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The budgeting and economic consequences of ageing in the Netherlands

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Abstract

The costs of population ageing are primarily reflected in larger expenditures on pensions and health care. This paper explores the consequences of ageing for the Netherlands in a baseline scenario simulated with a dynamic general equilibrium model. We discuss the sensitivity of the results under alternative projections for population ageing. We explore also the effects of three types of social security reform: a reduction in benefits, an increase in the retirement age and smoothing of the public pension premium over time. We find that the welfare effects of ageing and the reforms are substantial.

Keywords: Population ageing; Pensions; Dynamic general equilibrium model; Social security reform; Public pension premium

1. Introduction

All OECD countries will be confronted with an ageing population. For some countries, the peak in the number of elderly people will occur earlier than for other countries and for some countries the share of the elderly in the total population will be higher at its peak than for other countries. Nevertheless, the demographic pattern

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will be broadly the same for all these countries.[1] This shift in the age composition of the population will have far-reaching consequences for economic growth and the intergenerational distribution. The increase in the dependency ratio will erode the base of taxes and social security contributions, which requires either a substantial increase in contribution rates or a reform of social security.[2]

These scenarios raise a number of questions. How reliable is the projected increase in the tax burden of the current social security systems? What are the expected welfare costs of maintaining these systems for current and future generations? What options exist for a reform of social security to counter a projected rise in the excess burden? What will be the effect of these measures for the intra-generational distribution and, in particular, the low-income households?

A large number of studies have appeared that address these questions. Most studies use an overlapping generations (OLG) framework to disaggregate the household sector by age (exceptions are Cutler et al., 1990, and Turner et al., 1998). A particularly useful approach is the method of intergenerational accounting, introduced by Auerbach et al. (1991). A recent article by Kotlikoff and Leibfritz (1999) compares the intergenerational accounts for a large number of countries. From this study, it appears that most countries face serious deficits in the second quarter of this century, resulting in a substantial generational imbalance.

For the Netherlands, Ter Rele (1998) estimates that the tax burden of future generations needs to rise only a few percentage points, due to a future increase in labour participation and the substantial funding of Dutch pensions. In line with the method of intergenerational accounting, this assumes an equal burden for all unborn generations. Van Ewijk and Ter Rele (1999) explore the consequences of this policy for the government budget. It appears that this implies a substantial budgetary surplus for the government for the next three decades.

In comparison with generational accounting, applied general equilibrium (AGE) models with overlapping generations offer a much larger scope of policy options.[3] Auerbach et al. (1989) is an early study that uses an AGE/OLG model to explore the consequences of ageing for saving and factor prices. They too find a substantial increase in the burden of future generations. In addition, the model predicts a sizable decline in the interest rate and an increase in the real wage, providing a partial compensation to young generations for the increase in tax rates. On the normative side, the authors compare the welfare effects of a number of policies and show that a cut in social security benefits most generations, although the current old generations

[1] De Beer and de Jong (1998) provide demographic projections for the countries in the European economic area.

[2] For example, Gokhale et al. (1999) estimate that for the United States to balance the budget of the social security and medicare funds an immediate and permanent increase by 15.8% of the income tax rate is needed, keeping real federal purchases constant.

[3] There is no need to assume an equal tax burden for unborn generations, which is not a useful benchmark anyway, as it does not imply an equal distribution of welfare, considering that factor prices respond to shifts in the supply of labour. In addition, a general equilibrium model takes the welfare effects of ageing for existing generations into account. Most importantly, it enables us to take into consideration the rise in the excess burden that results from the demographic shift.

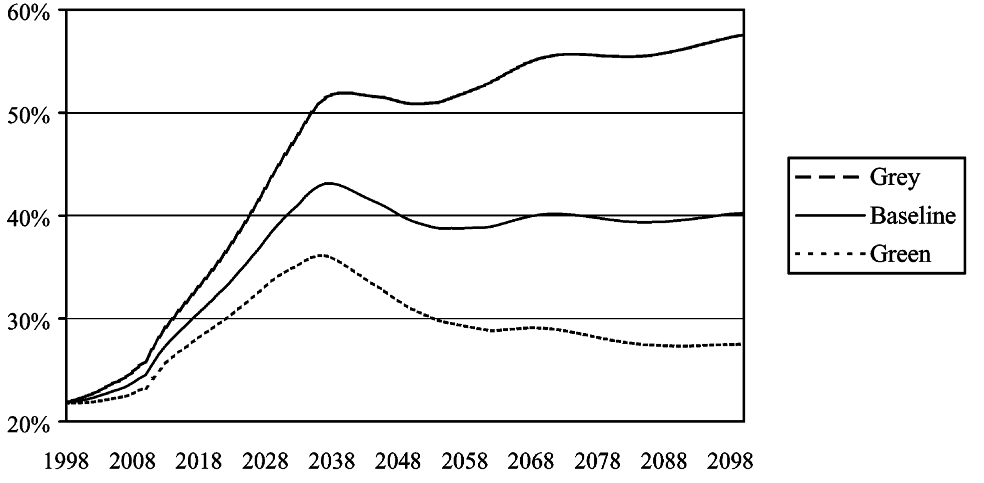

Fig. 1. Dependency ratio of number of 65 years and older divided by number of 20–64 years old (%).

suffer. Miles (1999) updates the analysis for the UK and Europe as a whole, with similar conclusions.

By cutting unfunded social security, the government provides households with an incentive to increase their private savings to replace pension benefits by capital income. The efficiency gains of this policy arise from two sources, namely the tighter linkage between contributions and benefits and the higher rate of return of funded systems in an era without population growth. This policy is, therefore, similar to a privatization of social security, as discussed in Feldstein (1998). The drawback of this reform is that during the transition period some generations have to contribute both to the unfunded social security system and for the funded one. To reduce the adverse distributional consequences of pension reform for existing generations, therefore, requires a transition period, which reduces the effectiveness of the system.

This raises the question under what conditions a Pareto improving reform of social security is possible. Theoretical research by Raffelhüschen (1993) and Breyer and Straub (1993) has shown that a necessary condition is that the reform removes or reduces a prior existing distortion. Broer et al. (1994) provide an example of such a Pareto improving reform in an AGE/OLG model of the Dutch economy. Typically, these reforms rely on a broadening of the tax base, together with the use of debt to shift part of the burden of the reform between generations.

The case for a broadening of the tax base is also borne out by studies into the determinants of labour supply of older workers. Gruber and Wise (1997) survey the relation between social security and labor force departure in a number of countries. They conclude that in many countries social security operates de facto as an early retirement scheme. The Netherlands provide a particularly striking example of the size of the distortions involved for elderly workers. Kapteyn and De Vos

Table 1
Assumptions for the three ageing scenarios

	Fertility	Life expectancy	Immigration	Emigration
Baseline	M	M	M	M
Grey	L	H	L	L
Green	H	L	H	H

Note: M = 'middle', L = 'low', H = 'high'.

(1998) show that the combined effects of different social security schemes create an implicit tax of over 100% for workers aged over 60.

These insights are also adopted by the European Commission (2001, p. 91), which sketches three broad strategies to deal with the future costs of ageing: (1) a rapid reduction of the public debt, (2) an increase in the labour supply and (3) social security reform. Whether these policies can effect a Pareto-improving reform is doubtful, however. Kotlikoff et al. (1998), Fehr (1999) and Broer (2001) show that with intragenerational heterogeneity a Pareto-improving transition is difficult to achieve. Different income groups are affected differently by alternative financing modes of the reform and are characterised by different tax-benefit linkages.

In this paper we use an AGE/OLG model to assess the budgeting and economic consequences of population ageing for the Netherlands and to evaluate the possible effects of currently debated reforms. We consider, in particular, the effects of different demographic scenarios on the spread of the tax burden and the intergenerational distribution of welfare. Fig. 1 exhibits, for three different scenarios, the projected dependency ratios of the number of people of 65 years and older, divided by the number of 20–64 years old.[4,5] Under the baseline scenario, this dependency ratio (to be denoted by D65+) rises rapidly from 22% in 2001 to a peak of approximately 43% in 2038. After the peak, the dependency ratio falls slightly, but it remains structurally high at a level of approximately 40%. Roughly speaking, the projected pattern is the result of the baby-boom shortly after the Second World War combined with a projected fertility rate of 1.7 children per woman and a moderate increase in (projected) life expectancy. The baby boom is responsible for the slight peak towards the end of the thirties of this century, while the low fertility rate and the high life expectancy together cause the number of elderly to remain high.

