discernible in terms of easing the growth loss associated with ageing and income distribution difficulties are evident. No such problems exist with the retirement age simulation which suggests large gains in

terms of growth (i.e. a gain of over 13% relative to the baseline), budgetary sustainability and income distribution. With regard to the fiscal gain, the retirement simulation suggests that the public expenditure impact of an increase in the effective retirement age is of the order of 1 for 1 (i.e. for each additional year worked before retiring, the public expenditure impact on pensions is reduced by close to 1 percentage point of GDP).

## 5. REFERENCES

- ABEL, A. (1999), 'The Social Security Trust Fund, the Riskless Interest Rate and Capital Accumulation', NBER Working Paper No. 6991.
- ABEL, A. (2000), 'The Effects of Investing Social Security Funds in the Stockmarket when Fixed Costs prevent some Households from Holding Stocks', NBER Working Paper No. 7739.
- BARR, N. (2000), 'Reforming Pensions: Myths, Truths, and Policy Choices', IMF Working Paper, WP/00/139, International Monetary Fund.
- BLÖNDAL S. AND S. SCARPETTA (1999), 'Early Retirement in OECD Countries: the Role of Social Security Systems', Economic Studies No. 29, OECD.
- BOHN, H (2001), 'Retirement Savings in An Aging Society: A Case for Innovative Government Debt Management', CESifo Working Paper, No. 494, Munich, www.CESifo.de.
- BROOKS R. (2000), 'What Will Happen to Financial Markets when the Baby Boomers Retire?', IMF Working Paper, WP/00/18, International Monetary Fund.
- BROOKS R. (2001), 'Population Aging and Global Capital Flows in a Parallel Universe', IMF Working Paper No. 151.
- BÖRSCH-SUPAN A. H. AND J. K. WINTER (2001), 'Pension Reform, Savings Behaviour, and Corporate Governance', Mannheim discussion paper (forthcoming).
- BÖRSCH-SUPAN A. H. AND R. SCHNABEL (1997), 'Social Security and Retirement in Germany', NBER Working Paper No. 6153.
- DANG, T., P. ANTOLIN AND H. OXLEY (2001), 'Fiscal Implications of Ageing : Projections of Age-Related Spending", OECD Working Paper No. 305.
- DAVIS, E.P. (1995), 'Pension Funds : Retirement, Income Security and Capital Markets, An International Perspective", Clarendon Press, Oxford.
- EUROPEAN COMMISSION (1999a), Communication 'Towards a Single Market for Supplementary Pensions', COM (1999)134.
- EUROPEAN COMMISSION (1999b), 'The EU Economy : 1999 Review".
- EUROPEAN COMMISSION (2000a), Progress Report to the ECOFIN Council on 'The Impact of Ageing Populations on Public Pension Systems', Working Group on the Implications of Ageing Populations of the Economic Policy Committee, EPC/ECFIN/581/00-EN.rev1.
- EUROPEAN COMMISSION (2000b), Study on 'Pension Schemes of the Member States of the European Union', DG MARKT, May 2000.
- EUROPEAN COMMISSION (2000c), Proposal for a Directive on 'The Activities of Institutions for Occupational Retirement Provision', COM (2000)507.
- EUROPEAN COMMISSION (2000d), Communication on 'The Future Evolution of Social Protection from a Long-term Point of View: Safe and Sustainable Pensions', COM (2000)622.

