Research Memorandum

No 135

Generational accounts for the Dutch public sector

Harry ter Rele

CPB Netherlands Bureau for Economic Policy Analysis, The Hague, May 1997

CPB Netherlands Bureau for Economic Policy Analysis
Van Stolkweg 14
P.O. Box 80510
2508 GM The Hague, The Netherlands

Telephone +31 70 33 83 380
Telefax +31 70 33 83 350

ISBN 90 563 5085 4

The responsibility for the contents of this Research Memorandum remains with the author(s)

Contents

1. Introduction[1]

This paper examines the intergenerational impact of government policies. The central question is how government policies affect the welfare of currently living generations and generations that are yet to be born. Traditionally, the long term consequences of fiscal policies in the Netherlands are assessed on the basis of the budget deficit, public debt and net government wealth. An explicit analysis of the effects of fiscal policy on the welfare of generations has received only little attention. For this analysis we use a tool that is known as 'Generational Accounting'. Its forward looking property allows one to explore the effects of various future developments that affect the generational impact of fiscal policies. In particular, in the decades to come, the prospective aging of the population and the depletion of natural gas reserves are expected to put a substantial burden on the public finances. At the same time, an increasing participation of the middle-aged in the labor force and the accumulation of funded private pensions are expected to alleviate this burden by strengthening the tax base. Generational acccounting is also comprehensive in that it includes all budget items (i.e. both spending and taxes). Hence, it provides a useful framework for exploring how fiscal policy and future developments interact in affecting the welfare of generations and the sustainability of the public finances.

The Generational Accounting methodology used here employs a number of extensions to the standard practice of performing these calculations, as developed by Auerbach, Gokhale and Kotlikoff. This paper therefore also serves a methodological purpose.

Several other studies have focussed on the aging problem in the Netherlands. None of these studies however, dealt with the budget in a comprehensive manner and took account of all future developments mentioned above. It is here that this paper stands out. Our analysis explores the effect of policies not only for generations, but also for future government budgets. In this way, it provides a link between the generational effects of fiscal policy and the more traditional tools of analyzing fiscal policy, such as the budget

[1]This paper benifitted from the cooperation of and discussions with Lans Bovenberg. I also want to thank Jelte Haagsma and Martin Vos for carrying out the calculations.

deficit and public debt. This may help to translate goals with respect to the generational effect of policies into more concrete and manageable terms.

The next section explains the methodology of Generational Accounting. In section 3 and 4 we explore the intergenerational effects of present policies and the sensitivity of the results for various assumptions. Section 5 deals with a number of ways to establish generational balance. Section 6 discusses the strengths and weaknesses of Generational Accounting. Finally, section 7 provides a summary of the main conclusions.

The main results of the present study were reported in section IV.1 of CPB (1997). This paper provides a more complete exposition and background materials.

2. Methodology

2.1 The background of the origin of Generational Accounting

Generational Accounting (GA) has been developed by Auerbach, Gokhale and Kotlikoff (AGK) out of discontent with the measure that is commonly used to assess the intertemporal impact of government policies: the budget deficit. Initially, this discontent brought about various proposals for correction of the deficit concept. For example, it was argued that the accumulation of unfunded public pensions should be added to the deficit. Other issues involving the correct definition of the deficit were the deduction of public asset formation and the adjustment of the deficit for the loss of real value of public debt due to inflation.

These discussions made it increasingly clear that the purpose of the deficit concept was unclear and should be defined more precisely. What is the ultimate, fundamental question? AGK concluded that this was one of four fundamental questions concerning the impact of government policies:

1. How much is the public sector consuming over time?
2. Which generations pay for this consumption?
3. How are projected lifetime payments of each generation allocated over its richer and poorer members?

4. How does the government distort economic decisions?

To address the second question AGK developed Generational Accounting.

AGK's ordering of the impact of government policies differs from the usual one. Traditionally, policy impacts are analyzed on the basis of their three main objectives: allocation, distribution and stabilization. One could roughly consider the first two of these to be covered by AGK's four questions. AGK do not mention the governments stabilization function, for which the deficit seems to be an appropriate indicator and a useful concept.

2.2 Generational accounting in a nutshell

Roughly speaking GA boils down to calculating how the public sector affects the welfare of an average member of currently living and future generations. The intergenerational impact of policies is measured in two phases. First, the net benefits (benefits from government expenditures minus taxes) are determined for the currently living generations over the rest of their lives. In this first phase, benefits are calculated under the assumption that present policies are continued. Accordingly, the intertemporal budget constraint does not restrict the benefits accruing to the currently living generations. This constraint enters the analysis only in the second phase, when the net benefits accruing to future generations are calculated residually from the intertemporal budget constraint of the government. In particular, in present value terms, the net benefit of future generations equal initial net government wealth minus net benefit enjoyed by the present generations. This intertemporal budget constraint reflects the conflict of interests between generations: policies that benefit the presently living impose a burden on future generations and vice versa.

GA yields two important measures. The first is the *level* of the (positive or negative) net benefit accruing to an average member of future generations. This concept is a more comprehensive measure for the burden that current generations transfer to future generations than public debt. It is also more comprehensive than other measures, such as public debt plus the present value of unfunded old age benefits, because it incorporates all taxes and expenditures.

The second measure is the *difference* between the net benefits of newly borns (these are the youngest members of the current generations), whose net benefits depend on current schemes, and the net benefit of future generations, whose net benefit is determined residually from the budget constraint. The net benefits of only the newly borns is comparable among current generations to those of future generations because the net future benefits of only the newly born apply to an entire lifetime. The difference measure provides a measure for the sustainability of present public schemes. If the net tax burden of the newly born and future generations coincide, current fiscal policy is consistent with the government budget constraint and is thus sustainable. However, if future generations enjoy a lower net benefit than the newly borns do, current fiscal rules will have to be adjusted in the future to meet the budget constraint. In view of these two advantages, this paper will focus on the second measure, i.e. the difference in the net benefits of newly borns and future generations.

2.3 The generational accounting instrument

Introduction

There are two dimensions to GA analysis, the time dimension and the generational dimension. Figure 1 clarifies the difference between these two dimensions. In the figure, and the remainder of this section, we shall assume that the maximum life of a generation is three time periods. PR^k_t represents the net benefit in period t enjoyed[2] by the generation born in period k. Time periods are shown on the horizontal axis and the age of the generation in each period on the vertical axis. The life of a generation therefore moves along a diagonal line from the top left to the bottom right of the figure.

[2]Section 2.4 explains the net benefit concept. It roughly equals the benefits from government expenditures minus the burdens from taxation.

Figure 1 *Net benefit, by year and by generation*

The sum of the 'cells' to the right of the vertical line is the remaining net benefit to be enjoyed by the generations alive in period 0. Net public capital W^g was formed in the past, being the complement of the net benefit enjoyed by those who have died and of the generations still alive (the `dotted' cells to the left of the line). This explanation also shows the zero-sum property of government policy that is inherent to the GA instrument. There is a conflict of interest between the generations. A positive net benefit enjoyed by one generation - calculated by discounting a diagonal summation - implies a negative net benefit for another generation[3].