The other two population scenarios are based on different assumptions about fertility and life expectancy (see Table 1).[6] Under the 'grey' scenario, primarily

[4] As a way to illustrate the ageing pattern of the population, this measure is preferred to the number of 65 years and older as a share of the total population. The reason is that the group of 20–64 years old contains almost all of those who are in the labour force, which is the group that has to bear the (financial) burden associated with an ageing population.

[5] The projections were computed in 1998 by the Central Bureau of Statistics (CBS) for the period 1999–2100.

[6] Immigration and emigration also play a role (see Table 1). The average immigrant is younger than the average person in the total population. Hence, more immigration dampens population ageing. More emigration also reduces the seriousness of population ageing, because a lot of emigrants are elderly non-residents who return to their home country.

driven by a projected lower fertility rate and a stronger increase in life expectancy, D65+ rises steeply until it reaches a peak of 52% in 2040. After the peak, it falls marginally and then resumes its rise, to reach a level of 57.5% in 2100. Under the 'green' scenario, which is based on exactly the opposite developments for fertility and life expectancy, D65+ attains a maximum of 36% in 2037 and then falls back and stabilises at a level of approximately 27.5%, still 5.5% points above the current value for D65+.

The grey and the green scenarios are rather extreme outcomes and are unlikely to materialise. Hence, it is likely that actual population developments will remain between these two extremes.[7] As these alternative projections suggest, the finding that population ageing is a very long-lasting, rather than a temporary phenomenon seems rather robust against the underlying assumptions about fertility and life expectancy (see also De Beer, 1999, and De Beer and Beetsma, 1999).

The welfare costs of an ageing population are primarily caused by the increase in unfunded pensions and the greater demand for health care. To explore the opportunities for a reduction of the costs of ageing we investigate a number of policy options. In particular, we investigate three reform measures: a 10% reduction in public pension benefits, an increase in the retirement age by 2 years and smoothing of the public pension contribution rate over time. The three types of reform have different intergenerational redistributive implications. The benefits for future generations are largest in the case of contribution rate smoothing and smallest when the retirement age is increased by 2 years. Our simulations suggest that increasing the retirement age is relatively less attractive (at least for the Netherlands) than sometimes claimed (see European Commission, 2001, page 94).

The remainder of this paper is structured as follows. Section 2 describes the model on which the simulations are based. Section 3 discusses the budgetary and economic projections for the baseline scenario. Section 4 investigates the effects of alternative population projections, while Section 5 explores the consequences of the three alternative reform scenarios. Finally, Section 6 concludes the main body of this paper. The Appendix contains the values of the important parameters.

2. The model

The simulations are based on the model of Broer (1999), which in turn is an extension of the model developed by Broer and Westerhout (1997). The Broer (1999) model is a dynamic general equilibrium representation of a small open economy (the Netherlands). The model contains eight sectors and four markets. The sectors are the households, private enterprises that produce tradables, private health insurance firms, a health care sector, public health insurance [basic health care and AWBZ (special medical treatments—see below)], a pension sector (basic and supplementary pensions), a government sector and a foreign sector. The markets are the labour market, the tradeable goods market, the market for health care and the

[7] The area between the green and the grey scenarios corresponds closely to the 95% confidence intervalobtained with simulations at the CBS (see Alders, 2001): they find that there is a 95% chance that D65+ lies between 33% and 52% in 2040.

capital market. Wages and the price for health care are domestically determined, while the prices for tradables and capital are determined on world markets. The capital and output markets are perfectly integrated into the world market. Labour, however, is perfectly mobile across sectors, but completely immobile across borders.

The population has an overlapping generations structure with individual death hazards that increase with age. Individuals not only differ by age, but within each generation they also differ in terms of their productivity and, therefore, their income. In other words, there is both inter- and intra-generational heterogeneity in the model. The heterogeneity implies that the important ratios, e.g. the savings ratio, labour productivity and labour participation, are all affected by changes in the age composition. To incorporate these effects, the model is calibrated on the actual, non-steady-state, demographic projection.

2.1. Firms

The model distinguishes a number of sectors of private business, viz., the tradable sector, the health care sector, private health insurance firms, public health insurance firms, and AWBZ insurance firms. Firms in the tradable goods sector maximise the present value of dividends, net of taxes and social security contributions. Changes in the capital stock are subject to adjustment costs. Firms issue debt in a fixed proportion to the value of their capital, so that the marginal source of finance is retained earnings. The production function is characterised by a two-layer (nested) constant-elasticity-of-substitution (CES) structure. The first layer is a CES function F[.] of raw materials and value added. The second layer is a CES function G[.] of capital and (effective) labour. Domestically-produced tradables are perfect substitutes of foreign goods. Although workers differ by age and skill type, all sources of labour input are perfectly substitutable. The production function may be written as

$$y = F[M,H] - \frac{1}{2} c_I I^2 / K \tag{1}$$

$$H = \mathrm{G}[K, L_{\mathrm{eff}}] \tag{2}$$

$$L_{\mathrm{eff}} = (1+\alpha)^t \sum_{t_0=-\infty}^{t} \int_0^1 h(i, t-t_0) L(t, t_0; i) \mathrm{d}i \tag{3}$$

where y denotes final goods production, M materials, H value added, I investment, K capital, and L_{eff} labour supply in efficiency units. Finally, $L(t, t_0; i)$ is the number of type-i households born in period t_0 and still alive in period t. The second term in Eq. (1) represents internal adjustment costs, which affect the short-run international mobility of physical capital. $h(i, \tau)$ denotes the exogenous productivity of a household of type i and age τ. t_0 is the generation index. Even though all labour is perfectly substitutable, the age composition of the working population does matter, since middle-aged workers have the highest productivity. For a given size of the work force, labour supply in efficiency units, therefore, increases if the average age of the population increases. Finally, technological progress is purely labour augmenting at rate α.

The market value of the firm V follows from the portfolio decisions of investors. It is assumed that the marginal investor is a working-age domestic household.[8] Investment is financed through retained earnings and debt. With perfect capital markets, the arbitrage equation reads as

$$\frac{V(t+1)-V(t)}{V(t)}+(1-t_d(t))\frac{Div(t)}{V(t)}=(1-t_k(t))r(t) \tag{4}$$

where t_d is the comprehensive dividend tax rate (including the basic pension premium and the AWBZ premium) and Div denotes dividends.[9] The right-hand side of the equation represents the alternative return on bonds for young households, where t_k is the comprehensive capital income tax rate (including the basic pension premium and the AWBZ premium) and r is the world real interest rate. Integrating Eq. (4) backwards gives the expression for the market value of firms. The firms are owned by working-age domestic households.

Firms in the health care sector and the insurance sectors use a fixed-coefficients technology, which requires only labour input. For example, for the health care sector the required labour input is:

$$L_z(t)=\bar{\zeta}_z(t)y_z(t) \tag{5}$$

where $y_z=c_{ZP}+c_{ZF}+c_a$ denotes demand for health care from privately insured households, publicly insured households, and AWBZ care, respectively (see below). Furthermore, $\bar{\zeta}_z(t)$ represents the required number of efficiency units per hour of health care.[10]

2.2. Households

Households are distinguished by age and by productivity. The productivity distribution is exogenous but varies by age. Let the productivity distribution be denoted by $P(h, \tau)$, where h denotes productivity and τ age. It is assumed that the productivity ranking of households is invariant by age (i.e. no cross-overs), so that productivity h defines a household type i according to its position in the distribution, $i=P(h, \tau)$.

Each household/individual has an age-dependent probability of dying in a given period. Let $\Lambda(t, t_0)$ denote the proportion of people of generation t_0 that survive to at least age t, then the death hazard of a person of generation t_0 and age t is $\lambda(t, t_0)=1-\Lambda(t+1, t_0)/\Lambda(t, t_0)$. This death hazard typically rises with age at an

[8] This assumption is required to achieve shareholder unanimity, as a consequence of the different income tax rates for pensioners and working-age households.

[9] In 2001 the Dutch tax system, in particular taxation of capital income, was reformed. These changes are not incorporated in this version of the model.