- EUROPEAN COMMISSION (2000e), Communication on 'The Contribution of Public Finances to Growth and Employment: Improving Quality and Sustainability', COM (2000)846.
- EUROPEAN COMMISSION (2001a), Communication on 'The Elimination of Tax Obstacles to the Cross-Border Provision of Occupational Pensions', COM(2001)214.
- EUROPEAN COMMISSION (2001b), Budgetary Challenges Posed by Ageing Populations: The Impact on Public Spending on Pensions, Health Care for the Elderly and Possible Indicators of the Long-Term Sustainability of Public Finances, Report of the Working Group on Ageing Populations to Economic Policy Committee, European Economy, Reports and Studies (forthcoming).
- FELDSTEIN, M. AND J.B. LIEBMAN (2001), 'Social Security', chapter for forthcoming Handbook of Public Economics, NBER Working Paper No. 8451.
- FRANCO, D. (1995), "Pension Liabilities - Their Use and Misuse in the Assessment of Fiscal Policies", ECFIN Economic Paper No. 110.
- FRANCO, D. AND T. MUNZI (1997), 'Demography and the Welfare State', European Economy, Reports and Studies, No.4.
- FREDERIKSEN, NILS KLEIS (2001), 'Pension Funding, Fiscal Sustainability and Government Debt', Danish Ministry of Finance (a mimeo).
- GERTLER, M. (1999). Government Debt and Social Security in a Life Cycle Economy. Carnegie-Rochester Conference Series on Public Policy Vol. 50. Pp. 61-110.
- GROUP OF TEN (1998), 'The Macroeconomic and Financial Implications of Ageing Populations, Bank for International Settlements, the BIS web-site.
- GRUBER J. AND D. A. WISE (1999), 'Different Approaches to Pension Reform from an Economic Point of View', a paper presented at the NBER conference on 'Social Security Pension Reform in Europe', 20-21.3.2000, the NBER web-site.
- HOLZMANN, R. (1997), 'On Economic Benefits and Fiscal Requirements of moving from Unfunded to Funded Pensions', European Economy, Reports and Studies, No.4.
- HOLZMANN, R. (1999), 'The World Bank Approach to Pension Reform', the World Bank web-site.
- KANE, C. AND R. PALACIOS (1996), 'The Implicit Pension Debt', Finance and Development, June.
- KOPITS, G. (1997), 'Are Europe's Social Security Finances Compatible with EMU', IMF Paper on Policy Analysis and Assessment.
- KOTLIKOFF, L., K. SMETTERS AND J. WALLISER (2001), 'Finding a Way out of America's Demographic Dilemma', NBER Working Paper No. 8258.
- LATULIPPE, D. (1996), 'Effective Retirement Age and Duration of Retirement in the Industrial Countries between 1950 and 1990', Issues in Social Protection, Discussion Paper No. 2, ILO.
- LINDBECK, A. (2000), 'Pensions and Contemporary Socioeconomic Change', A paper presented at the NBER conference on 'Social Security Pension Reform in Europe', 20-21.3.2000, the NBER web-site.
- MC MORROW, K. AND W. ROEGER (1999), "The Economic Consequences of Ageing Populations - A Comparison of the EU, US and Japan", ECFIN Economic Paper No. 138.
- MILES, D. AND A. TIMMERMANN (1999), 'Risk Sharing and Transition Costs in the Reform of pension systems in Europe', Economic Policy, No.29.
- MODIGLIANI, F., M.L. CEPRI AND A.S. MURALIDHAR (2000), 'A Solution to the Social Security Crisis', Sloan Working Paper No.4051.

- MERRILL LYNCH (2000), 'Demographics and the Funded Pension System'
- MERRILL LYNCH (2001), 'Progress Report European Pension Reforms'
- MURTHI, M., J. M. ORSZAG AND P. R. ORSZAG (2001), 'Administration Costs under a Decentralised Approach to Individual Accounts : Lessons from the United Kingdom', in Holzmann R. and J. Stiglitz (eds.), "New Ideas About Old Age Security", the World Bank.
- OECD (1998), 'Maintaining Prosperity in an Ageing World', Paris.
- OECD (2000a), 'Reforms for an Ageing Society', Paris.
- OECD (2000b), 'Institutional Investors Statistical Yearbook', Paris.
- OECD (2001a), 'Economic Outlook 2001', Paris.
- OECD (2001b), 'Fiscal Implications of Ageing: Projections of Age-Related spending', a work document for the Working Party No. 1 on Macroeconomic and Structural Policy Analysis, ECO/CPE/WP1(2001)1.
- OECD (2001c), 'Net Social Expenditure', DEELSA/ELSA/WD(2001)5.
- OECD (2001d), 'Private Pensions Systems: Administrative Costs and Reforms', Private Pensions Series, No. 2, Paris.
- OECD (2001e), 'Taxing Pensioners: A Study of Nine OECD Member Countries', a work document for the Working Party No. 2 on Tax Policy Analysis and Tax Statistics, DAF/CFE/WP2(2001)9
- OKSANEN, H. (2001a), 'A Case for Partial Funding of Pensions with an Application to the EU Candidate Countries', Economic Paper No. 149, DG ECFIN, European Commission.
- OKSANEN, H (2001b), 'Pension Reforms for Sustainability and Fairness', CESifo Forum (forthcoming).
- ORSZAG J. M. AND P. R. ORSZAG (2000), 'The Benefits of Flexible Funding: Implications for Pension Reform in an Uncertain World', A paper presented in the World Bank conference on 20.4.2000, the World Bank web-site.
- ORSZAG P. R. AND J. E. STIGLITZ (1999), 'Rethinking Pension Reform: Ten Myths about Social Security Systems', in Holzmann R. and J. Stiglitz (eds.), 'New Ideas about Old Age Security', the World Bank.
- ROEGER, W. AND J. IN'T VELD (1997), "Quest II - A multi country business cycle and growth model", ECFIN Economic Paper No. 123.
- ROEGER, W. (2000) "Ageing and Fiscal Sustainability in Europe". In Banca d'Italia: Fiscal Sustainability, pp. 255-286.
- SINN H-W. (2000), 'Why a Funded Pension System Is Useful and Why It Is Not Useful', International Tax and Public Finance, 7/2000, p. 389-410.
- VAN DEN NOORD, P. AND R. HERD (1993), "Pension Liabilities in the Seven Major Economies", OECD Working Paper No.142.
- VISCO, I. (2001), 'Paying for Pensions: How Important Is Economic Growth?', Banca Nazionale del Lavoro Quarterly Review, No. 214, March.
- THE WORLD BANK (1994), 'Averting the Old Age Crisis, Policies to Protect the Old and Promote Growth'.