For existing generations, only the net benefit over their *remaining* life is calculated. The cells to the left of the vertical line are thus not included in our calculations. A calculation of past PR's would require a painstaking amount of work[4]. The clear age-

[3]At this stage of the analysis, we abstract from the windfall wealth from natural resources.

[4]Van Kempen (1996), however, has performed these calculations for some selected generations back to birth year 1960.

dependency of the balance of burdens and benefits (see section 2.5) renders the remaining net benefit to be enjoyed by members of different existing generations difficult to compare. We can, however, make assumptions about *future* policy. We shall therefore concentrate on comparing the net benefit of newly borns with that of future generations (unborn). Among existing generations, only the current newly borns still have a full life ahead of them. Accordingly only a figure calculated for this group is comparable with that of the unborn. In this connection, one should realise that GA is concerned with comparisons of an *average member* of a generation. Accordingly, PR must be broken down into a volume component, 'a' (the number of persons in generation k in time t), and an 'lpr' component that indicates the net benefit of an average person in generation k in period t.

$$PR_t^k = a_t^k \; x \; lpr_t^k \tag{1}$$

The net life-time benefit of existing generations

The net lifetime benefit of an average person in generation k involves the diagonal summation of the lpr's. In the three period framework of figure 1, the net lifetime benefit of a person born in period 0 (lpr^0) is calculated as follows (*r* is the discount rate):

$$lpr^0 = \frac{PR_0^0 + \frac{PR_1^0}{1+r} + \frac{PR_2^0}{(1+r)^2}}{a_0^0} = \frac{a_0^0 lpr_0^0 + \frac{a_1^0 lpr_1^0}{1+r} + \frac{a_2^0 lpr_2^0}{(1+r)^2}}{a_0^0} \tag{2}$$

The lpr's in the current period are derived from the current size of budget items together with supplementary information on the allocation of the burdens and benefits associated with items over age groups. Section 2.4 discusses how net benefits are derived from items on the government budget. Section 2.5 addresses the allocation of benefits and burdens over age groups.

There are simple and more realistic methods to construct future lpr's. In the *simple* method, it is assumed that the lpr's increase over time in line with the forecast growth in an economy's labor productivity (y). Accordingly, the relative net benefit for every age group is constant.[5] Indeed, the future ratio between the lpr's will remain constant. Therefore, the ratio of the PR's in a period will change only in response to changes in the demographic composition (the ratio between the a's). A future change in the PR's and therefore in the sum of the PR's means there will also be a change in the composition of public sector finances. In concrete terms, an aging population will lead to a sharper increase of state pension payments than of tax and social security revenues, resulting in a rise of the budget deficit[6]. After calculating and summing the 'cells' of the existing generations (in Figure 1, six cells), both the net capital (W^g) and the sum of these discounted PR's are used to calculate the total inheritance of future generations. The algebraic calculation will be set out below.

A method to include *more realistic* elements when extrapolating lpr's is to use forecasts for aggregate spending and revenues categories. This method takes account of policies and changes in the economic environment. Generally however, these forecasts are available only for a limited time period. In our calculations we will incorporate realistic elements even beyond the period for which estimates of budget items are available. To do this, our method of calculating the future net benefit of the existing generations uses future changes in a number of factors affecting the lpr's. This is necessary to take account of changes in the age profile of incomes and taxes paid (due for example to an increase in labor participation or a relative increase in the pension incomes of the elderly) or of a government policy that hasn't yet taken effect fully (such as disability benefits legislation).

The net life-time benefit of future generations

[5]Expressed algebraically as: $lpr^{k+1}_{t+1}=(1 + y)\, lpr^{k}_{t}$.

[6]In this methodology, we assume that social security contributions are constant and do not respond to changes in social security spending in order to maintain balance in the social security accounts. This is consistent with the GA methodology in that existing generations do not face budget constraints.

As noted in 2.2, the sum of the net benefit of all future generations, discounted to period 0, must equal the 'inherited' capital. This is the budget restriction. This inherited capital is equal to the net capital at the beginning of period 0 (W^g) after deduction of the net benefit in the remaining life of the current generations (PR^{levre}). In Figure 1 the PR^{levre} is the present value of the sum of the six 'cells' to the right of the vertical line.

GA expresses the consequences for future generations in one quantity, the net benefit of the average unborn. The total inheritance must therefore be `distributed over' the individual members of the future generations. This also renders the future birth rate important. The (positive or negative) inheritance is distributed over the members of future generations in such a way that the individual benefit or burden rises with lifetime income. Every unborn gets an equal net benefit as a proportion of lifetime income. The quantity that expresses the net benefit of an average and representative unborn is scaled to the lifetime income of newly borns, this to attain comparability. Assuming that lifetime income increases in each generation by y, we can calculate the quantity expressing the net lifetime benefit of an average and representative unborn lpr^{ong} from the intertemporal government budget constraint as follows:

$$lpr^{ong} = \frac{W^g - PR^{levre}}{\sum_{t=1}^{\infty} a_t^t \left(\frac{1+y}{1+r}\right)^t} \qquad (3)$$

The numerator on the right-hand side of equation (3) is the present value of the net capital 'inherited' by the unborn.[7] In the denominator, this inherited amount is distributed

[7] A meningful solution of (3) requires that the denominator on the right hand side has a finite value. Denoting population growth as n, this requires that r > y + n. When r < y + n, the right hand side is not finite. This, however, is generally considered an exceptional circumstance and we shall therefore presume that $r > y + n$. All scenarios of `Nederland in Drievoud' and of `Overlevingsscenario's Lange Termijn Verkenning 1995-2020 ' assume r >y + n. The same holds for GA-calculations involving other countries.

over the unborn. By means of the adjustment with y for the future rise of lifetime income levels we obtain comparability to the net benefit of the recently born. The discount rate incorporates the time deferral factor.

the level measure

The intergenerational transfer to future generations comprises the balance of all burdens and benefits. It measures the inheritance for the future generations. If it is zero the government in a way resembles a fully funded pension fund that covers its `liabilities' (PR^{levre}) through capital (W^g). The W^g is the balance of all assets and liabilities. The assets produce future benefits and comprise financial and fysical assets, as well as the present value of revenues from natural resources. The liabilities produce future burdens and primarily consist of government debt. The magnitude of PR^{levre} depends on a combination of factors. One is the net benefit *level* of the present budget (the present sum of the PR's), as present (age specific) benefits are extrapolated. Another one is the *skewness* of the age profile[8]. An age profile that produces high benefit levels for the elderly will result in a high PR^{levre} due to the large part of the current population that will pass this stage of life. In an aging society, the skewness of the profile obviously becomes even more important. Other factors affecting the present value of the inheritance are the interest rate and productivity growth. Another channel through which demography affects the lpr^{ong} is the growth of births. This determines the number of the unborn.

the difference measure

As noted, determining the sustainability of public finances is concerned not with the level of the lpr^{ong} but with the *difference* between the lpr^{ong} and the lpr^0. These concepts are comparable as both apply to the entire lifetime. The lpr^0 is the net lifetime benefit current policies produce. If $lpr^0 > lpr^{ong}$ this benefit level is higher than the level the budget restriction leaves for the representative unborn. This obviously makes the policy unsustainable. Change is therefore inevitable. The longer the change is delayed, the higher the cost in the form of greater inequality between the generations.

