Social security reforms and early retirement*

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Abstract

In order to stimulate labor market participation and improve the financial viability of the social security systems, many recent reform proposals in various OECD economies suggest to scale down the non-actuarial parts of the pension systems. These reforms have a flavour of increased efficiency at the costs of welfare losses for low income individuals. Investigating such a belief, we employ an overlapping generations model which features an endogenous retirement age and heterogenous individuals within generations. Based on a simple theoretical version of the model we demonstrate that high income individuals are likely to gain. The sign of the welfare effect for low income households is ambiguous because we do not know whether the effect of lower pension benefits is offset by the effect of a reduced tax-burden. Employing an extended CGE version of the model, which is calibrated to the Norwegian economy, we consider five reform proposals. It turns out that the various reforms which scale down the public non-actuarial pension system, lead to increases in the retirement age and steady-state welfare gains for all income classes.

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1. Introduction

Social security reforms have been on the top of the policy agenda of most OECD economies for quite a while. The well-known reason is that ageing populations and associated increases in dependency ratios threaten the financial viability of these economies' social security systems. In order to combat this problem, decisionmakers may consider a combination of at least two policy measures. Firstly, increased funding in the sense that the government accumulates financial assets will alleviate the financial burden of social security since higher asset returns in the future counteract the need for tax increases. Secondly, stimulation of labor supply will have the same favourable effects on social security financing because it increases output and leads to a larger tax base. Both policies involve serious challenges when it comes to implementation, however. Increased government funding requires a degree of fiscal diciplin which is hard to sustain. Moreover, stimulation of labor supply must probably include a reversion of the observed escalation of early retirement, see Gruber and Wise (1997). This calls for rather controversial tax-transfer policies,which may alter the tax-transfer system's efficiency and distributional characteristics.

Using the Norwegian pension system as an example, this paper studies the long run steady-state welfare effects of social security reforms which scale down the non-actuarial parts of the public pension system. We focus on induced retirement effects and capture how the sign and magnitude of the welfare effects hinge on the interaction between the government's budget constraint and the behavioral responses. Our vehicle of analysis is an overlapping generations model with heterogenous agents within generations and endogenous retirement. Hence, we adopt the general setting of Brunner (1994, 1996) and Fenge (1995). These theoretical papers consider the possibility of pareto-optimal transitions from pay-as-you-go (PAYGO) to funded social security systems. Analyses which capture more complex pension formulas and endogenous retirement are not provided by Brunner or Fenge, however. In this paper we consider the Norwegian pension system in a simple theoretical version of our model as well as in an extended CGE version.

Compared to traditional overlapping generations models which assume representative agents within each generation, our framework with heterogenous agents within generations permits analyses that are more realistic in some important respects. For example, reported long run welfare gains obtained from scaling down non-actuarial parts of the pension system (or alternatively introducing completely actuarial and privatisized systems) often reflect that there is no scope for intragenerational redistribution in the adopted overlapping generations models at all, see for example the numerical analyses of Auerbach and Kotlikoff (1987, chapter 10), Feldstein (1995), Raffelhüschen and Risa (1995) and Kotlikoff (1996).[1] Contrary to their models, our framework explicitly captures a potential long run rationale for non-actuarial social security systems through the introduction of income heterogeneity within each generation.

During the last decades early retirement has escalated in almost all OECD economies. According to a large body of recent research, this is closely related to tax-transfer policies and early retirement schemes which give individuals strong incentives to withdraw from the labor force at an early stage, see the surveys by OECD (1998) and Gruber and Wise (1997). While this literature focuses on theoretical analyses of the impact of various policies on individual retirement behavior and econometric analyses of individual responses as well, incorporation of retirement behavior in long run general equilibrium models has not received much attention. Hence, this paper extends the early retirement literature in this direction.[2]

In the same way as most other public pension systems in the OECD countries, the Norwegian system consists of a fixed minimum pension, which acts as a safety net for all individuals, plus a non-actuarial supplementary benefit which is related to each individual's labor market participation and labor income. The regular "official" pension age is 67 years. Most individuals are eligible to early retirement benefits from the age of 62, however. The early retirement program (known as the "AFP" program) has been negotiated between the unions, the employers and the government which also contributes to the financing of the scheme. The early retirement benefit is rather generous and calculated as the pension benefit the individual would have received at age 67 *plus* an additional early retirement "subsidy". Early retirement does not influence the level of the ordinary pension benefits after age 67. Thus, it is not surprising that the induced retirement effects are substantial as documented by econometric studies, see Hernæs and

[1] In these models the assumption of a representative agent within each generation implies that non-actuarial social security systems leads to efficiency losses while the potential gains from intragenerational redistribution and social insurance are not captured.
[2] Hu (1979) and Aylott (1996) present overlapping generations models with endogenous retirement and representative behavior within generations. They focus on capital accumulation and introduce only a very simple tax and social security system. Analyses of the impact of tax-transfer policies or social security reforms which alter economic incentives are not provided.

Strøm (2000) and Bratberg et al. (2000). Clearly, these reported induced retirement effects have motivated the design of the pension reforms analyzed in this paper.

The rest of this paper is organized in the following way. The next section presents the theoretical model. Using this model, section 3 analyzes the steady-state effects of a sample of reforms which in various ways reduce the non-actuarial parts of the pension system in order to counteract early retirement. We demonstrate that high income individuals are likely to gain from these reforms. The sign of the welfare effect for low income individuals is ambiguous because we do not know whether the effect of lower pension benefits is offset by the effect of a reduced tax-burden. Section 4 presents our simulation model. In section 5 we report the simulation results from five reform proposals. Three of them scale down non-actuarial parts of the pension system by, respectively, i) substituting the early retirement subsidy by a early retirement tax, ii) privatizing the public supplementary pension and iii) privatizing both the public supplementary pension and the early retirement program. Here privatization refers to an abolishment of the public non-actuarial component combined with an introduction of a fully actuarial and privatized component. It turns out that all the three reforms lead to increases in the retirement age and steady-state welfare gains for all income classes. We also investigate two additional reform. One alter the slope of the pension function and the other keep the net present value of each individual's pension benefits independent of the retirement age. Section 6 summarizes our conclusions and offers some final remarks.

2. A theoretical overlapping generations model

We consider a small open economy which has access to a perfect international capital market with a strictly positive and constant real rate of interest (r). Time is discrete and in each period t there are two generations present. Both generations participate in the labor market. There are no bequests and for simplicity we disregard technological progress. Aggregate output (Y_t) is produced by a standard constant returns to scale production function $F(K_t,L_t)$, where K_t is real capital and L_t is total supply of efficient labor units in period t. Defining $y_t=Y_t/L_t$ and $k_t=K_t/L_t$, we may as usual write $y_t=f(k_t)$, $f'>0$, $f''<0$. Assuming perfect competition and no taxation of profits, maximization of profits implies $f'(k_t)=r$ and $w_t= f(k_t)+ k_t\, f(k_t)$ where w_t is gross wage per efficiency unit of labor. Therefore k_t and w_t are determined by the constant r, and we obtain $k_t=k$ and $w_t=w$ in all periods t.

Population

We define N_t as the size of the young generation in period t (generation t). The rate of population growth is n, and we have $N_{t+1}=(1+n)N_t$. We assume $r=n$, i.e. we disregard dynamic inefficiency. Following Brunner (1994, 1996), we assume that there are two types of individuals within each generation. The different types are characterized by high (h) and low (l) ability indices equal to $1+\varepsilon$ and $1-\varepsilon$ ($0\leq\varepsilon<1$), respectively. There are no information asymmetries regarding individuals type of ability. Ability influences how one time unit of labor is transformed to efficiency units. Accordingly, we assume that the gross wage rates per time unit of labor are given by $w^h=(1+\varepsilon)w$ and $w^l=(1-\varepsilon)w$, i.e. we have two income classes corresponding to the two ability types. Within each generation we assume that the income classes are of equal size.

