AGEING IN THE NETHERLANDS: ANALYSING POLICY RESPONSES WITH AN AGE MODEL

Nick Draper, Harry ter Rele and Ed Westerhout[*]

Understanding the behaviour of economic agents is as important as understanding fiscal institutions. Our model integrates the generational-accounting approach with an applied-general equilibrium setup. The recognition of economic behaviour improves our assessment of the intergenerational consequences of government policies; accounting for fiscal institutions improves our projections of future economic developments.

This paper illustrates the benefits from an integrated approach by presenting projections and policy simulations. Two analytical simulations demonstrate the working of the model. A third simulation shows the economic and intergenerational effects of a much discussed policy reform, i.e. *a gradual increase of the official retirement age.*

1. Introduction

Since their introduction in the early nineties (Auerbach *et al.*, 1991), generational-accounting (GA) models have been quite successful. As they make so few specific assumptions, they can be applied in a variety of circumstances. Indeed, GA models are nowadays applied worldwide by researchers to assess the stance and intergenerational implications of fiscal policies in their countries (Auerbach *et al.*, 1999), Raffelhueschen, 1999a, 1999b).

One reason for their success may be that generational-accounting models allow for an assessment of both the sustainability as well as the generational impact of fiscal policies, two issues that are highly relevant for fiscal policy-making. By focussing on the future, they are perfectly well suited to analyze the implications of trends that have a long-term nature, as for example the ageing of the population. When it comes to the analysis of policy reforms, generational-accounting models are less suited, however. Indeed, by abstracting from any kind of economic behaviour on the part of economic agents, they may give false answers to questions about the incidence of taxation (Haveman, 1994, Buiter, 1995). Similarly, due to their neglect of economic behaviour, GA models are not very well suited to simulate the effects of policy reforms.

In another field, we have witnessed the birth of several applied general equilibrium (AGE) models which are constructed precisely for simulating the effects of policy reforms (Auerbach and Kotlikoff, 1987, Altig *et al.*, 2001, Bovenberg and

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[*] CPB Netherlands Bureau for Economic Policy Analysis, The Hague, The Netherlands.
The views expressed in this paper are not necessarily those of CPB.

Knaap, 2005). Most of these models that focus on ageing populations distinguish between different generations, allowing them to focus on the effects of policies on different generations. When it comes to making future projections and assessing fiscal sustainability, models of this class seem less suited, however. The reason is not so much fundamental, but more practical. Applied general-equilibrium model often lack the kind of institutional details that may be particularly relevant for predicting the likely future behaviour of the economy.

This paper uses an applied-general equilibrium model that is based on a generational accounting model, named GAMMA (Generational Accounting Model with Maximizing Agents). It combines age profiles of different expenditure and tax items with demographic projections like generational-accounting models do. However, unlike these models, it accounts for changes in age profiles that result from future trends. As Bovenberg and ter Rele (2000) have shown, it is particularly relevant to account for likely changes of labour market participation rates and for the increasing scope (maturing) of pension schemes. In addition, GAMMA endogenizes the age profiles of various tax items. Indeed, the age profiles of labour income taxes, consumption taxes, taxes on pension income and taxes on corporate income all relate to the corresponding tax bases. Policy reforms that affect these tax bases may change these age profiles as well.

Our approach also extends the scope of generational accounting. Where GA calculations tend to focus on the transfers to and from the public sector, our model also accounts for the development of income that is earned in the private sector. This is important in these cases in which policy reforms affect not only net benefits from the public sector, but also the development of labour and capital income.

By combining the best of the AGE and GA worlds, GAMMA can be used for both projections and simulations. This is illustrated in this paper by presenting a baseline projection and the effects of a number of policy reforms.[1] The projection assesses the sustainability of current fiscal policies in the Netherlands. The simulations show how different policy reforms that improve fiscal sustainability, differ in terms of effects upon the Dutch economy, upon different generations and upon the time path of the government deficit and the government debt.

The structure of the paper is as follows. Section 2 describes the applied-general equilibrium model ands its relation with the underlying GA model. Section 3 discusses the projections in the field of demography and labour market participation rates. Section 4 describes the implications of our baseline projection for the economy and different generations. Section 5 discusses a number of policy reforms

[1] This paper draws heavily from a recently published study on the impact of ageing on Dutch public finances (Van Ewijk *et al.*, 2006). This study, which can be downloaded from www.cpb.nl, is input into the process that guides policy-making for the coming government period, 2007-11. In particular, the coming government will be advised on government debt policies by a committee that uses the CPB study as a quantitative background. This study contains many more projections than contained in this paper. Indeed, this paper presents only a baseline scenario and three policy variants; the background study adds eight alternative scenarios and three alternative policy variants.

that restore the sustainability of fiscal policies. Section 6 contains concluding comments.

2. The applied general-equilibrium model

As explained above, our model is based on the GA approach, but extends this by incorporating economic behaviour. This section discusses first the AGE part, in particular the behaviour of households, firms and pension funds. Next, the section discusses the GA part, *i.e.* the various age profiles and the definition of lifetime welfare.

2.1 The AGE part

2.1.1 General characteristics

GAMMA can be characterized as an applied general equilibrium model of the Dutch economy with overlapping generations of households. The model describes in detail the government sector and the pension sector, and comprises a comprehensive set of generational accounts for all current and future generations. GAMMA goes beyond the traditional generational accounting framework, however, by incorporating economic behaviour of households, firms and pension funds. Households decide on labour supply and private saving, firms decide on demand for labour and capital, and pension funds decide on pension contributions and benefit levels. Agents are rational and forward looking, and optimise in a consistent microeconomic framework. GAMMA thus allows for welfare analysis of policy reforms. A caveat is that GAMMA assumes perfect labour and capital markets. GAMMA is therefore not equipped to describe short- and medium-term dynamics.

GAMMA attaches the following features to the Dutch economy. First, the Dutch economy is small relative to the outside world. Domestic policies do not affect the interest rate, which is determined on world capital markets. Second, the goods produced at home are perfect substitutes to those produced abroad: prices are given and terms-of-trade effects are absent. This fits in with the long-term horizon of the model. Third, the model is deterministic. Lifetime uncertainty is recognised, but perfect capital markets enable households to insure against longevity risk.

Finally, the model assumes that agents are rational and forward-looking. They take into account the future consequences of their decisions. In the context of the long-term analysis, this is the only way to ensure consistency in behaviour, from a microeconomic and macroeconomic point of view. It is a prerequisite for meaningful welfare analysis, and yields plausible predictions for behaviour on a macroeconomic level.