[8]The age profiles are discussed in section 2.5 and appendix 1.

The difference measure can be expressed in money terms and as a percentage of (estimated) lifetime income. The latter probably better reflects its significance.

the policy adjustment measure

Another measure for the intergenerational imbalance and sustainability of present policies is the policy adjustment required to obtain a difference measure of zero and thereby sustainability. The advantage hereof is that it does not necessitate the somewhat unrealistic assumption of an unchanged set of policies for the currently living over the rest of their lives. One example of this measure is a well-known one, the (immediate) tax adjustment required to arrive at a sustainable tax level.

Normative issues

The difference and adjustment measures indicate whether a policy can be sustained forever. However, it must not be interpreted as an indication of when or how a policy adjustment should be implemented. This is a political or normative issue, as this decision affects the interests of generations. In the light of economic growth in the market sector, it might be decided not to close the generational gap immediately, thereby bringing about a certain intergenerational redistribution in favor of the current (and poorer) generations.

2.4 Net benefits and the public budget

The definition of net benefit

Which expenditures and revenues of the public sector form part of the net benefits? Since we are now concerned with the *type* of expenditure or revenue, we express this net benefit in economic categories[9] (for the sake of simplicity, we have left out the generation and time indicators):

$$PR = C + U + (D + r.KF) - BP^{ex} - S \qquad (4)$$

[9]The net benefit concept adopted here differs from the concept used by Auerbach, Gokhale and Kotlikoff (1991). Section 2.6 discusses the differences.

where:

C	=	public sector material consumption
U	=	transfer payments
D	=	depreciation of public sector physical assets
KF	=	physical assets
BP^{ex}	=	taxes, social security contributions and non-tax revenues, excluding revenues from capital and from gas
S	=	seignorage

An explanation of the net benefit concept

It can be seen from equation (4) that net benefit is the balance of benefits and burdens. The composition of the benefits differs from that of public expenditures and that of the burdens differs from that of public revenues. A significant difference is that flows between government and the private sector can be counted as burdens and benefits only if there is *no exchange in return.* If there is an exchange in return, it is a 'normal' economic transaction and the flow cannot be considered to be a burden or a benefit. The fact that the public sector is the counterparty is irrelevant. This point is particularly important with regard to flows stemming from public assets and liabilities. Interest payments, for example, are not counted as a benefit since they are a normal return on an investment. Accordingly, revenues from financial assets and from the government gas resources are not included. The same is true of the profit remitted by DNB (the Dutch central bank). Although these expenditures and revenues are not a *direct* burden or benefit, such public assets and liabilities do have an *indirect* effect by increasing, respectively reducing, future net benefits.

Another difference between the items included in the net benefit concept and the items of the public budget is that we do not include gross investments as benefits. Nor do we include funds borrowed to finance the budget deficit as a burden. These items have *future* effects. However, the benefit concept does include benefits from the stock of public sector physical assets. These have to be estimated since there is no directly observable flow. We do so by equating these benefits to the sum of depreciation on physical assets and a component that is calculated as the product of physical assets and

the discount rate of the public sector.[10] To be 'profitable', and we presume that past public investments were made with good reason, the benefit of these assets must be at least this amount. If this condition is satisfied, the present value of the future benefit is always equal to the value of the assets, thus guaranteeing the zero-sum property.

A final difference is 'seignorage'. This is the cost to the private sector of holding notes and coins. This cost counterbalances the remittance of DNB's profit. The central bank earns this profit on assets (mainly gold and foreign exchange) that were deposited by the private sector to obtain money balances. Since interest is not earned on notes and coins, this exchange is accompanied by a loss of interest for the private sector, and thus involves a burden. DNB therefore influences the PR by way of two opposing channels. First, it generates public sector income by means of its profit remittance, so that (present or future) benefits can be increased (by reducing taxes or increasing expenditure). Second, the use of money entails a burden. On balance, therefore, the net effect is largely a transfer within the private sector from money users to tax payers.

In symbols, the difference in the structure of net benefit from that of the balance of public sector expenditure and revenues, which is the budget deficit, can be expressed as follows:

$$PR = VT - (I - D - r.KF) - (RU - RI - GI - DNB) - S \qquad (5)$$

where:

RU, RI	=	interest expenditure and income from financial assets, excluding DNB
DNB	=	DNB profit remittance
GI	=	revenues from gas resources
I	=	public sector investments (gross)
VT	=	budget deficit

[10]We apply this procedure only to physical assets. Hence public expenditures on the environment, R&D and education are assumed to be consumptive expenditures.

We assume that the return on public sector financial assets and liabilities (FA and FP respectively) is equal to the discount rate. If we assume also that this is the case for DNB's profit as a share of its assets (GD) and for the private sector's loss of interest for holding notes and coins (Ch), equation (5) can be reformulated as follows:

$$PR = VT - (I - D) + r\,(KF + FA + GD - FP) + GI - r\,Ch \qquad (6)$$

Moreover, we can break down current gas revenues into a component that reflects the decline in the present value of the future gas revenue flow (this is the depreciation of the gas stock in a financial sense) and a component that better reflects real current revenues from gas. It can be deduced (see appendix 3) that the latter component is equal to the product of the discount rate and the present value of the remaining gas revenues flow (rG). The depreciation component is then equal to GI - rG. For the sake of simplicity, we further assume that DNB's capital income is equal to the private sector's cost of holding notes and coins (r GD = r Ch). Equation (6) can thus be reformulated as:

$$PR = VT - (I - D) + (GI - rG) + r(KF + G + FA - FP)$$

$$= \quad - VV \quad + r\,W^g \qquad (7)$$

where:

FA, FP	=	financial assets, liabilities
G	=	present value of future gas revenues
VV	=	net wealth formation by the public sector
W^g	=	net public sector capital (balance of physical assets, net financial assets and present value of gas income)

Because of the adjustment of the deficit for interest payments and receipts, the net benefit concept used here moves somewhat in the direction of the primary deficit.

However, the net benefit concept is a more accurate measure of present benefits because it also deducts physical capital formation and adds benefits from the public capital stock.