In their first period of life (as "young"), we assume for simplicity that individuals of both types supply inelastically one time unit of labor. In the second period of life (as "old"), retirement is possible. The individual is free to choose the proportion of the period which is spent in the labor force. This proportion is given by α_t^j ($0<\alpha_t^j<1$) for a type j individual ($j=l,h$) who is old in period t and consequently belongs to generation $t-1$.[3] It follows that time spent in retirement is given by $1-\alpha_t^j \equiv x_t^i$. We assume that there is a standard "official" retirement age α^*. In the following theoretical analysis we will focus exclusively on cases where $0<\alpha_{t+1}^j\leq\alpha^*$, i.e. we consider the large share of the population which retire before (or at) the standard retirement age and disregard the very few who stay in the labor force after that age.

Individual behavior

An individual in generation t and income class j maximizes the lifetime utility function

(1) $$U_t^j = \ln(c_{1,t}^j) + \frac{1}{1+\theta}\left(\ln(c_{2,t+1}^j) + v(x_{t+1}^j)\right),$$

[3] At this stage we may note that $L_t = N_t + 0.5N_{t-1}[\alpha_t^l(1-\varepsilon) + \alpha_t^h(1+\varepsilon)]$.

where ? is the rate of time preference and $c_{1,t}^{j}$ and $c_{2,t+1}^{j}$ are consumption in the first and second period of life. We assume that v'>0 and v''<0. The intertemporal budget constraint of the individual is given by

$$(2) \qquad c_{1,t}^{j}(1+\tau^{c})+\frac{1}{1+r}c_{2,t+1}^{j}(1+\tau^{c})=b_{t}^{j},$$

where t^{c} is a constant consumption tax rate and b_t^j is the net lifetime income (in present value terms);

$$(3) \qquad b_{t}^{j}=w^{j}(1-\tau)+\frac{1}{1+r}\left(\alpha_{t+1}^{j}w^{j}(1-\tau)+\pi_{t+1}^{j}(\alpha_{t+1}^{j})\right).$$

Here τ is a constant proportional labor income tax rate while $\pi_{t+1}^{j}(\alpha_{t+1}^{j})$ is a public pension benefit which is a function of the retirement age, see the pension formula below.

We assume without loss of generality that r=?. This implies that

$$(4) \qquad c_{1,t}^{j}=c_{2,t+1}^{j}=\frac{1+r}{2+r}\frac{1}{1+\tau^{c}}b_{t}^{j}\equiv c_{t}^{j}.$$

The individual's problem is then to choose α_{t+1}^{j} in order to maximize the utility function (1) subject to (4), (3) and $x_{t+1}^{j}=1-\alpha_{t+1}^{j}$. The first-order condition is given by

$$(5) \qquad \beta_{t+1}^{j}\frac{2+r}{b_{t}^{j}}=v'(1-\alpha_{t+1}^{j}) \quad , \quad \beta_{t+1}^{j}\equiv\frac{\partial b_{t}^{j}}{\partial\alpha_{t+1}^{j}}=\frac{1}{1+r}\left(w^{j}(1-\tau)+\frac{\partial\pi_{t+1}^{j}}{\partial\alpha_{t+1}^{j}}\right),$$

and implies that the optimal retirement age equalizes the marginal utility from a longer period in the labor force to the marginal utility from a prolonged retirement period.[4] We interpret β_{t+1}^{j} as the "price of a prolonged retirement period" because this derivative expresses the marginal price of a longer retirement period in terms of consumption expenditures. We assume that β_{t+1}^{j}>0. Otherwise no individual will choose to participate in the labor force in the second period of their life cycle. Clearly, the optimal choice of α_{t+1}^{j} is influenced by tax-transfer policies which alter t^{c}, τ or the parameters in the pension formula $\pi_{t+1}^{j}(\alpha_{t+1}^{j})$.

The pension function

We adopt the following pension formula:

[4] We assume that this first-order condition uniquely defines the optimal choice of α_{t+1}^{j}. It turns out that this imposes only very weak assumptions about the pension function and the $v'(\alpha_{t+1}^{j})$ function.

(6) $$\pi_{t+1}^{j}(\alpha_{t+1}^{j}) = (1-\alpha_{t+1}^{j})\left(A + \varphi f(y_{t+1}^{j})\right) + \psi(\alpha^{*} - \alpha_{t+1}^{j}) + p((1+r)\tau w^{j} + \alpha_{t+1}^{j}\tau w^{j}).$$

The first term on the RHS captures that the individual receives a flat benefit A (A>0) and a supplementary benefit $\varphi f(y_{t+1}^{j})$, (f(0)=0, $f'(y_{t+1}^{j}) \geq 0$) during retirement. Here f is a scaling-parameter which will be useful for our analysis below, f=0. The supplementary pension level is determined by the number of "earning points", y_{t+1}^{j}, which is closely related to gross income received earlier in life in a sense that will be explained below. The second term on the RHS of (6) reflects that the individual may face an additional early retirement subsidy (ψ>0) or penalty (ψ<0). Finally, the last term on RHS of (5) captures a possible direct relationship between own contributions and benefits (0≤p≤1).

The pension formula may well characterize the main parts of the Norwegian old age pension system. In the Norwegian system p=0 and ψ>0. Moreover, we have as an approximation that

(7) $$y_{t}^{j} = \max\left\{0\,, w^{j}(1+\alpha_{t+1}^{j}) + \kappa w^{j}(\alpha^{*} - \alpha_{t+1}^{j}) - y^{\min}\right\},$$

where $y^{\min}$ is an exogenously given minimum level of earning points necessary to receive a positive supplementary pension. The parameter ?≥0 captures to what extent the individual accumulates earning points in the early retirement period, i.e. the period between α_{t+1}^{j} and a*. As discussed in the introduction, the major part of the Norwegian labor force is eligible to a general early retirement scheme after the age of 62. According to this scheme, the number of earning points is – regardless of the actual retirement age – calculated *as if* the individual had continued in the labor force until the official retirement age (67). It follows from (7) that ?=1 captures this feature, i.e. in this case y_{t+1}^{j} is independent of the retirement decision.

Using (5) and (6), we obtain the following expression for β_{t+1}^{j}:

(8) $$\beta_{t+1}^{j} = \frac{1}{1+r}\left\{w^{j}(1-\tau) - \left(A + \varphi f(y_{t+1}^{j})\right) + (1-\alpha_{t+1}^{j})\varphi f'(y_{t+1}^{j})\frac{\partial y_{t+1}^{j}}{\partial \alpha_{t+1}^{j}} - \psi + p\tau w^{j}\right\}.$$

The magnitude of β_{t+1}^{j} determines to what extent the tax-transfer system stimulates individuals to substitute a longer retirement period for more time spent in the labor force.
As a benchmark we note that a fully actuarial system (p=1, A=0, ψ=0, $f(y_{t+1}^{j})$=0), or equivalently no public pension system at all, yields β_{t+1}^{j}=w^{j}. This leads to socially efficient retirement choices provided that the wage rate reflects the marginal productivity of the individuals.