2.1.2 Households

According to life-cycle theory, households rationally choose levels of current and future consumption and labour supply (leisure) on the basis of total wealth. The latter is defined as the sum of financial wealth and human wealth (the discounted value of potential[2] future labour and pension income). The adopted utility function implies that labour supply and its complement, leisure, depend on the marginal reward of labour (the price of leisure) only; leisure does not depend on total wealth. Leisure will be fixed unless its price changes. According to the life-cycle model, households smooth utility of consumption and leisure over their life cycle. Hence, as long as there is no change in the price of leisure, households will smooth consumption of goods. Every household is represented by a finitely lived adult. Longevity risk is assumed to be diversified; each household receives an annuity from a life insurance company in return for bequeathing the company its remaining assets upon decease. The tilt of the consumption path thus depends only on the difference between the interest rate and the rate of time preference.

GAMMA accounts for the fact that consumption profiles over the life cycle are hump-shaped. This can be explained by household composition and age-related preferences. For instance, households with children tend to consume more than is predicted by the pure life-cycle model. Taking account of these types of age effects, the life-cycle model in GAMMA is made consistent with the data (Blundell *et al.*, 1994, De Ree and Alessie, 2005).

GAMMA also accounts for the increase in labour market participation rates that are predicted in field studies. This is done by making the preference for leisure time-varying and calibrating it such as to produce the outside predictions. Note that this approach leaves intact the price sensitivity of labour supply.

Both taxes and pension contributions may affect labour supply. As labour supply depends on net wages, both the tax on labour income and that on consumption reduce labour supply. On average, participation in second-pillar pension schemes increases the labour supply. This effect is due to the implicit government subsidies in pensions: pensions are taxed at a lower rate than labour income, and pension savings are exempted from the capital tax.[3] As participation in pension funds is mandatory, this pension subsidy acts as a subsidy on labour supply.

2.1.3 Firms

Firms are assumed to operate in competitive markets where prices equal world market prices. The cost of capital is given by world market prices and the tax regime. As a corollary, taxes are fully shifted to labour. Indeed, in a small open economy, it is the net wage rate that has to accommodate changes in the tax rate.

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2 Potential labour income is defined as income with labour time equal to the total available time.

3 See Westerhout *et al.* (2004) for a more comprehensive treatment of this issue.

Table 1

Parameters Gamma

Rate of labour-augmenting technological progress *(percent)*	1.7
Substitution elasticity between labour and capital	0.5
Rate of time preference *(percent)*	1.3
Intertemporal substitution elasticity	0.5
Real rate of return	3.0
Substitution elasticity between leisure and labour supply	0.25

Production takes place with labour and capital according to a CES production function. Apart from their productivity, labour supplied by households of different ages is homogeneous. Labour productivity grows at a given rate in time. Capital adjusts without any delay. Wage accommodation thus also takes place immediately.

2.1.4 Pension funds

The Netherlands has a three-pillar scheme. The first pillar consists of public basic pensions. The public pension scheme is part of the public sector in GAMMA. The second pillar consists of private supplementary pensions. Pension contributions are deductible, while pensions are taxed. The difference between the tax rate on labour income and pensions implies an implicit subsidy, which stimulates labour market participation. The pension scheme contains defined-benefit elements. Hence, contributions may exceed the accrual of pension rights, and therefore may act as a tax on labour supply. The level of pension benefits is related to average wages earned over the working period. Furthermore, pensions are indexed to prices and partly to wages, reflecting the situation for the average Dutch pension fund.

2.1.5 Parameter values

The most important parameters of GAMMA are summarised in Table 1. The values of the parameters are based on the evidence produced by national and international research. This is discussed in more detail in Van Ewijk *et al.* (2006).

2.2 The generational-accounting block

2.2.1 Expenditures

We distinguish two types of primary government expenditures, age-related expenditures and non-age-related expenditures. Age-related expenditures consist of expenditures of which the benefits can be attributed to individual beneficiaries. This category consists of expenditures on social security, health care and education, and totals about 26 per cent of GDP. Non-age-related expenditures consist of the expenditures that cannot be that easily attributed to individual beneficiaries. This category, which includes expenditure on defence, general government, transfers abroad and subsidies, amounts to around 19 per cent of GDP.

2.2.2 Age-related expenditures

For the first category, future expenditures are constructed by assuming that – apart from indexation to productivity in the private sector – age-specific benefits per person from these expenditures remain unchanged. Average public expenditures related to a person of a certain age (e.g. a 30- or 70-year old) will thus increase each year at the rate of labour productivity growth.

There are three exceptions to this. The first concerns disability benefits. To derive the future numbers of beneficiaries, we include the effects of a number of recent policy measures that field studies predict will curb the inflow into these schemes. The second exception relates to unemployment benefits. Here, we take account of the effect of the business cycle in the first years of the projection. The third exception concerns health care expenditure. Here, we follow an extended procedure in order to account for death-related costs, similar to the one adopted in Van Ewijk *et al.* (2000) and Westerhout and Pellikaan (2005).

2.2.3 Non-age-related expenditures

The second type of expenditure consists of the expenditures that cannot be that easily attributed to individual beneficiaries. For these expenditure items we assume a "flat" age profile, entailing an equal benefit for each individual. This is obviously an arbitrary assumption, but better alternatives seem to be lacking. The aggregate growth rates of these items are assumed to correspond to the aggregate growth rate of GDP. The rationale for this may be that expenditure on these items is closely linked to the size of production in the economy – and GDP may be considered as the best measure for this concept. Again, this assumption is somewhat arbitrary.

2.2.4 Revenues

Government revenues consist of direct taxes, social security contributions, indirect and other taxes, corporate taxes and revenues from government assets (including natural gas). The model distinguishes direct taxes from various sources (*e.g.* taxes levied on labour income, pension income and private asset holdings). This makes it possible to account for trends such as the rise of labour market participation and the maturing of the pension system. Apart from the impact of specific trends (see below), the projections of labour income taxes, social security contributions and taxes on private wealth are based on the evolution of income and savings as predicted by GAMMA's lifecycle model. The projection of indirect and other taxes is split up into the part related to consumer spending and the part levied on investments. Revenues from natural (gas) resources follow a time path that deviates strongly from that of taxes. Due to the depletion of gas reserves these revenues are projected to decline from its current level of 1.6 per cent of GDP to zero in 2050.