Financial and physical assets differ in their impact on the generational accounts. As the imputed rent from physical assets forms part of the net benefit concept, extrapolating the present benefit profile to the future means that existing generations as well as future generations benefit from these assets. This is not the case for financial assets and liabilities because the returns on these assets do not form part of the net benefit concept. In this latter case the whole burden or benefit is absorbed by future generations.

By the same token, a policy of deficit financing investment projects is not intergenerationally neutral if taxes are not raised to cover depreciation and the resulting extra interest payments. In particular, existing generations benefit from the investment whereas the whole burden of financing the project would be shifted to future generations.

Table 1 provides a numerical illustration of the adjustments of the budgets for 1995 and 1998 into the items that form part of the net benefit concept.

Table 1 The 1995 and 1998 budget and its conversion into benefits and burdens

	1995 Expenditures	adjustment	Benefits	1998 Expenditures	adjustment	Benefits
	% BBP					
Defence	1.9		1.9	1.7		1.7
General government	10.2	-0.1[1]	10.1	9.8	-0.0[1]	9.8
Infrastructure	1.7	-0.9[1]	0.8	1.8	-0.9[1]	0.9
Education	4.7	0.1[1]	4.8	4.5	0.0[1]	4.5
Subsidies	2.3		2.3	1.8		1.8
Health	8.9		8.9	8.4		8.4
Social Security	16.3		16.3	14.4		14.4
Transfers abroad	2.4		2.3	2.4		2.4
Interest payments	6.0	-6.0[2]	0.0	5.0	-5.0[2]	0.0
Total	54.5	-6.9	47.6	49.9	-5.9	44.0
	Revenues	adjustment	Burdens	Revenues	adjustment	Burdens
Income tax + social security contr.	25.8		25.8	24.2		24.2
Corporate tax[3]	3.7		3.7	4.2		4.2
Other revenues[4]	17.2		17.2	16.8		16.8
Revenues from capital, including gas[5]	3.7	-3.7[2]	0.0	3.0	-3.0[2]	0.0
Seignorage	0.0	0.2	0.2	0.0	0.2	0.2
Total	50.4	-3.5	46.9	48.2	-2.8	45.5
	Deficit	adjustment	Net benefit	Deficit	adjustment	Net benefit
	4.0	-3.4	0.7	1.7	-3.2	-1.5

[1] These adjustments are the net result of deducting gross investments and adding the imputed rent.

[2] These adjustments are a consequence of not including budget items in the net benefit concept that involve voluntary market transaction.

[3] This item also comprises taxes on dividends and on personal wealth.

[4] This item consists of indirect taxes, various small taxes and non-tax revenues that are counted here as burdens. Components of these latter revenues are sales of defence equipment and government revenues from providing services. These revenues are no burden as such and should ideally be deducted from expenditures. However, because they couldn't be attributed to any expenditure category, they were deducted from benefits this way. Non-tax revenues also consist of capital transfers received by the government, such as death duties.

[5] This item consists of revenues from capital, gas revenues and net government revenues from buying and selling land. The latter item is considered a disinvestment (see appendix 1).

2.5 Distribution of net benefits over ages

GA-calculations necessitate assigning benefits and burdens of the budget to age groups. This is done by distributing the budget items included in the net benefit concept over the age groups. Appendix 1 explains how this is carried out for base year 1995 with the help of additional information and how the future age profiles are constructed.

Chart 1 reveals the distribution of the benefits for base year 1995. It shows that these generally rise with age. The two main components of this rise are social security and health care. Benefits from social security rise with age mainly due to old age benefits (AOW), which are paid only to citizens over 65 years of age, and disability benefits, which increase with age for those younger than 65 years. Health care costs rise with age because of growing costs of illness and of provisions for the old aged. Obviously benefits from expenditures on education accrue to the the young. Benefits from the other expenditures and from the public capital stock are distributed evenly over all people living.

Chart 2 reveals that also taxes vary with age. Until the age of about 50, labor incomes (and hence tax revenues from these incomes) rise with age, explaining the upward slope in the tax profile. Beyond the age of 50, tax payments fall due to a gradually decreasing participation in the labor force. The declining labor incomes are not fully offset by various forms of pension incomes, which are subject to income tax. Accordingly, both incomes taxes (which include social security premiums) and indirect taxes (which are linked to net income) fall with age. Compared to indirect taxes, direct taxes drop more rapidly at age 65 because individuals over 65 are exempt from contributing to various social security schemes, including the public old-age scheme. Overall, compared to the middleaged, the elderly contribute significantly less to the budget. Combining the expenditure and revenue sides of the budget, chart 3 shows the age profile of total net benefit from the public sector.

Chart 1 *Age profile of benefits, 1995*

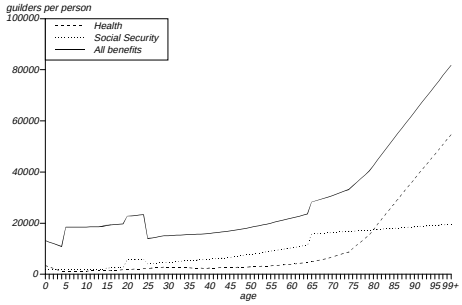


Chart 2 *Age profile of burdens, 1995*

Afbeelding niet beschikbaar

Chart 3 *Age profile of total net benefits, 1995*

Afbeelding niet beschikbaar

2.6 The standard practice of Generational Accounting

The approach adopted in this paper differs on a number of points from the standard practice, as used by AGK (1991). The first is that the standard practice includes neither the benefits of public sector consumption in the net benefit concept, nor the benefits from public physical assets. Net benefit is simply the balance of transfer payments, or the balance of benefits received from transfer payments and taxes and social security contributions paid. As benefits from public spending on goods and services are omitted, the values of the PR of most of the 'cells' in Figure 1 (and the related lpr) are negative. This means that the intertemporal budget restriction of equation (6) has to be adjusted. Kotlikoff calculates the net benefit of the representative unborn person as:

$$lprex^{ong} = \frac{WEX^{g} - PREX^{levre} - \sum_{t=0}^{\infty} G_t}{\sum a_t^{t} \left(\frac{1+y}{1+r}\right)^{t}} \qquad (8)$$

where:

$PREX^{levre}$	=	present value of the net benefit of current generations over their remaining life, excluding the allocation of the benefits of material consumption and physical assets
$lprex^{ong}$	=	as $PREX^{levre}$, but for a representative unborn person
G	=	public sector spending on consumption and investments
WEX^{g}	=	public sector financial wealth (i.e. excluding physical assets)

AGK probably omit public spending because of the obvious problems of assigning benefits to age groups. However, what is relevant is the inter-generational redistribution of *all* benefits and burdens and not only those distributed by means of transfer

payments.[11] The advantage of assigning is that alternative assumptions can be made which enables a sensitivity analysis to check the robustness of the result. Section 4 employs such a sensitivity analysis.

Another disadvantage is that AGK's instrument does not permit calculations of the intergenerational effects of measures involving public sector investments since the benefits of the investments are excluded from the calculation.