We observe from (8) that a higher τ, a higher A and $\varphi f(y_{t+1}^j)$, a lower value of $\varphi f'(y_{t+1}^j)\dfrac{\partial y_{t+1}^j}{\partial \alpha_{t+1}^j}$, a higher ψ and a lower p all contribute to reductions in β_{t+1}^j relative to the socially efficient level. The consumption tax rate does not influence β_{t+1}^j.[5]

In the Norwegian case (p=0 and $\dfrac{\partial y_{t+1}^j}{\partial \alpha_{t+1}^j}=0$), (8) simplifies to

$$\text{(8')} \qquad \left(\beta_{t+1}^j\right)^{Norway} = \frac{1}{1+r}\left\{w^j(1-\tau)-\left(A+\varphi f(y_{t+1}^j)\right)-\psi\right\},$$

and we observe that all the parameters in the Norwegian pension formula contribute to reductions in β_{t+1}^j compared to the socially efficient case. Using (3), (4), (5), (6) and (8'), it is straightforward to derive the comparative static results which are summarized in Table 1.

Table 1: Comparative static results – Norwegian case

	$\partial\alpha_{t+1}^j/\partial A$	$\partial\alpha_{t+1}^j/\partial\psi$	$\partial\alpha_{t+1}^j/\partial\varphi$	$\partial\alpha_{t+1}^j/\partial\tau^c$	$\partial\alpha_{t+1}^j/\partial\tau$
Substitution effect	<0	<0	<0	<0	<0
Income effect	<0	<0	<0	>0	>0
Total effect	<0	<0	<0	0	?

The government budget constraint

We assume for simplicity that the only function of the government is to run the old age pension system. The system is strictly pay-as-go financed. This implies that the government budget constraint can be written as

$$\text{(9)} \quad \frac{N_t}{2}\tau(w^l+w^h)+\frac{N_{t-1}}{2}\tau\left(\alpha_t^l w^l+\alpha_t^h w^h\right)+\frac{N_t}{2}\tau^c\left(c_{1,t}^l+c_{1,t}^h\right)+\frac{N_{t-1}}{2}\tau_c\left(c_{2,t}^l+c_{2,t}^h\right)=\frac{N_{t-1}}{2}\left(\pi_t^l+\pi_t^h\right),$$

i.e. total revenues from labor income taxation and consumption taxes in period t must equal total expenditures on pension benefits in period t.

In steady state the consumption levels are constant across lifetimes and generations for each income class. This means that $c_{1,t}^j=c_{2,t}^j\equiv c^j$ (j=l,h). Using that $N_{t+1}=(1+n)N_t$, we then obtain the following steady-state version of the budget constraint:

[5] This is due to our choice of a ln utility function. It is easy to verify that t^c vanishes when we derive the first-

(10) $\tau\left((1+n)(w^l+w^h)+(\alpha^l w^l+\alpha^h w^h)\right)+\tau^c\left((2+n)(c^l+c^h)\right)=\left(\pi^l+\pi^h\right).$

Here steady-state values of variables are denoted without time-subscripts. It is well known that the pay-as-go system – compared to a funded system – implies lower benefits for given tax-contributions as long as $r>n$. Recalling our assumption $r=n$, we note that the systems are equivalent in the special case of $r=n$ (i.e. the economy is on a golden rule growth path). Equivalently, we may investigate the consequences of a funded system by simply substitute r for n in (10).

3. Steady state effects of social security reforms – theoretical analysis

Without paying attention to transition paths, we consider the steady state effects of three possible social security reforms which scale down various non-actuarial parts of the pension system. Relating our analysis to the Norwegian pension system, we assume at the outset that p=0 and $\frac{\partial y_{t+1}^j}{\partial \alpha_{t+1}^j}=0$. In two of the reforms we consider reductions in respectively the early retirement subsidy ? and the flat minimum benefit A. Both reductions are accompanied by reductions in the consumption tax rate which satisfy the government budget constraint. The third reform scales down the supplementary pension $\varphi f(y_{t+1}^j)$ and reduces the consumption tax rate. We imagine that this last reform is accompanied by an introduction of a fully actuarial and potentially privatized supplementary pension.

A lower early retirement subsidy

It follows from (3), (4), (6) and (10) that the consumption tax response to an adjustment of the early retirement subsidy is given by

(11) $$\frac{d\tau^c}{d\psi}=\frac{\left(1-\frac{(2+n)\tau^c}{(2+r)(1+\tau^c)}\right)\left(\frac{\partial\pi^l}{\partial\psi}+\frac{\partial\pi^h}{\partial\psi}\right)+G_\psi}{(2+n)(1+\tau^c)^{-1}(c^l+c^h)},$$

where the term $G_?$ captures the induced retirement effect of a lower ?:

order condition (5).

(12) $$G_{\psi}=-\frac{\partial\alpha^{l}}{\partial\psi}\left(\tau w^{l}+\frac{(2+n)\tau^{C}}{(2+r)(1+\tau^{c})}w^{l}(1-\tau)\right)-\frac{\partial\alpha^{h}}{\partial\psi}\left(\tau w^{h}+\frac{(2+n)\tau^{C}}{(2+r)(1+\tau^{c})}w^{h}(1-\tau)\right).$$

We observe that $G_{?}$>0. In order to determine the sign of the numerator, we note that

(13) $$\frac{\partial\pi^{j}}{\partial\psi}=(\alpha^{*}-\alpha^{j})-\frac{\partial\alpha^{j}}{\partial\psi}\left(A+f(y^{j})\right)-\frac{\partial\alpha^{j}}{\partial\psi}\psi,$$

and this expression is positive (recall that we disregard at the outset that individuals retire after the official age). The denominator is obviously positive. Hence, $\frac{d\tau^{c}}{d\psi}>0$, i.e. a lower early retirement subsidy means intuitively a lower consumption tax.

The effect on the retirement decision is given by $d\alpha^{j}=\frac{\partial\alpha^{j}}{\partial\tau^{c}}d\tau^{c}+\frac{\partial\alpha^{j}}{\partial\psi}d\psi$. Since $\frac{\partial\alpha^{j}}{\partial\tau^{c}}=0$ and $\frac{\partial\alpha^{j}}{\partial\psi}<0$, it follows that both income classes will choose to retire later in response to this experiment.

Turning to the effects on consumption, it follows from (4) that

(14) $$dc^{j}=-c^{j}\frac{1}{1+\tau^{c}}d\tau^{c}+\frac{1}{(2+r)(1+\tau^{c})}\left(\frac{\partial\alpha^{j}}{\partial\psi}w^{j}(1-\tau)+\frac{\partial\pi^{j}}{\partial\psi}\right)d\psi.$$

Using (11) and substituting for dt^{c}, we obtain

(15)
$$\frac{dc^{j}}{d\psi}=-\frac{c^{j}}{c^{l}+c^{h}}\frac{\left(1-\frac{(2+n)\tau^{c}}{(2+r)(1+\tau^{c})}\right)\left(\frac{\partial\pi^{l}}{\partial\psi}+\frac{\partial\pi^{h}}{\partial\psi}\right)+G_{\psi}}{(2+n)}+\frac{1}{(2+r)(1+\tau^{c})}\left(\frac{\partial\alpha^{j}}{\partial\psi}w^{j}(1-\tau)+\frac{\partial\pi^{j}}{\partial\psi}\right).$$

In order to interpret (15) we make one assumption. We assume that the low income class retires before or at the same time as the high income class, $a^{l}=a^{h}$. This assumption is supported by empirical research and probably reflects that low income individuals face a higher net replacement rate than high income individuals, see Bratberg et al. (2000).