2.2.5 Net benefits

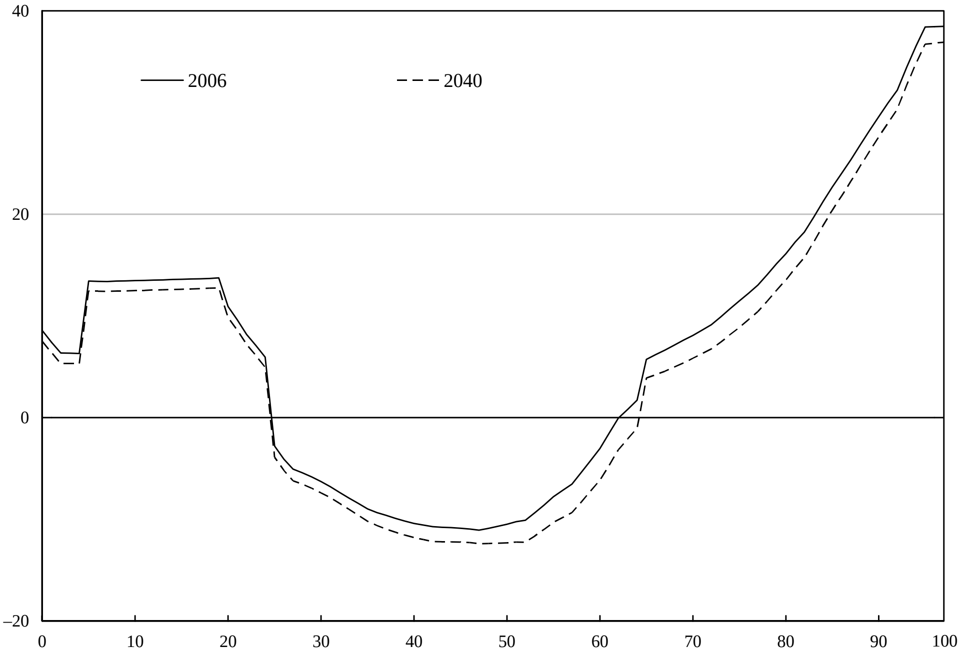
Figure 1 shows the age profile of the (average) net benefit from the public sector, where net benefit is defined as benefit minus costs. It turns out that the young and the elderly are net beneficiaries of the government. The middle-aged are net contributors. This pattern of intergenerational redistribution through the public sector is common in GA studies. Similar to Figure 1, we could draw a figure reflecting the net benefit from the second-pillar pension scheme. We would then see negative net benefits during the period in which people pay contributions to the pension scheme and positive net benefits during the period they are retired.

Importantly, our approach allows the age profile of net benefits to change over time. As explained above, the age profiles of expenditure on disability benefits, expenditure on unemployment benefits and health care expenditure will change over time due to reforms in disability schemes, business-cycle considerations and death-related costs respectively. But also the age profiles of tax items may change over time. In particular, the age profiles of the labour income tax and the consumption tax may change because of increasing labour market participation. Moreover, the age profile of net benefits from the supplementary pension scheme will change because of maturing of the pension scheme. For illustration, Figure 1 also shows the age profile of net benefits from the public sector in 2040. Comparison of the 2006 age profile and the 2040 age profile (corrected for the productivity growth in 2006-40) show that important shifts are expected to occur; the main characteristics of the age profile of net benefits remain unchanged, however.

There are four reasons for the downward shift of the age profile of net benefits. The first is the projected future rise of labour market participation (see Section 3), which raises taxes paid by the active population. The second lies in the maturing of pension funds (see above). This raises tax revenues from pension income and shifts down the profile for the age group older than 65. The third is due to our assumption that the output gap, which is estimated to be negative in the base year, will vanish in four years time. This bolsters tax revenues and reduces expenditure on unemployment benefits. After four years this factor is projected to lift the government balance by 1.4 per cent of GDP. The fourth reason relates to the way non-age related expenditure is extrapolated in this paper (see above). By linking it to GDP, and therefore to the size of the workforce, the rising number of inactive people due to the ageing of the population pushes down per capita benefits from this part of government expenditure.

Figure 1

Age Profile of Net Benefits, 2006



Due to the extension of the GA approach with economic behaviour, this paper can focus on the concept of lifetime welfare. This lifetime welfare is defined as the sum of three components. The first is the present value of the income that the members of the generation earn during their lifetime (*i.e.* their human wealth). The second and third components of lifetime welfare are equal to the present value of the net benefits from the government and pensions funds, respectively. As usual, we chart lifetime welfare and its components only for the future generations (*i.e.* those born in 2006 and later); for generations already alive at present, GAMMA can only be used to calculate welfare over their remaining lives. It should be noted that, in measuring lifetime welfare, no value is attributed to people's leisure time.

3. Inputs for the projection

The projection part of the analysis draws on a host of assumptions. Important is that we take the real interest rate to be constant at a level of 3 per cent and that we assume that there is labour-augmenting technical progress of 1.7 per cent per year. This section discusses two assumptions that are highly relevant for the projection exercise, *i.e.* the assumption on demographic developments and that on the development of labour market participation rates.

Table 2

Population and Its Composition in 2006-2100*

	2006	**2020**	**2040**	**2060**	**2100**
Age group			*(thousands)*		
0-19	3976	3752	3831	3824	3940
20-64	10036	9828	9188	9513	9694
65+	*2345*	*3244*	*3983*	*3557*	*3841*
Total	16358	16825	17003	16895	17462
Elderly dependency ratio	23.4%	33.0%	43.4%	37.4%	39.6%

* The data apply to the end of the year.

3.1 Demography

The demographic projection employs the most recent baseline projection of Statistics Netherlands. This is based on projected fertility rates, mortality rates and immigration patterns. The baseline demographic scenario assumes that the fertility rate is about 1.75 over the whole period, and that net immigration increases from its current negative value of around 2,000 annually to a structural level of 30,000. Mortality rates continue to decrease in the future, especially at older ages. As a result, life expectancy will also increase. Life expectancy at birth will increase from its present level of 76.7 years to 79.6 years for males in the period 2005-2050. Similarly, life expectancy at birth for females will increase from its present level of 81.2 years to 82.6 years in 2050. In the space of 45 years, average life expectancy will thus increase by a good two years. The gain is concentrated at higher ages: life expectancy at the age of 65 will increase with about 1.5 years.

Table 2 provides an overview of the change in the age composition of the population that is brought about by these developments. The elderly dependency ratio, defined as the number of 65+ as a percentage of the 20 to 64-year olds, is projected to rise from 23.4 in 2006 to 43.4 per cent in 2040. After 2040, it stabilises at a more-or-less constant level of around 39 per cent. The total population will grow to just over 17 million in 2040, and after a dip around 2060, will rise further to 17.5 million in 2100.