Not assigning benefits from public spending to generations also entails that net benefits of generations cannot be readily interpreted as wealth transfers.

The second important deviation from the standard practice of GA is that this paper allows for shifts taking place in the economic environment that do have an effect on future age profiles. In this way, we can take account of a number of factors that will exert an important impact on future government revenues. These factors will be discussed in the next section.

3. The intergenerational impact of present fiscal policies

3.1 The extrapolation of current policies

As noted in section 2.3, the simple method for calculating the generational accounts extrapolates the present age profile. This method, however, ignores several important future changes in the Dutch economic environment affecting the life-cycle pattern of net benefits. These changes include, first, an increase in labor-force participation; second, a rise in pension contributions; third, the maturing of private, funded pension funds; and fourth, a flattening of the age-earnings profile. These factors have to be taken into account when extrapolating the present (average) tax rates. Finally, we will also take account of the present high level of investment, as will also be explained below.

the implemented policy

[11] This point is raised also by Buiter (1995) and Haveman (1994).

The basis for the extrapolation of policies is the projected budget in 1998, when the present government completes its legislative period.[12] This budget incorporates the effects of all policies agreed on by the political parties making up the present government. In addition, for the period beyond 1998, we account for the lagged impact of already legislated measures that restrict the eligibility for disability and survivor benefits. We assume that social security premiums are constant after 1998[13] and do not follow the Dutch practice to maintain balance in the social security accounts.

Rising labor-force participation

The simple method of GA implicitly assumes that the currently observed rate of labor-force participation remains constant in the future. For the Netherlands, this assumption is unrealistic. This country has traditionally featured a low participation rate of women. Over the past decade, however, the participation rate of women has started to rise sharply and is expected to continue to increase substantially in the future. Rising educational levels of women contribute to this development. Moreover, lower fertility not only gives rise to aging but also boosts participation of women. Recent policy measures limiting the eligibility for disability benefits are expected to further increase labor-force participation, especially of the age groups of over 50.

A higher participation rate widens the tax base by raising labor incomes. To account for this effect, we assume that taxes paid by a particular age group depend not only on labor productivity and the number of people in that group but also on the projected labor-force participation rate of the age group involved. Table 2 compares current age-specific participation rates with projections of these participation rates in 2020 for three alternative scenarios. The projections for the European Coordination scenario, on which the analysis hereafter will be mainly focussed on, shows that the participation rate of those between 20 and 64 years of age (adjusted for the rise in part time employment)

[12]For the period between 1995 and 1998, we adopt the realized and projected budget figures contained in CPB (1997).

[13]However, we do adjust future social security contributions for its temporary high level in 1998. In that year these contributions are set ƒ 3.2 bln above the balancing level to compensate for past deficits.

will rise by about 10 % (or 6.4%-points) between 1995 and 2020. The older age groups are expected to feature the largest boost in labor-force participation.

Table 2 Participation rates of various age groups, 1995 and 2020

	1995	2020[1]		
		Divided Europe	European Coordination	Global Competition
Participation				
20-34	73.1	76.6	75.8	77.2
35-49	72.0	79.2	84.1	86.2
50-64	37.7	43.7	55.3	60.5
Total	64.1	65.3	70.5	73.9

Source: Participation growth rates in these scenarios are devided from `Population and labor supply', three scenarios until 2020', CBS/CPB (1997).

[1] Adjusted for rise in part time employment.

higher occupational pension contributions

During the last decade or so, pension funds were in the comfortable position of receiving high returns on their investments. This enabled them to impose a low level of tax deductable pension contributions. As the returns to investment are expected to be lower in the future, pension contributions will have to rise, thereby reducing the tax base. Per percentage-point lower difference between returns to investment and productivity growth than the average of 4% during the last decade, we assume that pension contributions will have to rise by 10%. In the benchmark-scenario we assume that the return to investment equals the discount factor of 4 percent. Since the growth rate is assumed to be 2 percent, pension contribution rates will rise by 20%.

Rising pension incomes

A projected increase in private pension incomes is the second factor requiring an adjustment of the age profile. Public pension benefits in the Netherlands are flat (i.e. unrelated to income) so that the public benefit level is relatively low for middle- and high-income earners. For these income groups, collective labor agreements supplement

the public benefits with compulsory occupational pension provisions. These provisions are financed by funded pensions funds, which have accumulated sizable financial assets by international standards (see Table 3). During the coming decades these funds are expected to mature so that an increasing part of the population will have accumulated substantial pension rights when reaching retirement age.

Table 3 Assets of pensionfunds, 1991

	as a % GDP
Netherlands[1]	75.9
Germany[1]	15.5
United Kingdom	60.1
France	4.6
Denmark	51.6
Belgium	10.5

Source: Report by the European Commission's Network of Experts on Supplementary Pensions.
[1] 1992.

Higher pension incomes strengthen the tax base because retirement benefits are subject to income tax while indirect taxes are levied on consumption out of these benefits. It is assumed that the average net income of an individual over 65 years of age relative to that of an individual between 35 and 49 year rises from 78 % to 85 % between 1995 and 2020[14]. The resulting increase in tax payments alleviates the generational imbalance further.

Flatter age-earnings profile

The third phenomenon that calls for adjusting the future age profile of taxes is the expected flattening of the age-earnings profile. Wages currently rise rather sharply with

[14]These figures are derived from Deelen (1995) and the 'European Renaissance'-scenario in CPB (1992). This scenario employs projections about future labor force participation similar to the European Coordination scenario in Table 3.

age. A number of developments, however, are expected to reduce wages of older workers compared to wages of the young. First, market forces increasingly link wages to productivity, thereby reducing the importance of implicit life-time labor contracts in firms. Second, the aging of the labor force renders younger workers more scarce compared to older workers, thereby reducing relative wages of the latter.

We assume that wages of young workers of 20 years of age will increase by 9% relative to the average wage between 1995 and 2020. A worker of 45 years old will experience an average rise in wages. Wages of older workers of 60 year will lag the average by 10%[15]. The flattening of the age profile of earnings dampens the rise in tax revenues due to a change in the composition of the labor force towards older workers with higher wages. Hence, it reduces the improvement in the generational imbalance brought about by higher pension incomes and a higher participation rate.

The high level op public investment

Also the level of current public investments affects the future age profile. At the moment some large infrastructural projects are carried out. Te extrapolation of the 1998 investment level generates a growth rate of the public capital stock that exceeds the GDP growth rate. The public capital stock to GDP ratio then rises from the current level of 28% to 39% in the year 2020 and to 56% in 2060. As the benefits from the capital stock are proportional to its size (see section 2.4), this rise will lift the overall age profile of net benefits.

The consequences of the high investment level will be measured by comparing its effects to the effects of an investment level that leaves the capital stock to GDP ratio at its present level of 28%. Another matter is the choice of the way of financing. The additional investments on the current budget can be assumed to be either tax financed or debt financed. Both possibilities will be examined below.