[10] In the sequel, variables that are indexed only by t, denote aggregate (average) variables or variables that apply to every individual in period t.

increasing rate. Households maximise their expected lifetime utility over the consumption of goods, health care and leisure, subject to their lifetime budget constraint and a constraint for the available amount of time in each period. The expected utility of a person of generation t_0 at time t is given by

$$\frac{1}{1-1/\gamma}\sum_{\tau=t}^{\infty}(1+\beta)^{t-\tau}\frac{\Lambda(\tau-t_0+1,t_0)}{\Lambda(t-t_0+1,t_0)}u(\tau,t_0)^{1-1/\gamma} \tag{6}$$

where γ denotes the intertemporal elasticity of substitution and β the rate of time preference. The utility flow $u(\tau,\ t_0)$ depends on current consumption of goods c, consumption of leisure v, and consumption of health care c_z. Consumption of goods is separable from leisure and health care, $u=u(c,\ c_v(\theta_v v,\ \theta_z c_z))$ where both $u(.,.)$ and $c_v(.,.)$ are CES functions of their arguments. The preference coefficients θ_v and θ_z depend on both time and age, in such a way that the demand for leisure and health care increases with age to match the observed consumption profiles of both categories. Households divide the available time ($l_{\max}$) between leisure, health care and labour l,

$$l(t,t_0)=l_{\max}-v(t,t_0)-c_z(t,t_0) \tag{7}$$

This formulation implies that the opportunity costs of time are an important component of the costs of consumption of health care.

Households insure themselves against their death risk by bequeathing their remaining assets to an insurance company that pays them a return on their assets as long as they are alive. In terms of the taxes and social security contributions they have to pay, we need to distinguish households along the following dimensions: young and old (i.e. whether they have a pension income or not), whether they are covered by public or private health insurance (public insurance is mandatory below a certain income level) and whether they accumulate supplementary pensions (high income) or not (low income). Young households sell their shares upon reaching the retirement age as a result of tax arbitrage (see footnote 8).

The dynamic budget restriction for a household is as follows[11]

$$\begin{aligned}A(t+1,t_0)=&(1+(1-t_k(t))r(t))A(t,t_0)+\lambda(t,t_0)A(t+1,t_0)\\&+(1-t_y(t)-\pi^y(t,t_0))(p_l(t,t_0)l(t,t_0)-\pi_{FC}(t,t_0))\\&+(1-t_y(t))(y_{FC}(t,t_0)+y_{\mathrm{PAYG}}(t,t_0))-\pi_Z(t,t_0)\\&+T(t,t_0)-(1+t_c(t))c(t,t_0)\end{aligned} \tag{8}$$

Here, A denotes financial assets, t_y denotes the tax rate on non-capital income and π^y denotes the PAYG contribution rate. Households of age 65 and older do not pay pension contributions, so π^y is zero for old generations. The first term on the right-hand side of Eq. (8) represents after-tax capital income. The second term represents after-tax annuity income from the life insurance fund. Life insurance pays a fraction $\lambda(t,\ t_0)$ of end-of-period assets, which corresponds to the bequests left to

[11] In order not to burden the notation unnecessarily, we leave out the reference to the productivity type. However, all decision variables and the wage rate are dependent on the type of the household. The complete equations are given in Broer (1999), Eqs. (30)–(32).

the fund by the fraction of households that dies at the end of period t. The third term denotes the after-tax labour income (with $p_l(t,t_0)=p_l(t)h(t-t_0)$ the wage earned by the household per unit of time spent working). Contributions to the occupational pension fund π_{FC} are deductible from labour income, while the benefits later in life are taxable at the then going rate (the first term in line three). y_{FC} denotes the benefits from the occupational fund and y_{PAYG} denotes the benefits received from PAYG social security. π_Z denotes the contributions to the health insurance sector. The effects of the pension system and the health care system on marginal tax rates are discussed in Sections 2.3 and 2.4. Finally, T denotes transfers and t_c denotes the consumption tax rate.

It is assumed that the maximum age a household can reach is 100, i.e. $\lambda(99, t_0)=1$. In the absence of a bequest motive, the lifetime budget constraint may then be written as $A(100, t_0)=0$ Due to a lack of data, the distribution of assets over existing generations at the start of the simulation period is assumed to equal the steady-state distribution. Households maximise expected lifetime utility, given by Eq. (6), subject to their lifetime budget constraint and the time constraint, Eq. (7).

2.3. The pension system

The pension sector is characterised by two (complementary) schemes. The first is a public pension scheme (AOW), which operates on a pay-as-you-go (PAYG) basis. It provides a flat, minimum benefit to any person of 65 years or older. The scheme is financed through levies on labour and capital income of those younger than 65 years. Those who are 65 years or older are exempt from AOW contributions. Budgetary balance of the PAYG fund requires adjusting the contribution rate π^y each period so that

$$y_{\mathrm{PAYG}}(t)N_o(t)=\pi^y(t)(p_l(t)L^y_{\mathrm{eff}}(t)-\Pi_{FC}(t)+y_K(t)) \tag{9}$$

where N_o denotes the number of elderly, L^y_{eff} the total labour supply of those under 65 years in efficiency units, Π_{FC} the total contributions to the occupational pension scheme and y_K the aggregate capital income of young households (excluding capital gains).

The occupational scheme supplements the AOW for retired households who previously enjoyed wages above the social minimum. The scheme is funded and its benefits are based on the final pay and the number of contribution years. Contributions to this supplementary pension scheme are levied on labour income if it exceeds a certain threshold (the franchise). These contributions are deductible for income tax and AOW contributions. However, the benefits will be subject to income taxation.

Contributions to the occupational fund per participating household are given by

$$\pi_{FC}(t,t_0,i)=w(t)\max\left[p_l(t,t_0,i)-f(t),0\right]l(t,t_0,i) \tag{10}$$

where $f(t)$ denotes the franchise and $w(t)$ the contribution rate. The payment, like the contribution, is in excess of the franchise. It is based on the final wage, and the number of contribution years:[12]

$$y_{FC}(t,t_0,i) = \frac{p_l(t)}{p_l(t_0+n_y)} \max\Big[p_l(t_0+n_y,t_0,i) - f(t_0+n_y),0\Big] ac \sum_{\tau=t_0}^{t_0+n_y-1} l(\tau,t_0,i)\chi_{FC}(\tau,t_0,i) \tag{11}$$

The first term on the right-hand side covers the wage indexation of the benefits. The second term checks whether the final wage exceeds the franchise at the statutory retirement age, n_y. Finally, ac denotes the accumulation rate of pension rights, while the last term gives the number of contribution years.

Regulations in the Netherlands require that occupational pension funds hold sufficient capital to cover the projected benefit obligations accumulated thus far. The present value of benefit obligations can be obtained from future pension payments, assuming that no further contributions to the fund are made.[13] Denote the projected benefit obligation by PBO(t). Then, the pension contribution rate $w(t)$ is determined by the requirement that

$$A_{FC}(t+1) = A_{FC}(t)\frac{\mathrm{PBO}(t+1)}{\mathrm{PBO}(t)}\left(\frac{\mathrm{PBO}(t)}{A_{FC}(t)}\right)^{\lambda_{FC}} \tag{12}$$

where A_{FC} denotes the assets of the occupational pension fund,

$$A_{FC}(t+1) = (1+r(t))A_{FC}(t) + \sum_{t_0=-\infty}^{t}\int_0^1 (\pi_{FC}(t,t_0,i) - y_{FC}(t,t_0,i))\mathrm{d}i \tag{13}$$

We use $\lambda_{FC}=0.1$ to represent the lagged adjustment of contribution rates to changes in returns. It follows that the path of the contribution rate depends not only on current contributions and benefits, but also on future wages and interest rates. The future development of the contribution base plays a role only in so far as it affects wages.

2.4. The health insurance sector

Contributions to the health insurance system depend on the income level of the household. Low-income (i.e. low-productivity) households are publicly insured. They pay a contribution $\pi_{ZF}(t)$ which is proportional to their labour income, as well as a small nominally fixed contribution. The public health insurance system, which operates on a PAYG basis, reimburses nearly all health care expenditures. Higher-income households are privately insured. They pay a lump sum contribution $\pi_P(t)$. The private health care system reimburses a fixed proportion of the health care expenditures of their clients. Within the public health insurance sector there is also a second scheme (the AWBZ), to which both publicly and privately insured

[12] $\chi_{FC}(\tau, t_0, i)$ equals unity if household i contributed to the fund in year t, and zero otherwise.