3.2 Labour market participation

In the last two decades, labour force participation has increased markedly. This trend is expected to continue in years to come, although at a somewhat lower

Table 3

Decomposition of the Change in Labour Participation
(percent of population aged 20 to 64 years)

	2005	2005-20	2005-50
Level (in ultimate year)	72.1	75.6	74.9
Demography		–1.7	–1.2
Participation men 20-54 years of age		0.7	0.5
Participation men 55-64 years of age		0.5	0.3
Participation women 20-54 years of age		1.5	1.1
Participation women 55-64 years of age		2.5	2.1
Total change (in years)		3.5	2.8

rate. Participation is projected to rise by 3.5 percentage points in the period until 2020 and 2.8 percentage points in the period until 2050. Measured in full-time equivalents, the rise will be less – mainly due to a higher incidence of part-time work.

As appears from Table 3, the principal determinants of future labour force participation are demographic changes and the continuing rise in the participation rate of women. The continuing increase in female participation rates occurs as older cohorts of women with relatively low participation rates will be replaced by younger cohorts with higher participation rates. Aside from this so-called "cohort effect", trends of emancipation and individualisation will lead to an increase in female labour force participation. The current projection assumes that female participation rates in the Netherlands will move towards those of Swedish women, such that by 2020 about half of the difference between both countries will have disappeared. The rationale for this partial convergence is that additional policy measures would be needed for further convergence – and such policy measures are assumed to be absent in our projection.

Another important change lies in the ageing of the population. As can be read from Table 3, this effect reduces the participation rate with 1 to 2 percentage points. In the third place, policy measures introduced recently will have an effect on the development of future labour force participation. For the period 2020-50, a modest decline is foreseen in the aggregate labour participation rate, of 0.6 per cent; behind this decline is a rising share of non-western immigrants, with relatively low participation rates.

4. A projection of public finances

4.1 Budgetary developments

Table 4 presents how public finances develop in our baseline projection in the period 2006-2100. In the period up to 2040 the ageing of the population exerts an upward pressure on public expenditure by raising the costs of public pensions and health care by 4.1 and 4.3 per cent of GDP respectively. In addition, natural gas revenues will decrease in this period by 1.5 per cent of GDP as a result of the depletion of gas reserves.

At the same time however, there are alleviating factors. First, tax revenues will increase through rising pension incomes that are subject to income taxation. First- plus second-pillar pension incomes will rise in the period till 2040 by 8.5 per cent of GDP (from 9.0 to 17.5 per cent of GDP). This raises tax revenues from this source (both direct and indirect) by 4.1 per cent of GDP. Second, expenditure on disability schemes is expected to fall considerably due to policy reforms in recent years.

On balance however, the burdening factors outweigh the alleviating factors. After an initial improvement due to cyclical factors, the primary balance deteriorates after 2011 as ageing and the decline of revenues from natural gas hit the budget. This eventually translates into an explosion of debt levels and interest payments. This in turn illustrates that government finances are currently on an unsustainable path and measures are required to render public finances sustainable.

Hence, there is a sustainability gap. It can be calculated that total debt (the sum of the statutory debt and the implicit debt due to ageing and declining gas revenues) is about 2 times GDP. The corresponding sustainability gap amounts to 2.6 per cent of GDP. The latter means that a permanent reduction in material government consumption by 2.6 per cent of GDP as from 2006 would suffice to fully restore fiscal sustainability.[4] Pursuing this policy reform would improve government balances which in turn would reduce debt and interest payments and make it possible to cover the future costs of ageing.

Table 5 shows how public finances, if made sustainable in this way, are affected if a permanent reduction in material government consumption is adopted to achieve fiscal sustainability. Primary expenditure is reduced by 2.6 per cent of GDP and the primary balance improves accordingly. As a result, the EMU balance improves. Next, the ratio of debt to GDP shows a sharp decline and eventually becomes negative. The burden of interest payments develops accordingly. Eventually, government balances and debt levels stabilise at a constant ratio relative to GDP.

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[4] Note that this sustainability measure is different from the one proposed in Auerbach *et al.* (1999). That measure assumes that the sustainability gap is closed by payments by future generations only; ours spreads out the cost of adjustment over the currently living as well. We consider our measure more transparent than theirs. Furthermore, our measure might be easier to translate into policy measures since it does not require policies to differentiate policy measures with respect to age.

Table 4

Public Finances without Budgetary Measures in the Baseline Projection
(percent of GDP)

	2006	2011	2020	2040	2060	2100
Expenditure						
Social security	12.0	12.4	13.5	15.5	14.5	14.9
public pensions	4.7	5.3	6.6	8.8	7.8	8.2
Disability benefits	2.0	2.1	1.9	1.6	1.6	1.6
unemployment benefits	1.2	1.0	1.0	1.0	1.0	1.0
other benefits	4.1	4.0	4.0	4.1	4.1	4.1
Healthcare	8.8	9.3	10.3	13.1	12.5	12.6
Education	5.4	5.5	5.4	5.8	5.7	5.8
Other expenditure excluding	19.2	18.5	18.4	18.2	18.3	18.3
Primary expenditure	45.3	45.7	47.8	52.5	51.0	51.5
Interest payments	2.5	2.0	1.5	2.5	4.2	7.2
Total	47.8	47.7	49.3	55.0	55.2	58.7
Revenues						
Income tax and social security contributions	21.8	23.1	23.7	25.3	24.9	25.2
of which on pension income	1.8	1.9	2.5	3.6	3.4	3.6
Indirect and other taxation	14.9	15.6	15.9	17.3	16.7	16,8
of which on consumption by population aged 65 and older	1.9	2.2	2.9	4.2	3.6	3.7
Corporate income tax	2.6	2.6	2.5	2.4	2.3	2.3
Natural gas revenues	1.6	1.2	0.8	0.1	0.0	0.0
Other income	5.2	5.3	5.2	4.9	4.7	4.4
Total	46.1	47.9	48.1	50.0	48.6	48.8
EMU balance	–1.7	0.2	–1.1	–5.1	–6.6	–9.9
Primary EMU balance	0.7	2.2	0.4	–2.6	–2.4	–2.7
EMU debt*	54.4	47.7	41.0	74.5	126.4	213.3

* Value at the end of the year.

Table 5

Public Finances on the Basis of Sustainable Policies in the Sustainable Baseline Projection
(percent of GDP)

	2006	2011	2020	2040	2060	2100
Expenditure						
Primary expenditure	42.7	43.1	45.2	50.0	48.4	49.0
Interest payments	2.5	1.5	0.1	–0.7	–0.4	–0.4
Total	45.2	44.6	45.3	49.3	48.0	48.6
Revenues	46.1	47.9	48.1	50.0	48.6	48.8
EMU balance	1.0	3.3	2.9	0.6	0.7	0.2
Primary EMU balance	3.4	4.8	3.0	–0.0	0.2	–0.2
EMU debt*	51.7	31.6	0.6	–19.4	–12.9	–10.2

* Value at the end of the year.