3.2 The results

Table 4 (column 1) reveals the generational accounts for selected existing generations. The pattern of the accounts over the age groups reflects the age profile of net benefits

[15]These assumptions are based on the 'European Renaissance'-scenario in CPB (1992) and Deelen (1995).

in chart 3. For the young and the age group over 50 years the accounts are in surplus, for the middle group in deficit. Columns 2 to 7 show how the various factors mentioned in section 3.1 affect the results. The increase of participation and the rise of pension incomes, both raising the level of taxes, turn out to have a large negative effect on the net lifetime benefit of existing generations. The increase of pension contribution rates and the flattening of the age profile of wages have a small positive effect.

Table 4 Present values of net benefits per capita over their remaining life[1,2]

Age in 1995	Results	effect of:					
	with present policies	higher participation	higher pension-incomes	higher pension contributions	flattening of wage profile	high investment level, when financed by:	
						indirect taxes	high deficit
	in thousands of guilders						
0	88	-52	-10	3	2	7	13
10	-44	-62	-12	4	5	3	11
20	-209	-65	-13	4	11	-4	9
30	-219	-60	-16	3	15	-10	7
40	-103	-41	-19	2	12	-15	5
50	63	-16	-19	1	5	-18	4
60	220	-4	-13	0	1	-16	2
70	270	0	-5	0	0	-10	1
80	252	0	-1	0	0	-5	0
90	212	0	0	0	0	-2	0

[1] productivity growth = 2%, discount rate (real) = 4%

[2] In prices of 1995.

The influence of the high investment level depends on the way it is financed. Tax financed investments generally exert a negative effect on the present generations

because part of the benefits from the investments are enjoyed by future generations. Debt financed investments, in contrast, benefit present generations as the whole burden of financing the investments is shifted to future generations.

Table 5 tests present policies for sustainability. With the aid of the intertemporal bud-get restriction, we first calculate the total net benefit of future generations. Then we derive the net benefit accruing to an average (and comparable) member of future generations (see equation (3)). It turns out that an average member of future generations receives a positive net benefit of ƒ 45 000,-. This is according to the level measure as discussed in sub-section 2.3. However, the difference measure (the difference between the net benefit of newly borns and that of future generations) indicates that present policies are unsustainable. Future generations receive a lower net benefit than newly borns do, a difference that amounts to ƒ 43 000 in present value terms. Expressed as a ratio of lifetime income this disadvantage is 3.2%. Columns 2 to 7 show the effect of the various factors discussed in section 3.1 on the difference measure. The increase in participation and the higher pension incomes bring about an increase in the present value of the heritage of future generations of ƒ 608 bln and ƒ 208 bln respectively. Without these factors, future generations would receive a negative rather than a positive inheritance as measured by the level measure. Moreover, the difference measure would have been much more negative, indicating a much more serious sustainability problem. Both factors affect this measure by 9.2% and 2.6% respectively of (estimated) lifetime income.

Table 5 Testing sustainability

	Results with present policies	effect of: increase of participation	high pension-incomes	rise in pension contribution rates	flattening of wage profile	high investment level, when financed by: indirect taxes	higher deficit
	billions of guilders						
Net government wealth[1]	35	0	0	0	0	0	0
Net benefit of present generations[2]	-352	-608	-208	31	114	-133	97
Net benefit of future generations[2]	387	608	208	-31	-114	133	-97
	thousands of guilders						
Net benefit of an average unborn[2]	45	71	24	-4	-13	15	-11
Net benefit of a newly born[2]	88	-52	-10	3	2	7	13
Difference measure	-43	123	34	-7	-15	8	-24
Difference measure as a % of lifetime income	-3.2	9.2	2.6	-0.5	-1.1	0.6	-1.8

[1] Net wealth is the balance of assets and liabilities. The assets include also the present value of future gas revenues. Appendix 2 discusses how the value of net wealth is determined.

[2] In present value.

4 Sensitivity analyses

GA requires many assumptions about the future. This section explores the sensitivity of the results with respect to the most important of these assumptions. In particular,we will investigate the sensitivity with respect to the discount rate, productivity growth, labor participation, the aging of the population, the costs of health care and government

wealth. Finally, we will explore how sensitive the results are with respect to an alternative way of assigning the benefits from public spending over the age groups.

Table 6 shows the sensitivity of the results with respect to *interest rates* and *productivity growth*. A higher interest rate tends to reduce the generational imbalance as measured by the difference in the present value of taxes paid by future generations and newly borns. The opposite holds for higher productivity growth. However when expressed as a ratio of the present value of lifetime incomes, the results are far more stable.

Table 6 Sensitivity for discount rate and productivity growth

Productivity growth (per cent)	1½			2			2½		
Discount rate (per cent)	3	4	5	3	4	5	3	4	5
	Thousands of guilders (in present value)								
Net benefit of:									
newly borns	77	100	120	70	88	110	72	77	98
Future generations	28	67	95	7	45	78	-8	23	60
Generational imbalance:									
in guilders	-49	-33	-26	-63	-43	-32	-80	-54	-39
as a percentage of life-time income	-3.0	-2.9	-3.1	-3.3	-3.2	-3.3	-3.4	-3.3	-3.5

Section 3.2 employed a base-case assumption for the expected growth of labor-force participation. However, in view of the considerable uncertainty surrounding this important variable, CPB has constructed two alternative scenarios for the future development of the participation rate (see Table 3). All three scenarios involve an increase in participation. Whereas the 'low' case projects only accumulated 2% growth till 2020, the 'high' case involves an accumulated growth of 15 % by 2020. This compares to 10 % growth in the base case.

Table 7 Sensitivity for participation rate

	Divided Europe	European Coordination	Global Competition	European Coordination, with lower productivity of new participants
Net benefit of:				
newly borns	117	88	58	99
future generations	11	45	85	34
Generational imbalance				
in dollar terms	-106	-43	26	-65
as a percentage of life-time income	-8.0	-3.2	2.4	-4.9
Average GDP-growth rate in 1995-2020	2.3	2.5	2.8	2.4

Table 7 reveals that the generational imbalance is rather sensitive to labor supply. Indeed, in the scenario featuring high labor participation, the additional labor supply offsets the effect of aging so that future generations actually benefit more from public finances than the newly borns do. This reveals that a high level of labor supply is an important factor in supporting sustainable public finances.

We also explored the effect on the generational accounts of a lower productivity of the new participants, by assuming that their productivity is only 80% of that of the existing participants. This might reflect the lower education level of this extra labor supply. Table 7 (column 4) reveals that the sustainability measure then deteriorates by ƒ 22 000 to ƒ 65 000.