We imagine for a moment that the retirement responses are zero, i.e. $G_{?}$=0 and $\frac{\partial\pi^{j}}{\partial\psi}=\alpha^{*}-\alpha^{j}$. We may then rewrite (15) as

(15’) $$\frac{dc^{j}}{d\psi}=-\frac{c^{j}}{c^{l}+c^{h}}v_{1}\left(\frac{\partial\pi^{l}}{\partial\psi}+\frac{\partial\pi^{h}}{\partial\psi}\right)+v_{2}\frac{\partial\pi^{j}}{\partial\psi},$$

where the “weights” v_1 and v_2 are

$$v_1 = \frac{1}{(2+n)(1+\tau^c)} + \frac{\tau^c(r-n)}{(2+n)(2+r)(1+\tau^c)} \quad , \quad v_2 = \frac{1}{(2+r)(1+\tau^c)}.$$

We immediately observe that $v_1>v_2$ if $r>n$ and $v_1=v_2$ if $r=n$. Moreover, $a^l = a^h$ implies that $c^h>c^l$ and $\frac{\partial \pi^l}{\partial \psi} > \frac{\partial \pi^h}{\partial \psi}$. This means that $\frac{dc^h}{d\psi} < 0$. The sign of $\frac{dc^l}{d\psi}$ is ambiguous if $r>n$, but we have $\frac{dc^l}{d\psi}$ >0 for $r=n$. Thus, a lower early retirement subsidy increases the consumption level of the high income households while the consumption level of the low income houshold may increase or decrease. We note that the effect of pay-as-you-go financing is to increase v_1 and consequently the negative term in (15').

Taking the induced retirement effects into account, we observe that the $G_?$ term strengthens the first term on the RHS of (15), which is negative, for both income classes. Moreover the term $\frac{\partial \alpha^j}{\partial \varphi} w^j(1-\tau)$ is strictly negative and weakens the last term on the RHS of (15), which is likely to be positive. As long as the induced retirement effects do not alter the condition $\frac{\partial \pi^l}{\partial \psi} > \frac{\partial \pi^h}{\partial \psi}$, we therefore conclude that we still obtain $\frac{dc^h}{d\psi} < 0$, while the sign of $\frac{dc^l}{d\psi}$ is ambiguous. If the joint effect of pay-as-go-financing (which implies that $v_1>v_2$ when $r>n$) and a higher retirement age (which increases the economy's tax base) is strong enough, low income individuals may as well gain from a lower early retirement subsidy.

In order to derive the precise welfare effects of this reform, we must turn to numerical simulations (see the sections below). The theoretical analysis suggests i) that the high income individuals are likely to gain in terms of both consumption and welfare (i.e. the high income individuals may increase their consumption level even if we disregard the induced retirement effects) and ii) we can not disregard the possibility that low income individuals may gain as well.

A lower minimum pension

Looking at the effects of a lower minimum benefit, A, accompanied by a lower consumption tax, it turns out that the analysis is more or less similar to the analysis above. This is not surprising since A and ? enter the pension formula (6) in similar ways. We first note that the tax response is given by

(16) $$\frac{d\tau^c}{dA} = \frac{\left(1 - \frac{(2+n)\tau^c}{(2+r)(1+\tau^c)}\right)\left(\frac{\partial \pi^l}{\partial A} + \frac{\partial \pi^h}{\partial A}\right) + G_A}{(2+n)(1+\tau^c)^{-1}(c^l + c^h)},$$

where the term G_A captures the induced retirement effect of a lower A:

(17) $$G_A = -\frac{\partial \alpha^l}{\partial A}\left(\tau w^l + \frac{(2+n)\tau^C}{(2+r)(1+\tau^c)} w^l (1-\tau)\right) - \frac{\partial \alpha^h}{\partial A}\left(\tau w^h + \frac{(2+n)\tau^C}{(2+r)(1+\tau^c)} w^h (1-\tau)\right).$$

We observe that G_A>0. It follows that $\frac{d\tau^c}{dA} > 0$ because the expression

(18) $$\frac{\partial \pi^j}{\partial A} = (1-\alpha^j) - \frac{\partial \alpha^j}{\partial A}\left(A + \varphi f(y^j)\right) - \frac{\partial \alpha^j}{\partial A}\psi,$$

is positive.

The effect on the retirement decision is given by $d\alpha^j = \frac{\partial \alpha^j}{\partial \tau^c} d\tau^c + \frac{\partial \alpha^j}{\partial A} dA$. Since $\frac{\partial \alpha^j}{\partial \tau^c} = 0$ and $\frac{\partial \alpha^j}{\partial A} < 0$, it follows that also a reduced minimum pension accompanied by lower consumption taxes implies that both income classes will choose to retire later.

By employing the same steps as above, we obtain the following effect on consumption:

(19)

$$\frac{dc^j}{dA} = -\frac{c^j}{c^l + c^h}\frac{\left(1 - \frac{(2+n)\tau^c}{(2+r)(1+\tau^c)}\right)\left(\frac{\partial \pi^l}{\partial A} + \frac{\partial \pi^h}{\partial A}\right) + G_A}{(2+n)} + \frac{1}{(2+r)(1+\tau^c)}\left(\frac{\partial \alpha^j}{\partial A} w^j (1-\tau) + \frac{\partial \pi^j}{\partial A}\right).$$

Again the condition $a^l = a^h$ and in turn $\frac{\partial \pi^l}{\partial A} > \frac{\partial \pi^h}{\partial A}$ are crucial for the results. Accepting them, we obtain similar qualitative conclusions as above. Lower minimum pensions and consumption taxes reduce the efficiency losses, which in this framework means a higher retirement age for both income classes. The high income individuals increase their consumption levels and gain. In addition, the low income individuals may gain as well.

Scaling down the supplementary pension

This reform assumes that the supplementary pension is scaled down in the sense that the parameter f is reduced, while the consumption tax is adjusted according to the government budget constraint (10). We may imagine that this reform is accompanied by an introduction of a fully actuarial supplementary pension based on real accounts. The latter measure will not influence the results of the analysis, however, because a fully actuarial system is equivalent to private savings as long as the contributions are invested in an efficient way.[6] Consequently, a fully actuarial system will not distort the consumption and retirement decisions.

Following the same steps as in the two preceding reforms, we derive the response in t^c to the change in f. It is straightforward to show that $\frac{d\tau^c}{d\varphi} > 0$, i.e. a smaller supplementary pension reduces the consumption tax. In turn, the individuals in both income classes will choose to retire later. Moreover, we obtain a similar expression for the consumption response

(20)

$$\frac{dc^j}{d\varphi} = -\frac{c^j}{c^l + c^h}\frac{\left(1 - \frac{(2+n)\tau^c}{(2+r)(1+\tau^c)}\right)\left(\frac{\partial\pi^l}{\partial\varphi} + \frac{\partial\pi^h}{\partial\varphi}\right) + G_\varphi}{(2+n)} + \frac{1}{(2+r)(1+\tau^c)}\left(\frac{\partial\alpha^j}{\partial\varphi} w^j (1-\tau) + \frac{\partial\pi^j}{\partial\varphi}\right),$$

where

$$(21)\; G_\varphi = -\frac{\partial\alpha^l}{\partial\varphi}\left(\tau w^l + \frac{(2+n)\tau^C}{(2+r)(1+\tau^c)} w^l (1-\tau)\right) - \frac{\partial\alpha^h}{\partial\varphi}\left(\tau w^h + \frac{(2+n)\tau^C}{(2+r)(1+\tau^c)} w^h (1-\tau)\right),$$

$$(22)\; \frac{\partial\pi^j}{\partial\varphi} = (1-\alpha^j) f(y^j) - \frac{\partial\alpha^j}{\partial\varphi}\left(A + f(y^j)\right) - \frac{\partial\alpha^j}{\partial\varphi}\psi .$$

Equation (20) is analogous to the expressions for $\frac{dc^j}{d\psi}$ and $\frac{dc^j}{dA}$ (see the equations (15) and (19)). Provided that the conditions $a^l = a^h$ and in turn $\frac{\partial\pi^l}{\partial\varphi} > \frac{\partial\pi^h}{\partial\varphi}$ are fulfilled, the high income individuals will gain in terms of consumption and welfare when the supplementary pension is scaled down. The effect for low income households is ambiguous – but it seems quite possible that they may gain too. Turning to numerical simulations in the next sections, our main motivation is to assess whether the low income class may also gain from this kind of reforms.