4.2 *Generational accounting*

Table 6 shows that total lifetime welfare for someone born in 2006 is almost 850 000 euro in the sustainable baseline projection. By far the largest part of lifetime welfare (92.8 per cent) is derived from income earned during that person's lifetime. The remainder roughly coincides with the balance of net benefits from the government (7.3 per cent of lifetime welfare). The net benefits from the pension fund sector are negligible (–0.2 per cent of lifetime welfare).

Generations born after 2006 can expect higher lifetime welfare owing to the growth in labour productivity. Table 6 illustrates this for cohorts born in 2020, 2040, 2060 and 2100, respectively. Thus, the present value of the three components of lifetime welfare for people born in 2020 is (on their date of birth, in 2006 prices) over 200,000 euros higher than for people born in 2006. Each of the three components of lifetime welfare accounts for approximately the same share in lifetime welfare for people born after 2006 as for people born in 2006. The assumption that the government will realise sustainable public finances in 2006 is relevant here. Should the government defer the measures required to realise sustainable public finances, the net benefits from the government would be higher for people who are born before the government takes such measures. The same benefits will in that case thus be lower for people born after the government has started to implement reforms that realise sustainability.

Table 6

Generational Accounting on the Basis of Sustainable Policies

	Generations born in:			
	2006	**2020**	**2040**	**2060**
Lifetime income *(in percent of lifetime welfare)*	92.8	93.2	93.3	93.4
Net benefits from the government *(in percent of lifetime welfare)*	7.3	6.9	6.6	6.5
Net benefits from pension funds *(in percent of lifetime welfare)*	–0.2	–0.1	0.0	0.1
Lifetime welfare* (1,000 euro)	843.8	1062.4	1488.5	2087.7

* In 2006 prices.

As mentioned above, the concept of lifetime welfare does not attach value to leisure time. Therefore, our calculations underestimate the growth of net benefits from the public sector that is due to increasing longevity (that exceeds the increase of labour market participation).

Table 6 illustrates that future generations can expect net benefits from the government. In other words, the present value of the government expenditure attributable to them – over their entire lifetime – is greater than the present value of the tax and social security contributions they pay over their entire lifetime. The net benefits that future generations will receive from the government are essentially an inheritance that is handed down from their ancestors. For each generation, that inheritance consists of the wealth of the government on the date of birth plus net contributions to the government (during the remainder of their lifetime) from people already alive on that generation's date of birth. Assuming that the real return on government financial wealth exceeds economic growth, every generation can receive positive net benefits from the government while still leaving behind for the next generations an 'inheritance' that has grown with GDP.

5. Policy variants

The previous section used only one of the many possible instruments of government policy to render sustainable public finances, *i.e.* material government consumption, and assumed that the policy was implemented immediately. This chapter explores a number of alternative ways of achieving sustainability. We present a measure that (in contrast to government consumption) exerts behavioural feedback effects on labour supply and private saving, a measure that is implemented with a delay rather than immediately, and a policy of gradually increasing the retirement age. The first two of these variants show how large the required measures must be if an alternative policy direction is chosen to close the financing gap. The third variant assesses the effect on sustainability of an often discussed policy reform which may be an evident response to the costs of ageing in the light of the increase in life expectancy in the coming decades. We focus on economic, budgetary and intergenerational effects: employment and output, the key indicators of public finances (*viz*. the sustainable primary government balance) and the lifetime welfare effects across cohorts.

This section first shows how the policy adjustments that are necessary to render public finances sustainable affect the welfare of average members of each cohort (generation). Policy options to achieve sustainability are then discussed in more detail by comparing their economic, budgetary and intergenerational effects.

5.1 How does achieving sustainability affect the welfare of cohorts

To understand the effects of policies, we can examine their consequences on the welfare of separate cohorts. This section facilitates this process by showing how the lifetime welfare of an average member of each cohort is affected by various ways in which the government can achieve sustainability. The policy options are compared to a situation in which policies are not adjusted (and are thus unsustainable).

Similar to Section 4 (where levels of lifetime welfare are calculated) the measurement of lifetime welfare spans the full (remaining) lifetime. Comparability of the net benefits of unborn generations is obtained by adjusting their net benefits by a factor that corresponds to the difference in lifetime income.

The first component, the changes in primary income, can in a way be interpreted as the efficiency gain or loss due to the policy change (although any changes in leisure time are not included). In addition to our benchmark policies of adjusting material public consumption, we select three policy options for achieving sustainability:

1) raising indirect taxes in 2006. This variant introduces behavioural feedbacks, mainly by a reduction in labour supply. Another difference is that its annual incidence across age groups (its ‘age profile’) is not flat, as in the benchmark variant, but follows the pattern of private spending through life.
2) reducing government consumption in 2040 rather than in 2006. This variant is chosen to represent the effects of a delay of adjustment.
3) raising the retirement age by two years. This variant targets the costs of adjustment at the elderly. In 2015, the age of retirement is raised by one year to 66, followed by a further rise to 67 in 2025. This measure turns out not to bridge the full financing gap. The remaining part of it is closed by raising government consumption in 2006.