Table 8 explores the sensitivity of the generational accounts with respect to *demography*. The second column of this table contains the accounts if the age structure would remain constant. It reveals that without aging, future generations would benefit substantially more from the government budget than present generations do. In

particular, compared to current generations, they would enjoy an additional lifetime *benefit* of ƒ 114 000,- (8.6% of life-time income). This compares with an additional *burden* of ƒ 43 000,- (3.2% of life-time income) if the prospective change in age structure is taken into account. This contrast reveals that aging puts a heavy burden on the public finances. These results underscore the merits of the forward-looking quality of intergenerational accounting.

The assumption of a constant age structure, while useful for analytical purposes, is clearly not realistic. To further pursue the sensitivity analysis with respect to demographic developments, we employ alternative demographic scenarios provided by Statistics Netherlands. In particular, we construct two variants with rather extreme assumptions for the aging of the population. To analyze the impact of substantial aging, the first variant combines the assumption of a low birth rate with that of a high life expectancy. The other variant considers the other extreme case by assuming that a high birth rate coincides with low life expectancy. Table 9 displays the effects of these alternative assumptions on the elderly dependency ratio. The two last columns of Table 8 show the consequences of alternative demographic assumptions. In the low aging scenario, the generational imbalance measure turns out to fall to ƒ 20 000,-, which almost implies a sustainable situation. Surprisingly, also the high aging scenario shows a (small) drop in the imbalance measure when compared to the base case scenario of the first column. Both the high aging and the base scenarios feature the same life expectancy so that net benefits of present generations and thereby the total inheritance of future generations coincide. Since the inheritance is positive, the scenario with the lower birth rate features a higher net benefit for the average unborn.

Table 8 Sensitivity analysis: demographics

	middle birth rate, high life expectancy	no change in age structure	low birth rate, high life expectancy	high birth rate, low life expectancy
Net benefit of:	in thousands of guilders			
newly borns	88	17	88	79
future generations	45	131	49	59
Generational imbalance:				
in guilders	-43	114	-39	-20
as a percentage of lifetime income	-3.2	8.6	-2.9	-1.5

Table 9 Elderly dependency ratios[1], 1995-2060

	base case	alternative assumptions	
	(middle birth rate, high life expectancy)	low birth rate, high life expectancy	high birth rate, low life expectancy
1995	.20	.20	.20
2020	.31	.32	.29
2040	.45	.46	.40
2060	.40	.42	.33

[1] The number of 65+ as a percentage of the 18-64 year olds.

Source: Statistics Netherlands

Under the assumptions made here, the costs of *health care* will rise – due to the aging of the population – from 8.7% of GDP in 1995 to 9.8% in 2020 and 13.2% in 2040. Even this sharp rise, however, might be too conservative. In particular, an increase in the relative price of health care services combined with a low price elasticity for these services might boost the growth of these expenditures (the so-called Baumol-effect). A

high income elasticity of health care could further reinforce this cost increase. Table 10 (columns 2 and 3) explores how sensitive the generational accounts are with respect to an additional cost rise of publicly financed health care of 1% per year. We distinguish two variants: one with a corresponding tax increase – in line with current institutional regulations – and one without a tax increase. In the second variant the costs are fully shifted to future generations, heavily worsening their position. The first variant produces more mixed effects. The high health care costs improve the position of the current old at the expense of the young and future generations. As a result, the imbalance measure does not change much.

Table 10 Sensitivity for health care costs

	Results with base case assumptions	additional cost rise between 1998 and 2020 of 1% per year		shift of age profile	
		with tax increase	without tax increase	with tax reduction	without tax reduction
	thousands of guilders				
Net benefit of:					
60 year olds	220	246	246	207	193
30 year olds	-219	-208	-188	-230	-240
newly borns	88	70	118	103	74
future generations	45	28	-5	64	82
Generational imbalance:					
in guilders	-43	-42	-123	-39	8
as a percentage of life time income	-3.2	-3.2	-9.2	-2.9	0.6

Our analysis has assumed that the age profile of health costs is not affected by the increase in life expectancy. An alternative assumption is that, as life expectancy rises, an increased portion of the elderly experience good health (see OECD 1996). In that case, the consumption of health services is concentrated more in the period immediately

before death. To explore the sensitivity of the generational accounts with respect to alternative assumptions, we shift the age profile of the cost of health care for the elderly by assuming that these costs are directly related to the number of deaths. In particular, from the age of 60 on, the age profile of health care is shifted by an increasing margin until it reaches at the age of 70 a maximum of 3.6 years, being the expected increase of life expectancy. This shift is assumed to occur gradually between 1998 and 2020. Here we also distinguish a variant with a corresponding tax reduction and one without. Table 10 (columns 4 and 5) reveals the results.

Another source of uncertainty is the possibility of measurement errors in determining *net government wealth*. Table 11 reveals the effects on the GA's of a ƒ 50 bln higher stock of assets in 1995 than in the benchmark. The results show that it matters whether the measurement error is located in the financial assets or in the physical assets.

If financial assets or future gas revenues are currently underestimated, benefit levels of present generations are not affected because benefits from these assets are not part of the net benefit concept (see section 2.4). The whole benefit from the windfall is thus enjoyed by future generations, thereby reducing the generational imbalance.

A higher valuation of (present) physical assets has opposite effects. In that case, benefit levels of present generations are affected, because benefits from physical assets are part of the net benefit concept. Therefore, present generations' benefits are increased by the higher valuation of the assets. Because newly borns turn out to benefit more from present physical assets than future generations, the generational imbalance is slightly widened.

Table 11 Sensitivity for measurement error in government assets

	Base case results	ƒ 50 bln higher stock of:	
		financial assets or gas revenues	physical assets
	thousands of guilders		
Net benefit of:			
60 year olds	220	220	222
30 year olds	-219	-219	-216
newly borns	88	88	91
future generations	45	51	46
Generational inbalance:			
in guilders	-43	-37	-45
as a percentage of lifetime income	-3.2	-2.8	-3.4

One might question the arbitrary nature of *assigning the benefits* from public consumption and from the public capital stock evenly over all living persons. It might for instance be argued that the benefits from these expenditures are more closely related to the consumption level of individuals. Chart 4 shows how this alternative assumption would change the age profile of net benefit. Table 12 reveals how the G.A.'s would be affected.