[13] For the actual expression, see Broer (1999), Eq. (80).

households contribute. The AWBZ provides coverage for special medical treatments. For young households, the contributions to the health insurance system are specified as

$$\pi_Z(t,t_0)=\begin{cases}\pi_{ZF}(t)y_L(t,t_0)+\pi_{\text{AWBZ}}(t)(y_L(t,t_0)+y_K(t,t_0)) & \text{for } p_l(t,t_0)<g_{ZF}(t)\\ \\ \pi_P(t)+\pi_{\text{AWBZ}}(t)(y_L(t,t_0)+y_K(t,t_0)) & \text{for } p_l(t,t_0)>g_{ZF}(t)\end{cases} \tag{14}$$

$$y_L(t,t_0)=pl(t,t_0)l(t,t_0)-\pi_{FC}(t,t_0)+T(t,t_0)$$

where π_{AWBZ} denotes the AWBZ contribution rate and g_{ZF} the public health insurance income threshold.[14] The important point about the contribution to the health insurance system is that it acts as a distortionary tax that is *higher* for low-wage households.

Health insurance funds adjust the contribution rates to balance their budget each period. For the public health insurance fund, this requires that $\pi_{ZF}(t)$ be set so that expenditures equals income, where the latter is obtained by multiplying $\pi_{ZF}(t)$ by the contribution base of publicly insured households, and adding any subsidies from the government. The contribution rate is, therefore, nearly proportional to the average consumption of health care services by households, and as a result it will tend to rise with the average age of the insured households. Other insurance funds operate in a similar way.

2.5. The government

The productive activities of the government consist of education and general government. Both activities require only labour, in fixed proportions per skill type, as input. The amount of education to be provided for a given household is exogenous, but age-dependent. Labour input required for general government is proportional to the population size. Other expenditure categories for the government are interest payments on public debt, disability insurance payments, transfers to households, transfers to foreigners and the public health insurance subsidy. Disability insurance payments depend on the (exogenous) age–disability profile. The public health insurance subsidy is proportional to reimbursements for health care by the public health insurance sector. Transfers to households are linked to population size and net wages, while transfers to foreigners are linked to population size and productivity growth. On the revenue side the government disposes of income taxes (labour income, interest income and dividend), indirect taxes and corporate taxes. The government achieves budgetary balance by adjusting the income tax rate to maintain a constant debt/GDP ratio.

3. Simulation results

The simulations are based on the national accounts (and other data) for 1999. Except for population growth, the calibration uses a steady-state growth path for all

[14] Retired households remain with the fund they were insured with the last year of their working life.

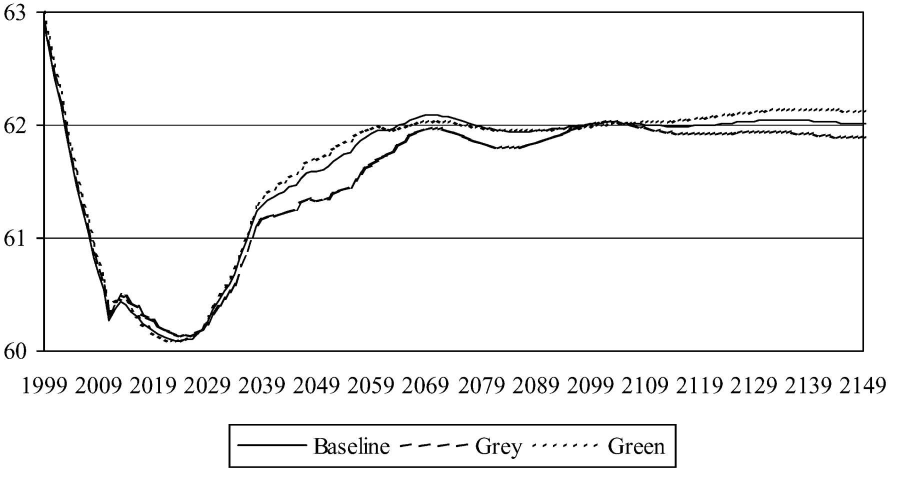

Fig. 2. Labour participation rate of 18–64 year old (%).

exogenous variables for the period after 1999. All the simulations (except for those based on the 'grey' or 'green' scenarios—see Section 4) use the baseline population projection, as shown in Fig. 1. The simulations based on the alternative demographic projections are implemented after a re-calibration of the model. The calibration for the other scenarios is identical to that of the baseline. The simulations of the model are run until 2200 (in order to attain a steady state), under the assumption that the population composition remains constant as of 2101.

The variants we discuss below all assume that the public debt/GDP ratio and the (world) real interest rate are held constant at 58% and 5%, respectively. The income tax rate acts as the closure variable for the intertemporal government budget constraint. In other words, the income tax rate is endogenous, while the other tax rates are exogenous. The social security contribution rates (AOW, public health care and AWBZ) are endogenous, because they adjust to balance the corresponding budgets.

3.1. The baseline case

The labour participation rate, measured as the share of the total amount of time available to 18–64 years old that is spent on working, falls from 62.4% in 2001 to a minimum of 60.1% in 2024 (see Fig. 2).[15] The participation rate in the labour force is driven by several factors. First, the working-age population itself grows older and older workers have lower participation rates, ceteris paribus. Second, there is an intratemporal substitution effect from goods consumption to time-related consumption (health care and leisure), caused by the increase in the tax and

[15] This figure excludes participation increases arising from social and cultural trends that are not a result of policy changes; see the projections in CBS/CPB (1997).

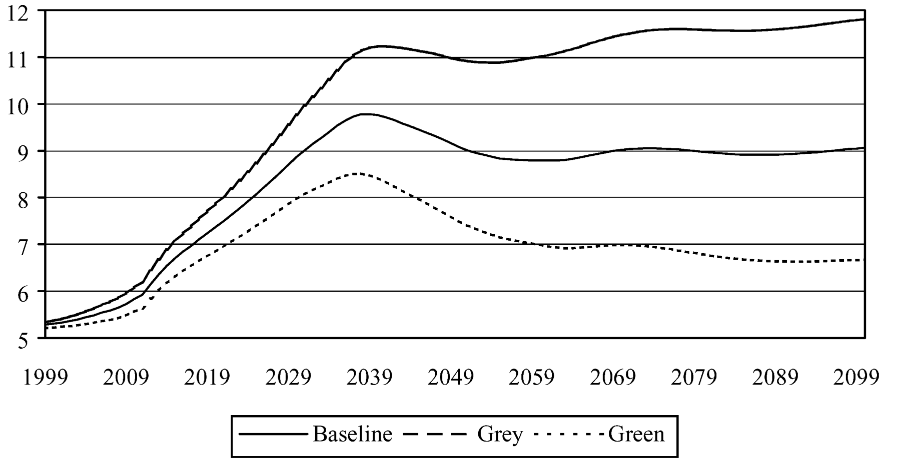

Fig. 3. AOW as a share of GDP (%).

contribution wedge. Finally, the growing wedge reduces the net future income. This implies a fall in individual wealth, which stimulates the labour supply. Apparently, this last effect is too small to offset the other two effects in the run-up to the ageing peak.

The projections, thus, show that the costs of population ageing have to be borne by the falling share of the population that actually works. This is, in particular, the case for schemes that are financed on a pay-as-you-go basis. Such schemes are balanced on a year-by-year basis. Hence, any disbursements in a year have to be matched by levying contributions from working households.

Indeed, as Fig. 3 reveals, AOW (public pension) contributions as a share of GDP rise from 5.3% in 2001 to a peak of 9.8% in 2039. After having reached their peak, they fall slightly and remain at a level of approximately 9%. The steep increase in the AOW contribution rate is the result of two factors that work in the same direction. First, the number of public pensions to be paid out rises relative to the number of people in the labour force. Second, the distortions that arise from the contribution rate increases (not only AOW, also other social security contributions) lead to reduced labour participation rates, as described above. In effect, the pattern of the AOW contribution closely follows the projection of D65+.

Fig. 4 depicts the public health sector as a share of GDP. The public health sector is defined as the sum of the public health expenditures and the AWBZ expenditures. It follows a time pattern that is very similar to that projected for the AOW. The pattern arises from the fact that the elderly demand more health care than the average population member. The public health sector as a share of GDP increases from 7.3% in 2001 to a maximum of 10.5% in 2040.