Figure 2

Lifetime Welfare Effects of Achieving Sustainability on Cohorts

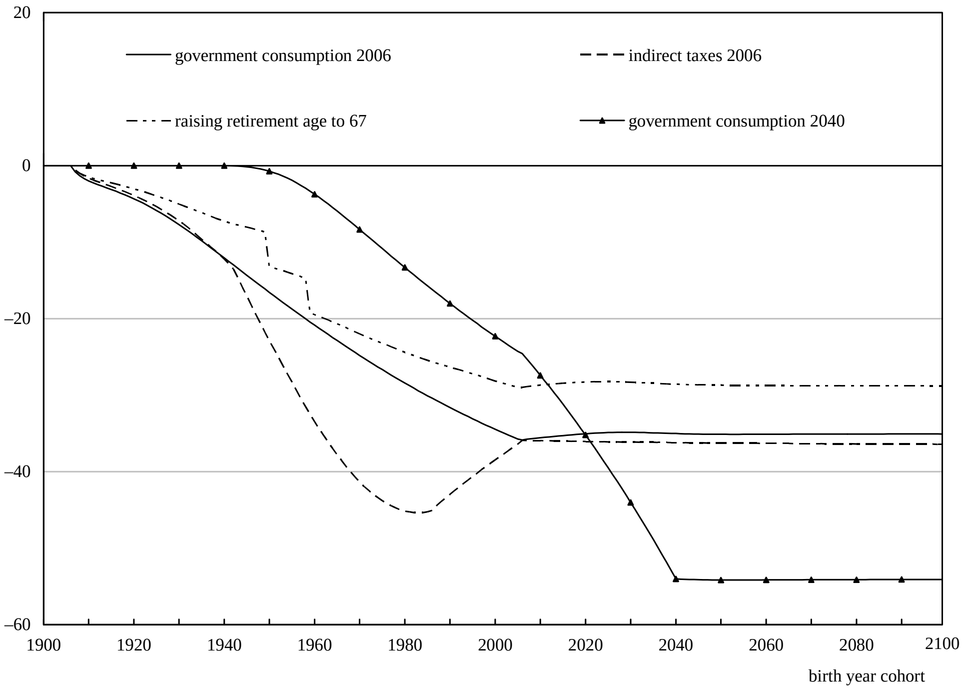


Figure 2 shows how the lifetime welfare of cohorts is affected in the four policy variants. The cohorts included in the figure are classified according to their birth year, ranging from birth year 1906 (the oldest of the currently living) to birth year 2100. In all variants, it is costly to restore fiscal sustainability. Hence, cohorts see their lifetime welfare decrease or remain constant in all variants. In addition, the costs of the adjustment generally rise the younger is the cohort involved. Apart from the delay variant, the costs of adjustment increase up to 30 to 40 thousand euros in present-value terms, and stabilise at that level for the yet-unborn generations (when corrected for their higher lifetime income). These maximum levels correspond to 3.3 to 4.5 per cent of lifetime welfare. In the delay variant, the elderly obviously escape the costs of adjustment. This variant, however, increases the costs for the unborn cohorts to a (income-corrected) level of 55 thousand euros (which corresponds to 6.5 per cent of lifetime welfare).

5.2 Comparing alternative ways to realise sustainable public finances

We now turn to an analysis of the economic, budgetary and intergenerational effects of the policy options outlined above for achieving sustainability. The approach is to compare the policies with the benchmark variant.

Table 7

Effects of Realising Sustainable Public Finances in 2006 by Raising Indirect Taxes, Compared to Reducing Government Consumption

	2011	2020	2040	2060	2100
(percent of GDP)					
Government consumption	2.6	2.6	2.6	2.6	2.6
Income taxes	–0.4	–0.4	–0.4	–0.4	–0.4
Indirect and other taxes	2.0	2.1	2.3	2.3	2.3
Primary EMU balance	–0.5	–0.3	0.1	0.1	0.1
EMU balance	–0.7	–0.6	–0.3	–0.4	–0.4
Government debt	3.6	7.6	10.2	9.9	10.6
(percent)					
Employment (in full time equivalents)	–0.8	–0.8	–0.8	–0.8	–0.8
GDP at base prices	–0.8	–0.8	–0.8	–0.8	–0.8

5.2.1 Raising indirect taxes

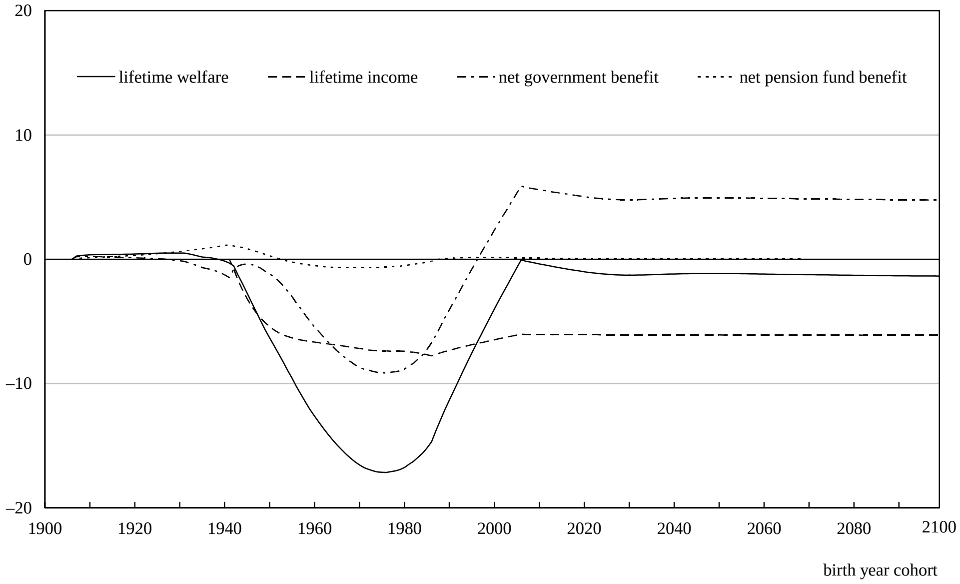
Table 7 shows the effects of an increase in indirect taxation in 2006. This variant obviates the need for a curtailment of material government consumption by 2.6 per cent of GDP from 2006. The primary EMU balance is 0.5 per cent of GDP lower in 2011. In this case, attaining sustainable public finances in the near term requires a less demanding target for the primary EMU balance in 2011, because revenues from an increase in indirect taxation will grow in the future under the influence of ageing. The impact of ageing thus "lifts" the share of consumption in GDP in the next few decades. The primary EMU balance will therefore improve to a greater extent, over time, in this variant than in the baseline projection in which sustainable public finances are realised by a reduction in material government consumption.

Unlike curtailment of public consumption, indirect taxation produces behavioural effects. Indeed, a higher tax rate on consumption acts as a disincentive to the supply of labour. This variant therefore produces an adverse effect on employment and output. This hampers the attainment of sustainable public finances. Indeed, the fall in GDP decreases the revenues from income taxation. It means that a more substantial change in tax rates is required in order to achieve fiscal sustainability.

Figure 3 shows how this alternative affects cohorts. The figure presents the effects on not only lifetime welfare, but also its three components. Figure 3 shows that the policy change reduces lifetime primary income for each cohort born

Figure 3

Effects on Cohorts of Raising Indirect Taxes Compared to the Effects of Reducing Government Consumption



after 1942. This results from the detrimental effects on employment that were mentioned above. The distributional effects by the public sector show significant changes. Older cohorts are affected negatively because their contribution to consumption tax revenues is higher than their share in the benefits of material public consumption. Overall, lifetime welfare declines for all cohorts younger than 65. The costs, in the form of higher tax payments and lower labour income, clearly outweigh the benefits from higher public consumption.

Note that in this comparison of sustainable policy options, the changes in net benefits from the public sector and pension funds are purely the result of distributional effects, as the sum of net benefits from these sectors of the economy add up to zero. Therefore, changes in benefits cancel out across cohorts. The zero-sum property does not imply that changes of policies of the government or pension funds cannot have efficiency effects. To the contrary, policy changes may have serious efficiency effects, which will be reflected in primary incomes.