4. A simulation model for endogenous retirement decisions

[6] A fully actuarial supplementary pension based on real accounts may be privatized as highlighted in the U.S. debate (see Kotlikoff, 1996, and Feldstein, 1995) or – at least in principle – handled by the government. In the

Our simulation model is essentially a small open economy version of a dynamic simulation model in the spirit of Auerbach and Kotlikoff (1987). It can be regarded as an extended version of our theoretical model. The simulation model features 55 overlapping generations, with each adult living for 55 years, corresponding to the "natural'' ages 20 to 75. Each cohort consists of five income quintiles. Consequently, the model distinguishes 275 household types in each year.[7] Each household decides how much to consume and how many hours to work in each period, and when to retire from the workforce. Preferences for current and future consumption and leisure are the same for all lifetime income classes. However, wages grow across the lifecycle according to an exogenous specified, income-class-specific age-income profile. Thus, the distinction between rich and poor is solely attributed to differences in their earnings capacity, not in their preference structure. Formally, a household of income class *j* solves the following maximization problem[8]

$$(23) \qquad \max_{c_a,\, l_a,\, R} U\,(c_a, l_a, \ldots) = \frac{1}{1-1/\gamma}\left\{\sum_{a=1}^{R-1}\left(\frac{1}{1+\theta}\right)^{a-1} u(c_a, l_a)^{1-1/\gamma} + \sum_{a=R}^{55}\left(\frac{1}{1+\theta}\right)^{a-1} u(c_a, 1)^{1-1/\gamma}\right\}$$

$$\text{s.t.} \quad \sum_{a=1}^{55} (1+\tau^c)\, c_a\, (1+r)^{1-a} = \sum_{a=1}^{R-1} (1-l_a)\ \overline{w}_a\ (1+r)^{1-a} + \sum_{a=R}^{55} \pi_a\, (1+r)^{1-a} \ ,$$

where R is the retirement age, $\overline{w}_a$ is the average net wage rate at age a and γ denotes the intertemporal elasticity of substitution. The annual utility function takes the form

$$(24) \qquad u\,(c_a, l_a) = \left[(c_a)^{1-1/\rho} + \xi\,(l_a)^{1-1/\rho}\right]^{\frac{1}{1-1/\rho}}$$

where ? is a leisure preference parameter and r denotes the intra-temporal elasticity of substitution. Average and marginal net wages are computed as follows:

$$(25a) \quad \overline{w}_a = we_a\,(1-\overline{t}_a^{\,w} - \overline{t}^{\,p}) \ ,$$

$$(25b) \quad w_a = we_a\,(1-t_a^{\,w} - t_a^{\,p}) \ .$$

The gross-of-tax wage w is multiplied by the efficiency parameter e_a and the tax factor. Average and marginal taxes on labor income ($\overline{t}_a^{\,w}, t_a^{\,w}$) are computed directly from a progressive labor income tax schedule which reflects the Norwegian system. While average social security contribution rates ($\overline{t}^{\,p}$) are identical across ages and specified exogenous, the implicit marginal

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latter case, we may consider the pension formula (6) and imagine that p=1 and that the other parts of the pension system is completely financed by consumption taxes.

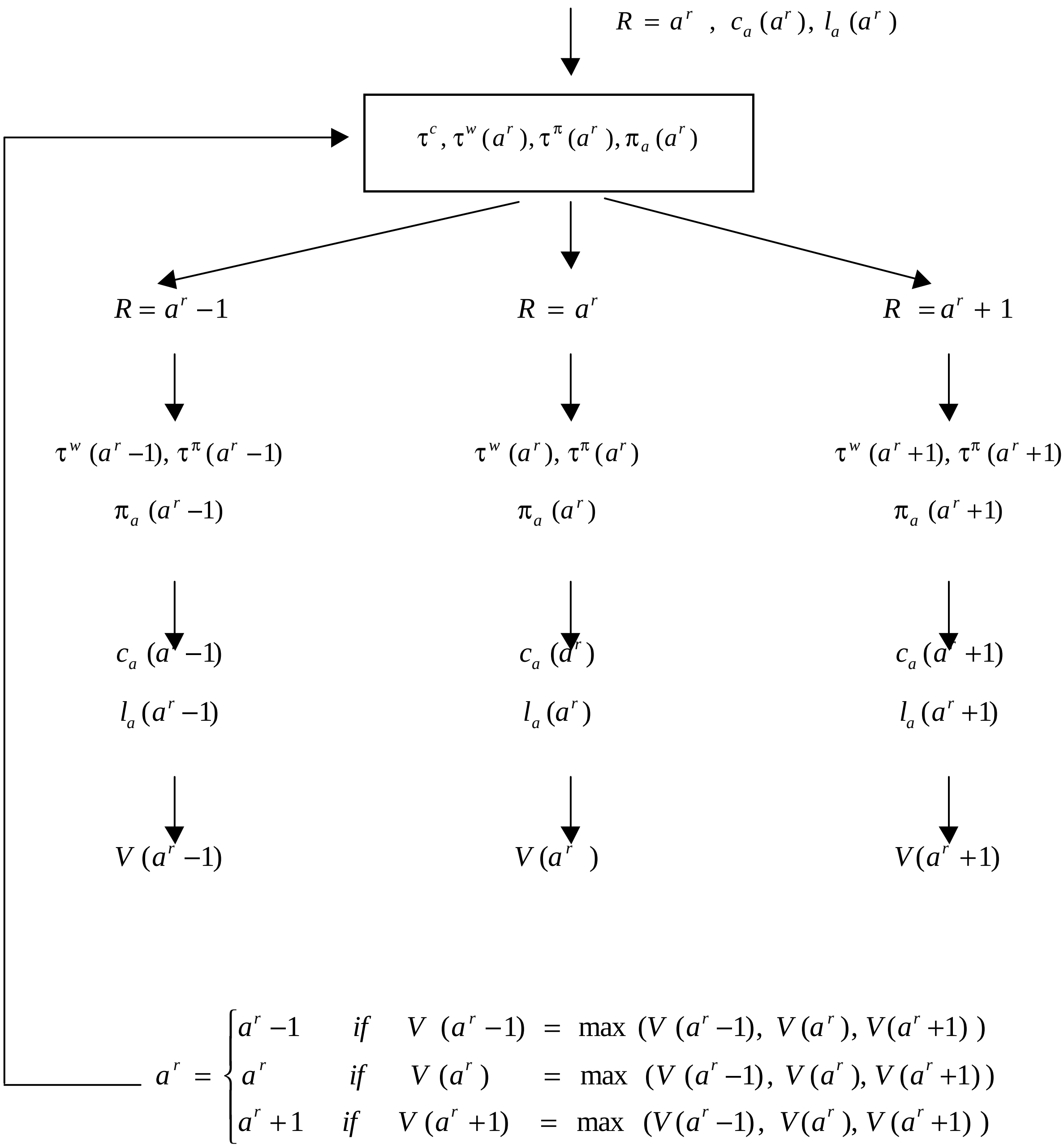
[7] For a similar approach, see Fehr (1999).

social security contribution rates (t_a^p) are age-dependent and reflects the incentive structure of the existing pension system (see below). Of course, computing the retirement age R is quite complicated, since the optimal retirement year for a household depends on his income structure, the progressive tax system and the early retirement incentives of the pension system. Figure 1 shows how the retirement age is derived in the model.