The projected contribution rate for supplementary pensions rises during the first two decades of this century (see Fig. 5). The reason is that supplementary pension benefits are indexed to the wage rate, which increases as a result of the fall in the

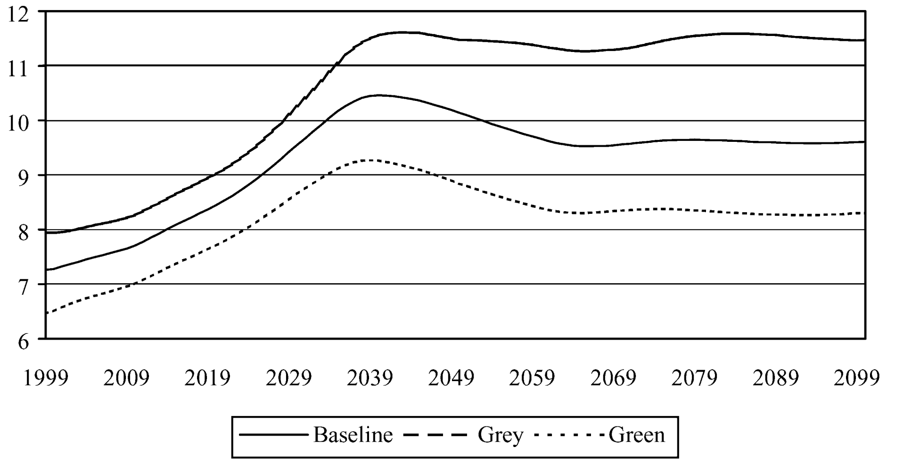

Fig. 4. Public health sector as a share of GDP (%).

labour supply. However, the increase in the contribution rate is very moderate: approximately 1 percentage point between 2001 and 2020. The reason is that the pension funds already own a substantial amount of assets (105% of GDP in 2001), because they are legally required to be able to cover the (discounted) accumulated pension rights of those already participating in the fund. In the event of a mismatch between pension assets and projected pension obligations (for example, as a result of a wage rise), the gap between these two will be closed at an assumed rate of 10% a year.

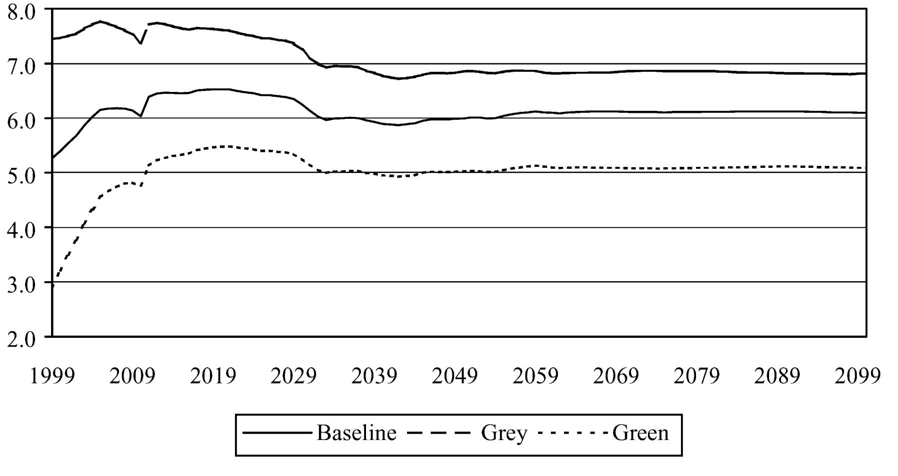

Fig. 5. Supplementary pension premium (%).

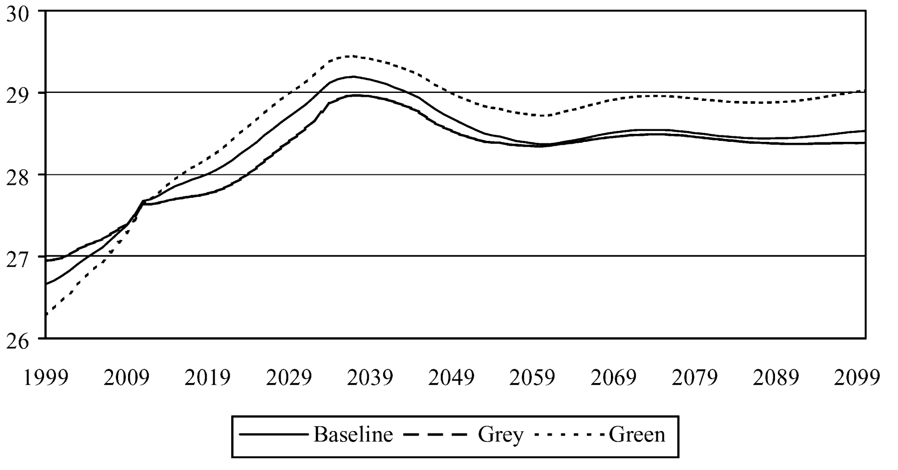

Fig. 6. Total taxes as a share of GDP (%).

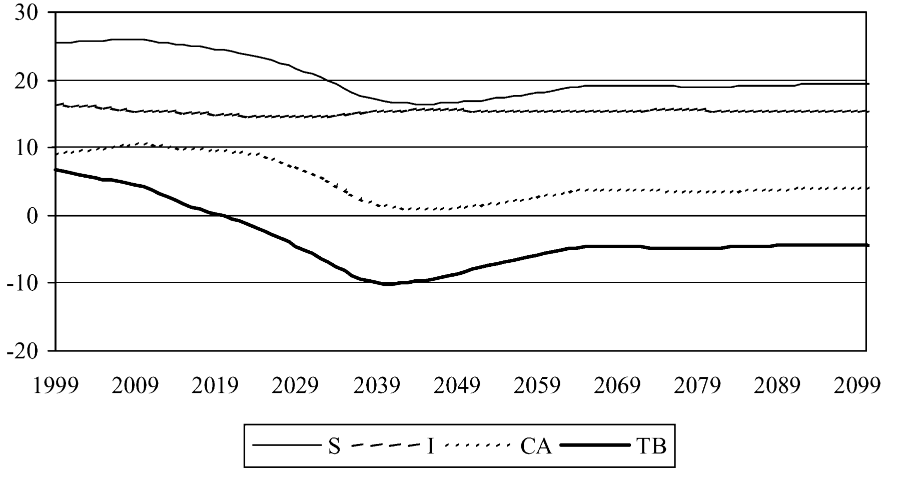

Fig. 7. Savings, investment, current account and trade balance as shares of GDP in the baseline (%).

Total taxes as a share of GDP (Fig. 6) rise from 26.8% in 2001 to a peak of 29.2% in 2037.[16] This change can largely be attributed to higher consumption tax revenues. While income tax revenues fall during the coming 2 decades (following the fall in the labour supply), consumption tax revenues rise sharply, because consumption as a share of GDP increases substantially. This increase is in line with the ageing pattern of the population. The total collective sector as a share of GDP is computed by adding AOW (Fig. 3), the public health sector (Fig. 4) and total

[16] These figures, thus, exclude AOW and the contributions paid to the public health sector.

tax revenues (Fig. 6). It increases by approximately 10 percentage points, from 39.4% in 2001 to a peak of 49.4% in 2039.

Fig. 7 shows national savings as a share of GDP. National savings is defined as the sum of private and public sector savings. Over the coming years the national savings rate will rise marginally to a maximum of 25.9% in 2008, after which it declines until it reaches a minimum of 16.4% in 2045. This fall in savings is explained by the increase in the number of old people that draw from their private pensions. The elderly reduce their (pension) wealth, thereby reducing national savings.[17] Investment as a share of GDP (also depicted in Fig. 7) falls by approximately 1.7 percentage points between 2001 and 2028, when this ratio reaches its lowest level. This fall is primarily the result of a shift of labour to sectors that use no capital (the health care and health insurance sectors).

The fall in investment and the initial increase in the savings rate are reflected in an improvement in the current account, which rises from 9.3% in 2001 to 10.5% in 2010. After 2010, the current account starts falling until it attains a minimum of 0.9% in 2045. The first three decades of the fall are driven by the falling savings rate, which dominates the falling investment rate. After 2028, investment picks up again, which, together with a savings rate that is still falling, causes the current account to deteriorate further. Consumption smoothing over time is reflected in the trade balance. The accumulation of foreign assets allows a deficit on the trade balance, starting in 2020. In the long run, interest earnings on foreign assets finance the trade balance deficit of 5.5%.