5.2.2 Delaying budgetary adjustment

This section explores a variant in which the achievement of fiscal sustainability is postponed to 2040. Like in the benchmark variant, public consumption is the instrument that is used to close the sustainability gap. Postponement increases the policy adjustment that is required to achieve fiscal

Table 8

Effects of Delaying the Realisation of Sustainable Government Finances by Reducing Government Consumption from 2006 to 2040

	2011	**2020**	**2040**	**2060**	**2100**
(percent of GDP)					
Government consumption	2.6	2.6	–1.4	–1.4	–1.4
Income taxes	0.0	0.0	0.0	0.0	0.0
Indirect and other taxes	0.0	0.0	0.0	0.0	0.0
Primary EMU balance	–2.6	–2.6	1.4	1.4	1.4
EMU balance	–3.2	–4.5	–4.2	–4.1	–4.1
Government debt	16.3	43.1	113.9	113.3	112.2
(percent)					
Employment (in full-time equivalents)	0.0	0.0	0.0	0.0	0.0
GDP at base prices	0.0	0.0	0.0	0.0	0.0

sustainability from 2.6 of GDP to 4.0 per cent of GDP, an increase of 1.4 percentage points of GDP (see Table 8).

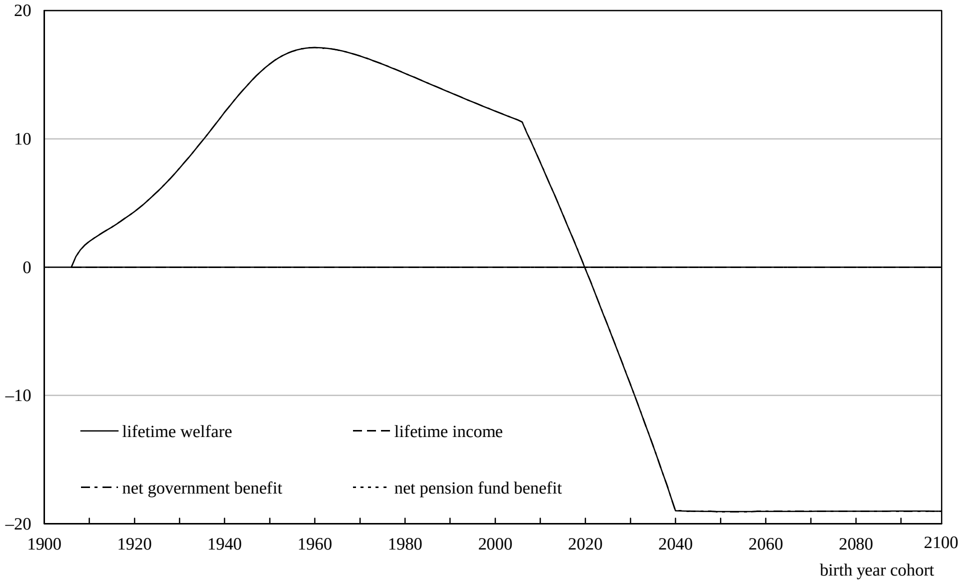
The effects of a delay on separate cohorts (see Figure 4) follow the expected pattern. Lifetime incomes do not change, since changes in government consumption do not affect employment. Substantial distributional effects occur, however, via the government. The elderly obviously benefit from the delay of adjustment. However, also groups that are faced with the increased size of the measure over a significant part of their lives benefit from the delay, as the short-term benefit turns out to outweigh the long-term burden involved in the higher requirement for budgetary adjustment. Even the unborn cohorts up to birth year 2020 benefit from the delay. Later born cohorts will have to pick up the bill. The costs of the delay for the cohorts born after 2040 amount to a sizable 19,000 euros (income corrected) – or 2.3 per cent of their lifetime welfare.

5.2.3 Raising the retirement age

This variant assumes that the age at which peoples' entitlement to a public pension and supplementary pension commences is raised in two steps, by a total of two years, to the age of 67. These calculations assume a one-year step-up of the

Figure 4

Effects on Cohorts of Delaying the Reduction of Government Consumption to 2040



retirement age in both 2015 and 2025.[5] We assume that, to the extent sustainability is not realised by this measure, the remaining gap will be covered by a reduction of government consumption in 2006.

We assume that the rates of labour participation after the increase in the retirement age for the groups aged 65 and 66 are the same as that for the group aged 64. The projection features participation rates for this group of 10 and 11 per cent, respectively, in 2014 and 2024. These figures are somewhat higher than their counterpart in 2006 (8 per cent), but low when compared to the average rate of labour market participation. This explains why the effects of increasing the retirement age on labour supply are limited.

The increase in the retirement age means that the reduction in material government consumption can be limited. Table 9 shows that it is 2.0 percentage points, which is 0.6 percentage points smaller than in the baseline projection. Fewer measures are now required for realising sustainable public finances – since the higher retirement age results in a smaller increase in spending on public pensions in the coming decades, coupled with higher government revenues as employment and output are boosted.

5 If a greater number of steps is assumed for bringing the retirement age up from 65 to 67, as is the case in the United States and Germany, the effects to be expected are roughly comparable.

Table 9

Effects of Raising the Retirement Age in 2015 and 2025 to the Age of Subsequently 66 and 67 Years if Sustainable Government Finances Are Realised from 2006 through a Reduction of Government Consumption

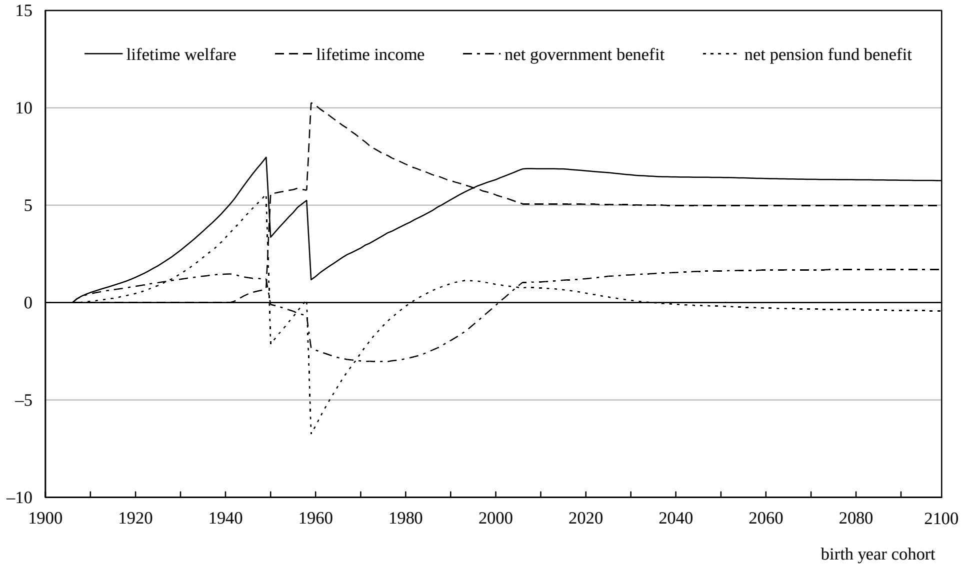
	2011	**2020**	**2040**	**2060**	**2100**
(percent of GDP)					
Government consumption	0.6	0.6	0.6	0.6	0.6
Income taxes	0.2	0.4	0.3	0.2	0.2
Indirect and other taxes	–0.2	–0.1	–0.2	–0.2	–0.2
Primary EMU balance	–0.7	–0.1	0.1	0.1	0.1
EMU balance	–0.9	–0.5	–0.2	–0.3	–0.3
Government debt	4.4	7.6	7.1	5.9	5.9
(percent)					
Employment (in full-time equivalents)	0.0	0.4	0.7	0.7	0.7
GDP at base prices	0.0	0.5	0.8	0.9	0.9