We start with an initial guess for the retirement age (a^r), and the consumption and leisure stream across the life cycle. Given these guesses, we can compute individual tax and contribution rates as well as pension benefits. In the next step we add the corresponding tax and contribution rates and pension benefits for the two closest alternative retirement ages. Of course, each retirement age implies a different pension benefit profile. In addition, we also have to adjust the tax and contribution rates to the retirement age, since in and after the year of retirement the average wage income tax rate is increased to unity. Given these different fiscal parameters, we compute the optimal consumption and leisure streams for each retirement age. Note that for each year after retirement, a shadow wage is computed which sets leisure consumption equal to the time endowment. Next we calculate the utility index V for each retirement age. The retirement ages which yields the highest utility level is then selected as a new guess and the computation starts again.

[8] For simplicity, the income class index j is omitted in the following variables.

Figure 1: The household's maximization problem



This procedure is repeated for each income class. Since it is quite complicated to solve the household problem, we have kept the remaining part of the model as simple as possible. The government sector of the model provides public consumption and the pension benefits. Revenues are derived by labor taxes and social security contributions, whereas the consumption tax rate is adjusted to balance the budget each year. The producer side of the economy is represented by a Cobb-Douglas technology, i.e. $Y_t = \phi K_t^\eta L_t^{1-\eta}$. The parameter ϕ is chosen in order to normalize the wage rate to unity. Since capital depreciates at rate δ and the population growth rate is set at n, investments (I) in the steady state can be computed from $I=(n+\delta)K$. Goods are traded with the foreign sector and international capital flows make sure that the balance of payments is in equilibrium. Since we neglect corporate taxation, the marginal product of capital is fixed to the world interest rate which in turn also fixes gross-of-tax wages.

Calibration and initial equilibrium

In order to solve the model, we have to specify the preference and technology parameters. Our parameter choices, which are reported in Table 2, are fairly close to the parameterization chosen by Auerbach and Kotlikoff (1987, 50f.).

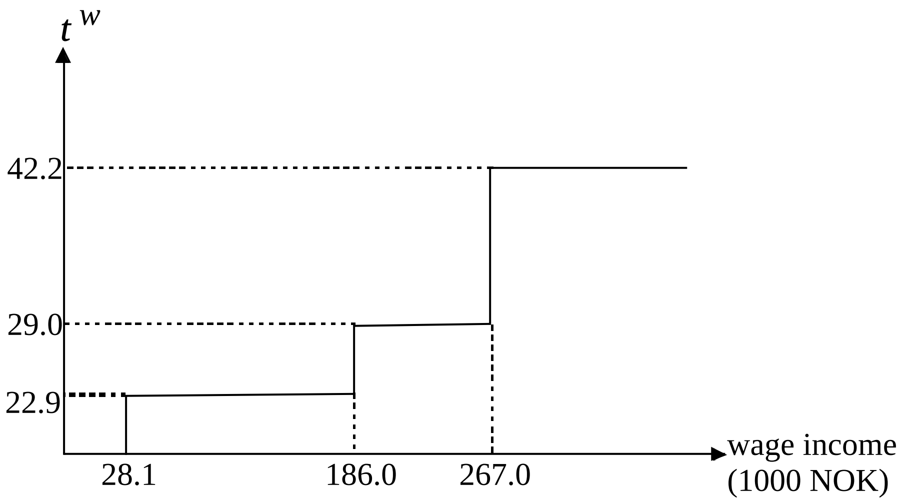
Table 2: Parameterization of the model

Household parameters:	*Production parameters, real interest rate:*
? = 0.01	d = 0.07
? = 0.25	? = 0.3
? = 0.8	n = 0.02
? = 1.5	r = 0.06

Next we have to specify the age-income profiles which distinguish the different income classes. Similar to Fehr (1999, 59) we apply a polynomial function on age and age squared for each income class. Wages, therefore, grow across the life cycle, but they grow faster in the higher income classes. For the lowest income class, the age-income profile peaks at age 61, while for the top income class it peaks at age 66.

Whereas the preference and technology parameterization is quite standard, the model's fiscal system features some important traits of the Norwegian public sector. As already explained above, labor income is taxed progressively and the marginal tax rate schedule is reported in Figure 2.

Figure 2: Marginal tax rate schedule for wage income

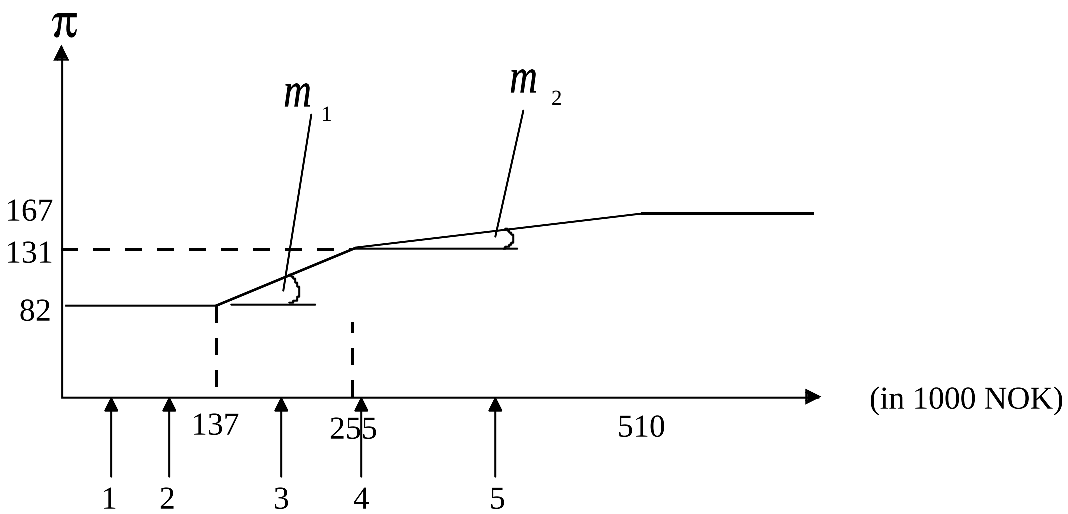


Below an annual taxable wage income of NOK 28,100, income tax is exempted. In the second tax bracket, which ends at NOK 186,000, the marginal tax rate is 22.9 per cent. After that the marginal tax rate is 29 per cent up to an income of NOK 267,000, above which the marginal tax rate is 42.2 per cent. In the initial steady state, the aggregate average wage tax rate is 20.7 per cent, while the aggregate marginal wage tax rate is about 31 per cent.

In addition to the wage tax, the government levies a social security contribution rate of 16 per cent, i.e. $\overline{\tau}^{\pi}$=0.16. This contribution rate is age-independent. In order to explain the implicit marginal contribution rate of the tax-transfer system, we first have to explain the pension system.