Fig. 8 displays the average (over productivity types) relative compensating variations for generations born at different points in time. The relative compensating variation of a particular generation is defined as the percentage increase in its (remaining) lifetime wealth needed to ensure that it experiences the same lifetime utility, corrected for technological progress, as the base generation, which is the one that enters (at age 18) the labour market in 1999. The correction is needed because on a steady-state growth path the utility of future generations will be higher as a result of technological progress.[18] The time-profile of the relative compensating variations is, thus, a way to illustrate the intergenerational distribution of the costs of population ageing. Indeed, along a steady state growth path [which requires a constant population composition by age (and skills)], the relative compensating variations will be equal to zero for all generations.

All generations that entered the labour market before 1999 are better off than the one that entered in 1999, because these older generations need to contribute (or have contributed) less to the costs of population ageing, while all the younger and future generations contribute more and are worse off. Fig. 8 makes clear that the

[17] The increase in the number of public pensions and the increase in the demand for health by the old do not have a direct effect on national savings, because these schemes are financed on a pay-as-you-go basis.

[18] The correction is obtained by premultiplying generation t's utility by a factor $(1+\alpha)^{(1999-t)/(1-1/\gamma)}$, where t is the year in which the generation enters the labour market, $\alpha = 0.02$ and $\gamma = 0.25$.

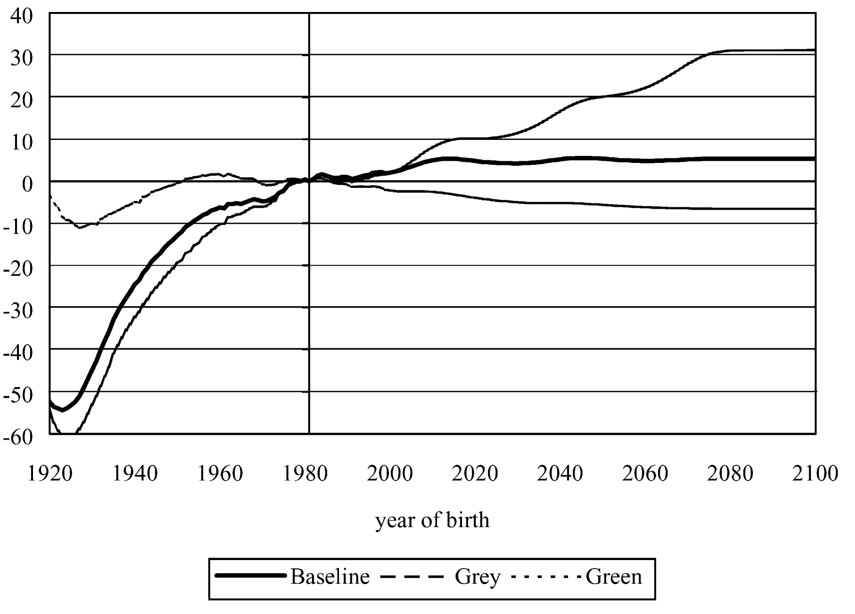

Fig. 8. Compensating variations, relative to 1981 generation (%).

relative compensating variations and, hence, the implicit intergenerational redistribution caused by population ageing are large (5.3% in the long run).

4. Alternative scenarios for exogenous variables

The model has been re-calibrated for two alternative population projections, the 'grey' and the 'green' scenarios (see Fig. 1). As mentioned in the Section 1, the grey scenario is primarily driven by assumptions about a favourable development of the life expectancy and a further reduction in fertility rates. The green scenario is based on exactly the opposite assumptions. We explore these two, rather extreme scenarios, because there is quite a lot of uncertainty about the future demography. These alternative scenarios provide us with an idea about the size of the implied deviations of key variables from their baseline paths. In addition, when contemplating policy adjustments in response to adverse demographic developments, there may well be a case for 'playing safe' and implementing policies that are robust against a substantially worse outcome of the ageing problem than under the baseline projection. This is especially important if one realises that the effectiveness of many policy responses increases, the further they are taken before the peak in the population ageing.

4.1. The 'grey' scenario

The implications of the grey scenario are straightforward. The increase in the average age of the labour force reinforces the fall in the labour participation rate

(Fig. 2). This development is exacerbated by the additional increase in the wedge between the gross and the net wage. Relative to the baseline, AOW as a share of GDP keeps on rising over the entire time horizon (Fig. 3). By the end of the century it exceeds its baseline level by more than 17 percentage points. The contribution rate for the supplementary (private) pension (Fig. 5) initially exceeds its baseline value by 2 percentage points. The difference is gradually reduced and stabilises at a level that is approximately 0.7 percentage points above the baseline path. The initial increase in the contribution rate for the supplementary pension results from a mismatch between pension assets and pension obligations. Next to the increase in life expectancy, obligations rise because the future fall in the labour supply boosts wages. With pensions of a defined-benefit nature, the obligations towards those that have already retired or that have entered the labour market before 1999 rise. In the long-run, the contribution rate for the supplementary pension remains above its baseline level, because of the permanently lower labour supply. The other major change implied by the grey scenario concerns the public health sector (Fig. 4), which, as a share of GDP, exceeds its baseline projection at the end of the century by 1.9 percentage points.[19]

The salient feature of the grey scenario is the dramatic increase in the excess burden of future generations, as shown in Fig. 8. In the long run, the welfare loss is more than 30% of lifetime income. This would imply that for the next few decades, the increase in income due to technical progress is largely annihilated by the increase in the tax burden. In comparison with the base scenario, the much larger increase in the excess burden indicates that the social security system is stretched to its limit in this scenario, so that a reform becomes inevitable.

4.2. The 'green' scenario

The green scenario contrasts with the grey scenario in that life expectancy does not increase and fertility does not fall. AOW payments as a share of GDP steadily fall over time relative to the baseline (see Fig. 3), although they rise in absolute terms during the coming decades. After reaching a peak in 2038, the share settles on a declining trend for the remainder of the century. Nevertheless, it always remains substantially above its current level. The contribution rate for the supplementary pension (Fig. 5) immediately drop by 2%-points as a result of the initial mismatch between assets and obligations. Afterwards, it rises more than in the base scenario, but it stays at a lower level permanently. Similar to the AOW social security contributions, the size of the public health sector increases (Fig. 4), although it remains smaller than under the baseline. As in the other demographic scenarios,

[19] A problem with both the 'grey' and the 'green' scenario is that public health expenditures already deviate in the base year from the baseline scenario. This discrepancy results from an interpretation problem with the calibration of forward-looking models. Changing the life expectancy of a household will affect, through wealth effects, the consumption path over the lifecycle. In principle, a parameter from the utility function could have been varied to maintain initial health expenditures at the level of the base scenario. However, we prefer to keep utility parameters the same over the scenarios. The downside of this choice shows up in different starting levels of public health expenditure.

labour supply as a share of the working age population falls during the first two decades and starts rising again after 2024 (see Fig. 2). It stabilises above the baseline path.

In terms of the intergenerational burden, the green scenario carries a lower burden of social security and health care, but a higher burden of education and investment to match the increase in the work force. This change implies a substantially different intergenerational welfare distribution. Fig. 8 shows that under the green scenario the intergenerational distribution is fairly flat. Future generations are better off than in the base scenario, as they profit from lower health care contributions and a higher return of the PAYG public pension fund, due to the higher growth rate of the population (Aaron, 1966). In contrast to the grey scenario, old generations are not necessarily better off than current young generations. They do not only face the increase in tax rates, necessary to finance the increase in education expenditures, but they also profit less from the future decline in social security and health care contributions.

5. Social security reforms

We have seen that the contributions for AOW and the public health sector are expected to rise steeply in the coming decades. Given their PAYG nature, these contributions are the source of substantial intergenerational redistribution effects. In addition, the growth of the public sector, combined with the distortionary character of these contributions, gives rise to efficiency losses.

In this section we explore three types of social security reform. They all reduce the efficiency losses associated with the financing of the ageing of the population. The first measure is a 10% cut in public pension (AOW) benefits. The ensuing shift from public to private pension provision reduces the marginal wedge on labour income. The second measure is an increase in the retirement age by 2 years. The final type of reform is the smoothing over time of the AOW contribution rate. A constant contribution rate reduces the discounted value of the efficiency losses.