The increase in employment in this variant is smaller than the increase of the labour supply of the group aged 65 and over, since the higher retirement age results in a greater tax wedge. Lower pension benefits and contributions reduce the extent to which workers can benefit from tax facilities on pension savings. This makes it less attractive to work. This effect is quite small, however. This can be derived from the negligible impact on employment in 2011, before the rise in retirement age takes effect.

Figure 5 shows that primary incomes increase for all cohorts younger than birth year 1942. This is mainly a result of the lengthened stay in the workforce by those who are currently active at the age of 64. The distributional effects through pension funds are at first sight somewhat counterintuitive. It turns out that the rise of retirement age benefits the elderly (see the cohort older than birth year 1942). This is explained by the fact that these cohorts escape the consequences of the rise in the retirement age. Moreover, the elderly even benefit from the rise because it reduces pension-fund liabilities, thereby improving the funding ratios of pension funds. This reduces the need to limit the indexation of pensions. The full burden is borne by the age groups that do face the direct consequences of the higher retirement age, but have a part of their careers behind them in which the pension premiums they contributed to pension funds were in accordance with the lower retirement age. The distributional effects through the government sector are relatively small. The elderly benefit because they are not faced with the higher retirement age, whereas they do benefit from the smaller reduction in government consumption. The middle-aged

Figure 5

Effects on Cohorts of Raising the Retirement Age by Two Years (see text)



and younger groups carry the burden of this policy change. These groups are fully confronted with the higher retirement age. The net benefits (which are very small) for the newborns and unborn cohorts reflect the net effect of the difference in age targeting between the increase of retirement age (the elderly) and the offsetting government consumption (all age groups equally). The lifetime welfare effects are positive for all groups. Generally, this results from the prevalence of the increases in primary lifetime incomes.

6. Conclusions

In our view, understanding the behaviour of economic agents is as important as understanding fiscal institutions. Our model integrates the generational-accounting approach with an applied-general equilibrium setup. The recognition of economic behaviour improves our assessment of the intergenerational consequences of government policies; accounting for fiscal institutions improves our projections of future economic developments.

This paper illustrates the benefits from an integrated approach by presenting projections and policy simulations. The two analytical simulations demonstrate most clearly the working of the model. The more realistic simulation of a gradual increase of the official retirement age shows how our model can be put into practice. It is this line that we want to explore further in future work.

REFERENCES

Altig, D., A.J. Auerbach, L.J. Kotlikoff, K.A. Smetters and J. Walliser (2001), Simulating Fundamental Tax Reform in the United States, *American Economic Review*, No. 91, pp. 574-95.

Auerbach, A.J., J. Gokhale and L.J. Kotlikoff (1991), "Generational Accounts: A Meaningful Alternative to Deficit Accounting", in D. Bradford (ed.), *Tax Policy and the Economy 5*, Cambridge (Mass.), MIT Press, pp. 55-110.

Auerbach, A.J., L.J. Kotlikoff and W. Leibfritz (1999), *Generational Accounting Around the World*, The University of Chicago Press.

Blundell, R., M. Browning and C. Meghir (1994), Consumer Demand and the Life-cycle Allocation of Household Expenditures, *Review of Economic Studies*, No. 61, pp. 57-80.

Bovenberg, A.L. and H.J.M. ter Rele (2000), "Generational Accounts for the Netherlands: An Update", *International Tax and Public Finance*, Special Issue on Public Finance and Transitions in Social Security, pp. 411-30.

Bovenberg, A.L. and T. Knaap (2005), Ageing, Funded Pensions and the Dutch Economy, CESifo, Working Paper, No. 1403.

Buiter, W.H. (1995), Do Generational Accounts Reveal the Effect of the Budget on Savings and Intergenerational Redistribution, NBER, Working Paper, No. 5087.

de Ree, J. and R. Alessie (2006), "The Life Cycle Allocation of Consumption and Female Time", Utrecht School of Economics, to be published.

Gokhale, J. and B. Raffelhueschen (1999), Population Aging and Fiscal Policy in Europe and the United States, *Economic Review,* No. 35, pp. 10-20.

Haveman, R. (1994), Should Generational Accounts Replace Public Budgets and Deficits, *Journal of Economic Perspectives*, Winter 1994.

Raffelhueschen, B. (1999a), "Generational Accounting: Method, Data and Limitations", in European Commission (ed.), *Generational Accounting in Europe*, Brussels.

———— (1999b), "Generational Accounting in Europe", *American Economic Review*, AEA Papers and Proceedings, No. 89, pp. 167-70.

ter Rele, H.J.M. (1998), "Generational Accounts for the Netherlands", *De Economist*, No. 146, pp. 555-84.

van Ewijk, C., B. Kuipers, H. ter Rele, M. van de Ven and E. Westerhout (2000), *Ageing in the Netherlands*, CPB, The Hague.

van Ewijk, C., N. Draper, H.J.M. ter Rele and E. Westerhout in cooperation with J. Donders (2006), *Ageing and the Sustainability of Dutch Public Finances*, CPB Netherlands Bureau for Economic Policy Analysis, The Hague.

Westerhout, E.W.M.T. (2006), "Does Ageing Call for a Reform of the Healthcare Sector?", CESifo, Economic Studies, No. 52, pp. 1-31.

Westerhout, E.W.M.T. and F. Pellikaan (2005), "Can We Afford to Live Longer in Better Health?", ENEPRI, Research Report, No. 10, July; CPB Document, No. 85, CPB, The Hague, June.

Westerhout, E.W.M.T., M. van de Ven, C. van Ewijk and N. Draper (2004), "Naar een schokbestendig pensioenstelsel - verkenning van enkele beleidsopties op pensioengebied", CPB document, No. 67, CPB, The Hague (in Dutch).