Pension benefits are computed from the average income of the best 20 years of work life. Since the age-earnings profile peaks slightly after age 60 and the mandatory retirement age is 67, the average labor income of the best years ($\bar{y}$) is computed from the income between the age 47 and 66. If people decide to retire earlier (i.e. $R \subset [62,66]$), then it is assumed for the calculation of average labor income that the income in the last year before retirement (*R*–1) is also earned during the years of early retirement. As highlighted in previous sections, this is a generous property of the Norwegian early retirement scheme. Given average labor income $\bar{y}$, pension benefits are computed from the following pension function:

Figure 3: The pension function



If the average annual wage income was below NOK 137,000, the worker is entitled to a tax free minimum pension of NOK 82,000. Then the pension benefit increases linearly up to an average income of NOK 255,000, corresponding to a before tax pension of NOK 131,750. The slope of the schedule is further reduced in the third bracket. For average incomes above NOK 510,000, the pension is constant and equal to NOK 167,450. Figure 3 also shows the average income of the five income classes in the benchmark. While the two lowest income classes receive the minimum pension, the three remaining income classes receive supplementary pensions.

In addition to this regular pension p, households receive a lump-sum subsidy ? of NOK 11.000 during the years of early retirement. Pension benefits at age *a* are consequently computed as follows:

$$(26) \qquad p_a = \begin{cases} p + ? & 62 \leq a < 67 \\ p & a \geq 67 \end{cases}.$$

The pension system implies that especially low income households have a very strong incentive to retire early at age 62. If they would work longer, they cannot increase their pension benefits. In addition, their labor income in the last years is either below (in the case of income class 1) or only slightly above the minimum pension. Middle and high income households – on the other hand – receive an annual income which is substantially above their respective pension level. In addition, they can increase their benefits somewhat if they retire later. In order to represent this incentive feature of the pension system, we compute the effective (or marginal) contribution rates for each households as follows:

$$
(27) \qquad \tau_a^{\pi} = \begin{cases} \bar{\tau}^{\pi} & \text{if} \quad a < 47 \\ \bar{\tau}^{\pi} & \text{if} \quad 47 \le a < R \quad \text{and} \quad \bar{y} < 137 \\ \bar{\tau}^{\pi} - \sum_{s=R}^{55} \dfrac{\mu_1 / 20}{(1+r)^{s-a}} & \text{if} \quad 47 \le a < R \quad \text{and} \quad 137 \le \bar{y} < 255 \\ \bar{\tau}^{\pi} - \sum_{s=R}^{55} \dfrac{\mu_2 / 20}{(1+r)^{s-a}} & \text{if} \quad 47 \le a < R \quad \text{and} \quad 255 \le \bar{y} < 510 \\ \bar{\tau}^{\pi} & \text{if} \quad 47 \le a < R \quad \text{and} \quad \bar{y} > 510 \end{cases} .
$$

Households in or above the third income class receive an income above the minimum pension threshold. Therefore, we compute for each year between 47 and the retirement age the present value of the marginal increase in future pensions, if he would earn one NOK more and subtract this sum from the average contribution rate. This procedure reduces the marginal contribution rates below the average contribution rate. Of course, the reduction depends on the slope of the pension function and increases with age since the present value of additional pension benefits increases with age.

In our benchmark simulation, the third income class has an average income which is in the second bracket of the pension function. Their marginal contribution rate falls significantly after age 47. If the household would increase its retirement age above 62, then the marginal contribution rate would increase significantly for all years between 47 and 62. Consequently, this gives a strong incentive to the household to retire early and work hard before age 62. In contrast, the representative household from the fourth income class is in the flat part of the pension function. His marginal contribution rates before retirement fall only slightly. Since his labor income is much higher than his retirement income, he will work much longer. The same argument applies to the top income class.

The retirement ages in the benchmark simulation reflect this reasoning. While the first three classes retire at age 62, income class 4 retires at 67 and the top class retires at 68. Consequently, our model is able to replicate the empirical retirement patterns. The aggregate pension benefits amount to about 7.4 per cent of GDP. In addition to pension benefits, the government supplies public goods which amount to 25 per cent of GDP, i.e. the aggregate government share in GDP in the model economy is about 32.4 per cent. In order to finance these outlays, the consumption tax rate is adjusted endogenously. In the initial equilibrium the consumption tax is 15.2 per cent. Table 3 summarizes the public budget and the retirement ages in the initial equilibrium.

Table 3: Public budget in initial equilibrium

Tax revenues (in per cent of GDP):	
Labor income tax	14.4
Social security contributions	11.2
Consumption tax	6.8
Outlays (in per cent of GDP):	
Public consumption	25.0
Pension benefits	7.4
Retirement ages:	
Income class 1, 2 and 3	62
Income class 4	67
Income class 5	68

5. Simulation results

Starting from the benchmark described in the last section, we simulate five different pension reforms. Three of them capture the effects of scaling down non-actuarial parts of the pension system in various direct ways. In the first scenario, the *"Early retirement reform"*, we substitute the early retirement subsidy by an early retirement tax (i.e. $\psi = -25000$ NOK). In the second scenario, we keep the early retirement subsidy, but eliminate the supplementary pension. Consequently, after the reform, households receive NOK 93.000 between the early retirement ages 62 to 66 and NOK 82.000 afterward. We will call this scenario the *"Flat pension reform"*. In the third scenario, the socalled *"Privatization reform''*, we eliminate supplementary pensions and pay no benefits before age 67. Clearly, these reforms should lead to the same qualitative effects as the reforms we examined theoretically, i.e. a higher retirement age (at least for some income groups), consumption and welfare gains for the high income groups but ambiguous consumption and welfare effects for the middle and low income groups.[9] In particular we note that the Early retirement reform and the Flat pension reform are qualitatively equivalent to the first and third of our theoretical experiments.

As discussed in the theory sections, we imagine that both the Flat pension reform and the Privatization reform are accompanied by an introduction of fully actuarial, and most likely privatized, supplementary pensions based on real accounts.

We also consider two additional reforms. In the fourth scenario we eliminate the early retirement subsidy as well as the flat part of the pension function. Consequently, at an average income of zero, pensions would be NOK 82000 and then they increase linearly up to NOK 131000 at an average income of NOK 255000. We will call this reform the "*Variable pension reform*". Finally, in the "*Neutrality reform*", it is assumed that all households have the right to claim the minimum pension of NOK 82000 for 14 years between age 62 and age 75. If they retire later, then the pension level is adjusted in a way that the present value of the pension benefit is kept constant. Consequently, the pension benefits do not alter the retirement incentives in this case.

Table 4 and Table 5 report the effects on the retirement age, some macroeconomic variables and the welfare changes.

Table 4: Retirement age and macroeconomic effects (changes vs. benchmark) of pension reforms

	Benchmark	*Early retirement reform*	*Flat benefit reform*	*Privati-zation reform*	*Variable Benefit Reform*	*Neutrality Reform*
Retirement age:						
Class 1	62	62	62	67	62	69
Class 2	62	62	62	67	62	69
Class 3	62	67	62	67	62	69
Class 4	67	67	68	67	67	69
Class 5	68	68	69	68	68	69
Pension benefits		–18.0%	–27.1%	–48.4%	10.8%	5.9%
Foreign assets		4.1%	14.1%	14.4%	–5.3%	–19.1%
Consumption		3.0%	2.0%	7.1%	–1.3%	1.4%
Consumption tax		–3.9 p.p.	–4.0 p.p.	–9.1 p.p.	2.2 p.p.	–0.2 p.p.

p.p.: percentage point

[9] We note that the retirement decision is discrete in the simulation model but not in the theoretical model. This implies that we should not expect all income groups to increase their retirement age even though the incentive to stay in the work force one additional year improves.

Table 4 shows that all reforms with the exception of the “Variable benefit reform” increase the retirement age of at least one group. However, they differ in their magnitude and in their macroeconomic effects. When the early retirement subsidy is substituted by an early retirement tax (the Early retirement reform), only households in the third income class increase their retirement age sharply. Pension benefits are reduced by 18 per cent and people increase their savings which increase foreign assets slightly. Since households work longer, consumption increases by 3 per cent and the consumption tax rate could be reduced by 3.9 percentage points.