5.1. A reduction in public pension benefits

Under this scenario, we assume a 10% reduction in AOW benefits. Relative to the baseline, the reduction in AOW as a share of GDP increases from 0.50 percentage points in 2001 to 0.83 percentage points in 2039, when the share of AOW in GDP is largest (see Fig. 9). The reduction in the AOW contribution rate is to some extent replaced by an increase in the contribution rate for supplementary pensions. However, the contribution rate for the supplementary pension is less distortionary than the AOW contribution rate, because, in contrast to AOW benefits, the size of the future pension benefits is positively related to the contributions. The contribution rate for the supplementary pension rises as households with productivity above the franchise level are compensated for the fall in AOW benefits with an increase in supplementary pension benefits. The resulting discrepancy between the

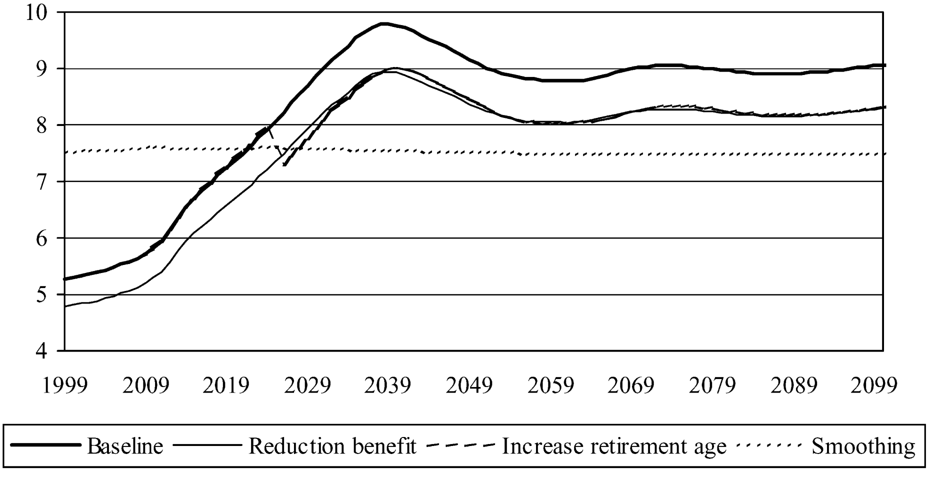

Fig. 9. AOW revenues as a share of GDP under Social Security reform (%).

pension fund's projected benefit obligations and its assets has to be closed by an increase in the contribution rate for the supplementary pension. This increase diminishes over time, as the gap between obligations and assets is reduced.

The lower AOW contribution rate reduces the marginal wedge for workers and, hence, stimulates the labour supply (Fig. 10), although the effect is very small. Fig. 11 reports the welfare effects of the pension reform. In particular, it shows the average percentage increase in the remaining lifetime wealth needed to restore utility to its level under the baseline. The reform benefits currently young and future

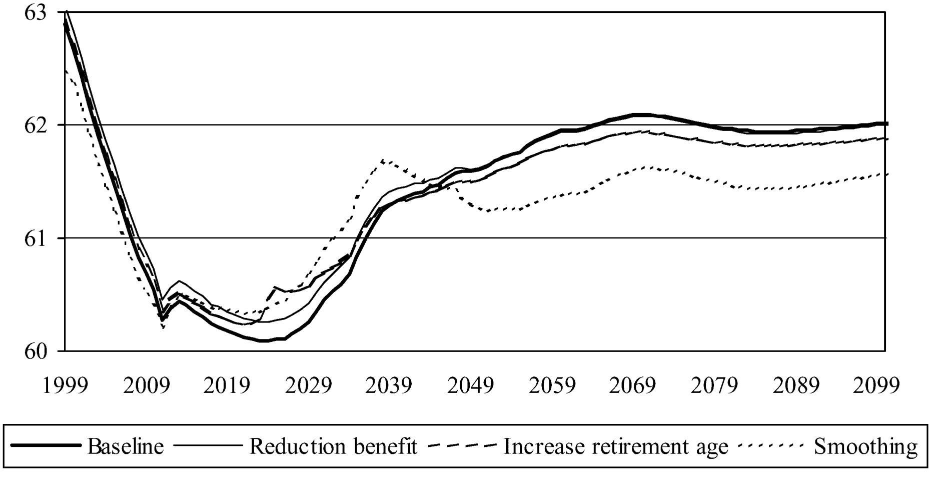

Fig. 10. Labour participation rates of 18-64 years old under Social Security reform (%).

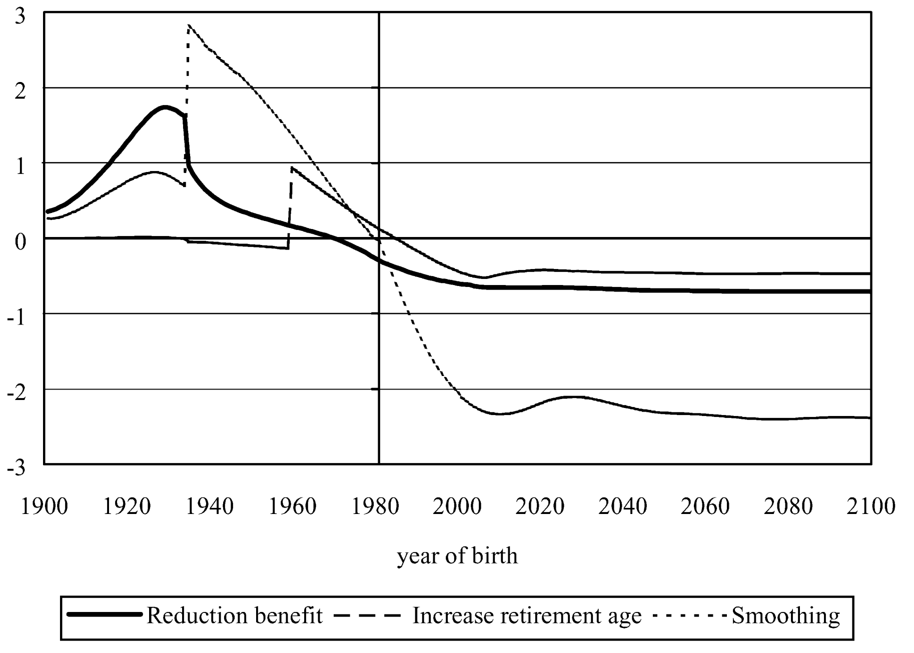

Fig. 11. Compensating variations for Social Security reform relative to the baseline (%).

generations. These generations all profit from the reduced deadweight loss. However, the other generations lose from the reform. In particular, the currently retired fail to benefit from the fall in the AOW contribution rate, because they are exempt from AOW contributions. Yet, those with productivity below the franchise level receive lower AOW benefits, without any compensation in the form of higher supplementary pension benefits.

5.2. An increase in the statutory retirement age

An increase in the statutory retirement age is often advocated (e.g. by the European Commission, 2001) as an effective way to deal with the costs of population ageing. Therefore, in this simulation, we raise the age at which individuals become eligible for AOW by two years, for all generations younger than 40 in 1999. Hence, older current generations are not directly affected by the policy reform (although they are indirectly affected through general equilibrium effects). Fig. 9 depicts a substantial drop in the AOW benefits (=revenues) in 2025 and 2026. Individuals remain eligible for a supplementary pension as of their 65th birthday. However, the abolishment of AOW for the 65 and 66 years old is assumed not to be compensated for by an increase in their supplementary pension.

The welfare effects of the reform (relative to the baseline) are summarised in Fig. 11. The losers are the generations born in the periods 1960–1984. These

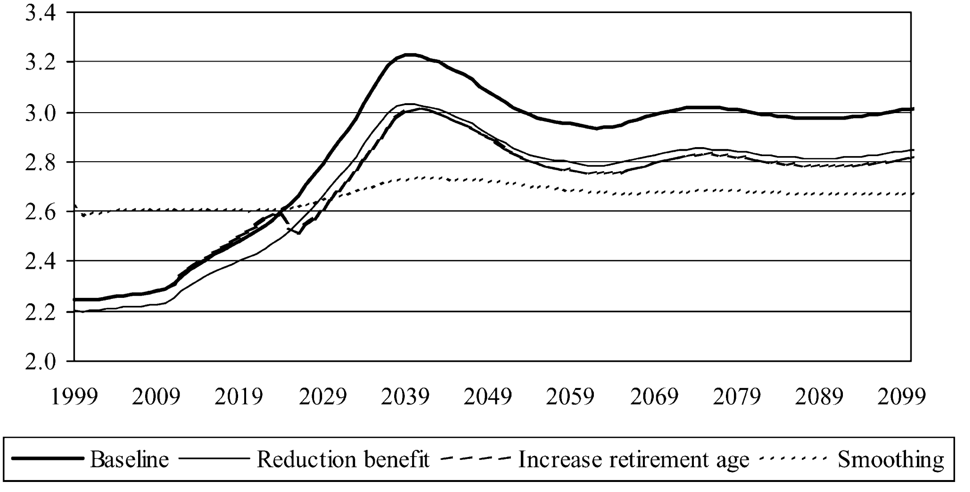

Fig. 12. Wedge on labor income.

generations pay AOW contributions for two more years, while they receive AOW benefits only from their 67th birthday onwards instead of from their 65th as under the baseline. The efficiency gains produced by the reform are not sufficient to compensate these generations. Younger generations or those born in the future are net beneficiaries of the reform (−0.5%).