If supplementary benefits are eliminated (the Flat benefit reform), the two top income classes increase their retirement age. Since pension outlays are reduced much stronger now, savings and foreign assets increase much stronger compared to the previous reform.

In the Privatization reform both the complete public early retirement scheme and the supplementary pension benefits are eliminated (i.e. only the minimum pension after the age of 67 remains). In this case all households increase their retirement age. Of course, this reform reduces pension benefits the most. Since savings (potentially in private pension accounts) and consumption increase dramatically, the consumption tax rate falls now by more than 9 per cent.

We observe that all the three reforms as predicted by theory stimulates labor market participation, reduce efficiency losses and tax burdens – and consequently increase aggregate private consumption.

Turning to the last two reforms, we first note that the Variable benefit reform does not change the retirement age. However, it increases the pension outlays, since low income classes receive higher pensions. As a consequence, foreign assets fall now and the consumption tax has to be increased. Finally, the Neutrality reform increases the retirement age of all classes to 69. Now pension outlays increase by almost 6 per cent. The additional pension outlays are financed by foreign borrowing. Consequently, the consumption tax remains almost constant.

Next we turn to the welfare effects which are reported in Table 5. As is common in must simulation studies of this kind, the welfare index is computed as a Hicksian equivalent variation and expressed in percentage of full time income, see for example Fehr (1999, 107).

Table 5: Welfare effects of pension reforms vs. benchmark (Hicksian equivalent variation)

	Early retirement reform	*Flat benefit reform*	*Privatization reform*	*Variable benefit reform*	*Neutrality reform*
Class 1	0.64	1.29	1.84	0.03	0.39
Class 2	0.82	1.29	2.37	0.19	0.53
Class 3	0.36	0.60	1.95	–0.50	–0.18
Class 4	1.30	0.83	2.60	–0.69	0.40
Class 5	1.26	0.88	2.62	–0.67	0.37

In the first three scenarios the welfare increases for the high income groups as well as for the low income groups. This means that the present value of the lower consumption taxes dominates the present value of the lower pension benefits for all income classes. In turn this reflects the effects of both a smaller magnitude of the pay-as-you-go pension system and the larger tax base caused by a higher retirement age. We should recall, however, that our analysis does not capture the intergenerational redistribution during the transition to steady state. In the Early retirement reform, for example, the current older households, who are receiving this transfer or who will receive it in the near future, will loose from this policy.

Table 5 shows that the three lowest income classes are gaining less than the two highest in the Early retirement reform. Of course, this reflects the fact, that only the three lowest income classes are directly affected by the policy. Although they received the early retirement subsidy before, they still gain. The two top classes are only indirectly affected by the reduced consumption tax rate. When supplementary pensions are reduced (in the Flat benefit reform), the picture turns somewhat around. Now the two lowest income classes are gaining more than proportional since they are not affected by the benefit reduction. In the "Privatization reform" the two top income classes benefit the most, since they have to alter their retirement age only slightly. All other income classes are hit more strongly by the benefit reduction, since they receive benefits in the early retirement years. In the new system they therefore increase their retirement age significantly.

Turning to the two last reforms, we observe that the Variable benefit reform yields an absolute welfare loss for the three highest income classes. Of course, this is due to the increased consumption taxes. For lower income households this effect is more than offset by the increased retirement benefits. Finally, the welfare gains of the income classes in the last reform (the neutrality reform) must be due to the fact that the choice of the retirement age is not distorted by the pension benefits. Households now can allocate their work and leisure time somewhat more efficiently over the life-cycle. But also the loss for the third income class can be explained without any problem. For this class marginal contribution rates increase by almost 20 per cent in some years.

6. Final remarks

During the last decades many OECD economies have expanded their social security systems in a way which has discouraged labor market participation in general and induced early retirement in particular. This tendency has contributed to reductions in potential GDP and accumulation of government debt, which in turn threatens the financial viability of social security. Consequently, the current debate highlights the need for reforms which stimulate labor supply and counteracts the observed escalation of early retirement. A crucial question is whether this means reforms which involve distribution of wealth and welfare from poor to rich, i.e. less redistribution. This paper sheds light on this debate. We have demonstrated that many reforms which scale down the non-actuarial parts of the public pension system actually increase welfare for all individuals in steady state. This reflects that the gains of lower tax burdens more than offset the disutility of less pension benefits – even for low income individuals.

Actual and proposed pension reforms in Sweden and Norway - two of the must prominent welfare states in the world - illustrate the policy messages of this paper. The brand new Swedish pension system, which is mainly financed on a PAYGO basis, is characterized by a very close link between contributions and benefits. Some recent Norwegian reforms or adjustments have, however, exactly opposite characteristics. Increased minimum pensions and a weaker link between contributions and benefits in the supplementary pension have reduced the degree of marginal actuarial fairness considerably. Obviously, the new Swedish system combats escalation of early retirement while the Norwegian reforms induce more early retirement. According to our analysis, all Norwegians may loose while all Swedish individuals may gain from these reforms in the long run.

This paper has focused exclusively on the long run steady state effects of the various reforms. Of course, the next natural step is to analyze the transition path and include the intergenerational redistribution explicitly. In the current model this was not possible since the computation of the marginal contribution rate and the marginal labor income tax made it already very complicated to solve for the steady state solution. However, in future research it should be possible to design a simpler tax-transfer system which allows us to compute the transition.

References

Auerbach, A.J. and L.J. Kotlikoff (1987*): Dynamic Fiscal Policy*, Cambridge University Press, Cambridge.

Aylott, G. (1996): "Social security, the golden rule and the optimal allocation of resources: The case of endogenous retirement and a strategic bequest motive", Economic Research Paper 473, University of Warwick, Warwick.

Bratberg, E., T.H. Holmås and Ø. Thøgersen (2000): "Assessing the effects of early retirement programs", NHH Discussion paper no. 4/2000, Norwegian School of Economics and Business Administration, Bergen.

Brunner, J.K. (1994): "Redistribution and the efficiency of the pay-as-you-go system", *Journal of Institutional and Theoretical Economics*, 150, 511-523.

Brunner, J.K. (1996): "Transition from a pay-as-you-go to a fully funded pension system: The case of differing individuals and intragenerational fairness", *Journal of Public Economics*, 60, 131-146.

Fehr, H. (1999): *Welfare effects of dynamic tax reform*, Mohr Siebeck Publishers, Tübingen.

Feldstein, M. (1995): "Would privatizing social security raise economic welfare?", NBER Working paper no. 5281, National Bureau of Economic Research, Cambridge MA.

Fenge, R. (1995): "Pareto-efficiency of the pay-as-you-go pension system with intragenerational fairness", *Finanzarchiv*, 357-363.

Gruber, J. and D. Wise (1997): "Social security programs and retirement around the world", NBER Working Paper no. 6134, National Bureau of Economic Research, Cambridge, MA.

Hernæs, E., M. Sollie and S. Strøm (2000): "Early retirement and economic incentives", *Scandinavian Journal of Economics*, forthcoming.

Hu, S.C. (1979): "Social security, the supply of labor, and capital accumulation", *American Economic Review*, 69, 274-283.

Kotlikoff, L.J. (1996): "Privatization of social security: How it works and why it matters", in: J.M. Poterba (ed.), *Tax policy and the economy*, Cambridge MA., 1-32.

OECD (1998), "The retirement decision", in *Economic Outlook 1998*, 179-192.

Raffelhüschen, B. and A.E. Risa (1995): "Reforming social security in a small open economy", *European Journal of Political economy*, 11, 469-485.