On the basis of OECD-simulations, the European Commission (2001), p. 94) suggests that '…delaying retirement is a more efficient way to improve the financing situation of pensions than reductions in benefits levels'. Our simulations allow for a comparison of these reforms in terms of overall welfare effects. The sum of the present value of the compensating variations arising from the reduction in AOW benefits is −13.4 billion Euro,[20] whereas total AOW spending decreases with 75.5 billion Euro (discounted at 5%), Hence, the welfare gain equals 18 cents per Euro reduction in AOW benefits. In contrast, the lagged implementation of the higher retirement age combines a smaller efficiency gain of −0.8 billion Euro with smaller savings on AOW outlays of 39.9 billion Euro. This implies a welfare gain of only 2 cents per Euro. The beneficial implications of a higher retirement age (relative to a reduction in AOW benefits) seem to be much smaller (at least for the Netherlands) than sometimes suggested. Intuitively, this result derives from the lagged implementation of the reform. The deferred increase in the retirement age maintains the original tax distortions till 2025. This is illustrated in Fig. 12, where the wedge on labor income is defined as:

[20] This sum is not simply equal to the surface under the curve in Fig. 11. In each period the compensating variation of an individual is multiplied with the size of its generation and discounted at 5%.

$$\text{wedge} = \frac{1+t_c}{1-(t_y+\pi^y+\pi_{ZF}+\pi_{\text{AWBZ}})} \tag{15}$$

Both reforms lead to a similar wedge in the long run but the decrease of the benefits immediately reduces distortions. A second explanation stems from the adverse announcement effects that result from deferred reforms. As is evident from Fig. 10, young households anticipate the lower tax burden that arises when the higher retirement age becomes effective. Compared to the case of a reduction in pension benefits, labour supply is lower prior to the reform, and peaks at the date of implementation. The deadweight loss of this substitution effect diminishes the favorable effects of the reform.

5.3. AOW contribution rate smoothing

Relative to the baseline projection, AOW contribution smoothing redistributes resources from current workers to future workers. Hence, the costs associated with population ageing will be more evenly spread out over the generations. In addition, contribution rate smoothing also minimises the distortionary intertemporal substitution effects of the increasing burden of social security.

The AOW contribution rate is held constant at a level of 11.4%. This is the constant rate that intertemporally balances the public pension system. It implies an initial increase of 3.4 percentage points relative to the baseline rate in 2001. During the first 2 decades, the AOW contribution rate remains above the baseline projection and the AOW buffer fund will be accumulating assets. After that, the baseline contribution rate exceeds the rate under smoothing for two reasons. First, the revenue on the accumulated assets in the initial decades will be spread out over the entire horizon. Second, the reduction in efficiency losses in the economy allows an additional reduction in the contribution rate. Fig. 10 shows that labour participation is initially lower than in the baseline scenario, as a result of the initial increase in the contribution rate. In later years, labour supply increases as a result of the lower wedge made possible by the buffer fund. Eventually, labour participation decreases again as a consequence of the general increase in the consumption of goods and leisure.

Fig. 11 makes clear that the introduction of AOW contribution smoothing has a substantial impact on welfare. Older participants in the labour force pay a higher contribution than under the baseline and are worse off, while younger generations for most of their working life pay a lower contribution and benefit from the reform. In addition, households that have not yet retired suffer a capital loss on their shares. This loss results from the initial fall of labour supply, which causes a temporary drop in the return to physical capital. Retired households escape this unexpected capital loss, since they sold their shares when retiring. In the long run, all individuals profit from the reduction in the efficiency losses that results from a constant AOW contribution rate.[21]

[21] In contrast to the other reforms, the calculation of the 'marginal cost of funds' is not useful in this variant. This reform does not aim at a reduction of AOW outlays but at a more even distribution of contributions over generations.

Table 2
AOW contribution rate (in %)

Scenario	2001	Peak	Peak reached in	2100
Baseline	8.0	14.8	2039	13.8
Grey	8.1	18.1	2100	18.1
Green	7.9	12.9	2038	10.1
Reduction AOW benefit	7.3	13.5	2039	12.6
Increase retirement age	8.0	13.3	2040	12.3
AOW smoothing	11.4	11.4	All	11.4

6. Concluding remarks

In this paper we explore the budgetary and economic consequences of the population ageing in the Netherlands. The baseline projections of the CBS suggest an almost doubling of the old-age dependency ratio between now and its peak in 2037. There is non-negligible uncertainty about these future demographic developments and alternative assumptions about the future fertility rate or the development of the life expectancy have substantial effects on the old-age dependency ratio.

The increase in the relative number of elderly has serious consequences for the AOW and the public health sector, whose baseline shares of GDP rise by 4.5 and 3.1 percentage points, respectively, between now and their peaks. Tables 2 and 3 summarise the numerical consequences of the population projections for the various contribution rates. The reported changes in the contribution rates translate directly into the marginal wedge and indicate how the incentive to supply labour is affected by the costs associated with population ageing.

We analyse the consequences of population ageing under a baseline scenario and two demographic variants. The results, in particular the sign of the welfare effects of ageing, are shown to be sensitive to the demographic projection employed. We also analyse the consequences of three reforms of the pension sector aimed at thwarting the adverse consequences of ageing: a reduction in AOW benefits (that is, a partial shift from public to private pensions), an increase in the retirement age and AOW contribution smoothing. The social security reforms discussed in this paper are all beneficial from an efficiency point of view. Of course, the efficiency gains are larger, the earlier these reforms are implemented. The reforms also have

Table 3
Public health care contribution rate in % (incl. AWBZ contribution rate)

Scenario	2001	Peak	Peak reached in	2100
Baseline	10.0	12.8	2042	12.1
Grey	10.9	14.0	2045	13.8
Green	9.0	11.6	2040	10.9
Reduction AOW benefit	10.0	12.9	2042	12.1
Increase retirement age	10.0	12.8	2042	12.1
AOW smoothing	10.1	12.7	2045	12.1

intergenerational redistribution effects. In particular, they all shift part of the ageing costs from the future generations to the retired or the older participants in the labour market, although the specific time profiles of these redistributions vary across the reforms.

While our economic model is rich in institutional detail and fully microfounded, a number of elements potentially relevant in the context of population ageing are missing. In particular, participation in the labour market is the outcome of carefully chosen time profiles for the preference parameters rather than the result of institutional features or frictions. Therefore, the next step in this research project is to extend the model in such a way that unemployment and labour market (non-) participation are directly related to these factors. With this extension, one can investigate what policy alternatives are most suitable for alleviating the ageing problem by stimulating labour market participation.

Acknowledgments

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Appendix A: Values of important parameters

Preferences:	
Rate of time preference	=2% (a year)
Elasticity of substitution between tradables and leisure/ health care index	=0.66
Elasticity of substitution between leisure and health care	=0.65
Intertemporal elasticity of substitution	=0.25
Technology:	
Labour saving technological progress	=2% (a year)
Technical depreciation rate of capital	=11.5% (a year)
Cost share of capital in tradables	=36.3%
Cost share of labour in tradables	=38.8%
Cost share of raw materials in tradables	=24.9%
Elasticity of substitution between raw materials and value added in tradables	=0.5
Elasticity of substitution between capital and labour in tradables	=0.5
Institutional:	
Fiscal depreciation rate of capital	=5.5% (a year)
Fiscal lifespan of capital goods	=13 years
Number of years between entering labour force and entitlement basic pension	=47
AWBZ expenses as fraction of health consumption	=0.77
Dividend tax rate	=Tax rate on labour income
Tax rate on capital gains	=0%
Consumption tax rate	=25%
Tax rate on interest income households	=0.5×Tax rate on labour income

Maximum total pension benefits	=70% of final pay
Other:	
Real interest rate (baseline)	=5%
Debt/capital ratio (in tradable goods sector)	=0.5
Maximum lifespan individual	=100 years

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