Chart 4 Sensitivity of age profile to alternative assumption

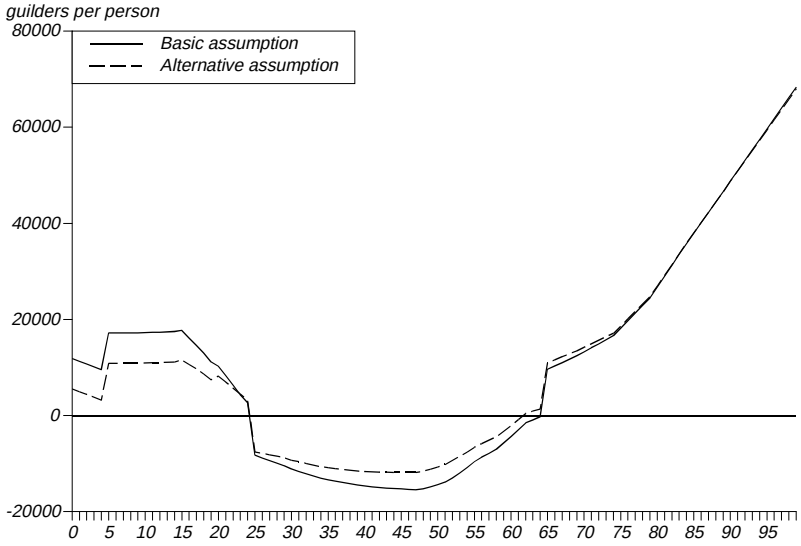


Table 12 Sensitivity for alternative assigning of benefits

	Results with base case assumptions	Results with alternative assumption
Net benefit of:		
60 year olds	220	235
30 year olds	-219	-147
newly borns	88	36
future generations	45	-18
Generational imbalance:		
in guilders	-43	-53
as a percentage of life time income	-3.1	-4.0

5. Establishing generational balance

5.1 The policy measures and their generational effects

Table 13 indicates policy adjustments that could serve to ensure sustainable public finances. It explores adjustments for a number of budget items. The measures are permanent and are assumed to be implemented in 1999. As could be expected from the relatively small generational imbalance in Table 5, the required policy changes are modest. Indeed, an adjustment in one of these budget items of about 0.9 to 1.6% of GDP would suffice (see column 1).

With the exception of investments in infrastructure, the policy adjustments required are about the same for all alternatives - irrespective of their age profile[16]. Table 13, however, indicates that the measures yield quite different effects on various generations. In particular, future generations benefit most from changes in budget items affecting the end of the life cycle, such as health and transfer payments. Changes in these budget items also have the smallest (negative) effect on the present value of net benefits of newly borns because the effect of these measures is discounted more heavily. This combination of affecting net life-time benefits of newly borns and future generations explains the relative insensitivity of the required adjustment for measure taken.

As stated in section 3.1, the extrapolation of the current level of investments generates a very high public capital stock to GDP ratio. This would rise from the present 28% to 39% in 2020 and 56% in 2060. This last figure seems excessively high. Therefore we also calculate the intergenerational effects in case the investment level is curtailed after 2020 and set at a level that keeps the capital stock to GDP ratio at a level of 39% reached by then. This entails an investment cutback of 0.6% of GDP. The tax level remains unchanged, implying a deficit reduction.

[16]In the case of infrastructure, the adjustment would have to be larger because benefits from these expenditures are lagged and therefore affect also future generations.

Table 13 Possible measures to obtain generational balance and its intergenerational effects

	measure[a]	Effect on net lifetime benefit of: future generations	newly born	30-year old	60-year old
	% GDP	thousands of guilders			
Defence, General government	-1.2	22	-20	-14	-7
Education	-1.2	9	-34	0	0
Health	-0.9	28	-14	-16	-17
Transfer payments net of taxes	-1.0	27	-15	-17	-14
Infrastructure	-1.6	20	-23	-12	-3
Income tax	1.1	25	-18	-18	-4
Indirect taxes	1.0	25	-17	-18	-7

[a] Every measure is scaled in such a way that it leads to sustainable public finances. This requires an effect on future generations which is ƒ 43 000 more favorable than that on newly borns.

Table 14 indicates that such an investment reduction lowers the generational imbalance by about 20%. The reason for this is that the lower benefits from investment affect both the present and the future generations, whereas the benefit of the lower cost of financing the investments accrues fully to future generations. In this case, therefore, the required adjustments to obtain sustainability, as displayed in Table 13, are also about 20% smaller.

Table 14 Generational effect of a lower investment level after 2020

	Generational imbalance	future generations	newly born	30 year old	60 year old
Current policies	-43	45	88	-219	220
Lower investment after 2020	-34	48	82	-221	220

5.2 Transforming the generational accounts into yearly budgets

why a transformation?

Transforming generational accounts into the corresponding future yearly budgets is useful for a number of reasons. First, it explicity states the implied size of future budget items. This improves the transparency of the consequences, thereby facilitating communication between the parties in the decision-making process. Second, it provides a link with the more traditional tools of analyzing fiscal policies, such as the budget deficit and government debt. This helps to transform policy objectives with respect to generational balance into more concrete deficit targets, rendering the balance objective more manageable. Third, it enables one to make explicit possible trade-offs between generational balance and possible other aspects concerning the deficit or debt, such as the EMU-criteria, the disadvantage of a large exposure of the budget to interest rate fluctuations, and the possible impact of public borrowing on the capital market and aggregate demand.

An example of sustainable future budgets

Table 15 reveals the budgets for selected years in the example that ensures sustainability by raising indirect taxes by 1.0% of GDP in 1999 (the last option of table 13). It shows that the aging of the population causes the old age benefits (AOW) and health care expenditures to rise substantially. Expressed as a percentage of GDP, old age benefits rise from 5.2% in 1995 to 7.1% in 2020 and 10.5% in 2040. Health care expenditures rise from 8.9% in 1995 to 9.8% in 2020 and 13.2% in 2040.

Until 2020, these rises are mitigated by the effect of the increase of labor participation on GDP. Also, the tax burden will rise due to the maturing of pensionfunds and the

resulting increase of taxable pension incomes relative to the size of the economy. The early implementation of a sustainable policy implies that, until 2020, the tax burden rises more than expenditures. This implies a (sharp) reduction of government debt and interest payments, which helps to create budgetary room for the increasing costs of the aging of the population in later years. After 2020 the costs of the old age benefits and of health care outweigh the rise in revenues, leading again to a rising deficit.

By first reducing government debt and interest payments in order to create room for the later rise of the age related expenditures, the future costs of the population aging are partly transferred to present generations.

Future deficits

Chart 5 shows how the budget deficit developes if present policies are continued. This would lead to a budget surplus by 2008, but would eventually result in new and soaring deficits when the aging causes expenditures to rise sharply. Chart 5 shows the course of the deficit also in case indirect taxes are raised in 1999 by as much as is necessary to arrive at a sustainable policy (the last line of Table 13). In this case, the budget reaches a surplus in 2002. This surplus would have to be maintained for several decades in order to reduce government debt. Enough room is then created to prevent an explosion of the deficit by the time the aging of the population `hits' the budget.

Apart from raising government saving by an immediate and permanent tax rise, there are alternative ways of arriving at a sustainable system, like strengthening the earning capacity of the economy and reducing the costs of arrangements that are sensitive to aging. The effects of a higher participation illustrate the first alternative. Chart 5 shows the course of the deficit in case the participation rise until 2020 exactly suffices to provide sustainability. Table 7 reveals that this requires an increase of participation somewhere in between of the increases of the `European Coordination'- and the `Global Competition'-scenarios. In this case, the budget deficit will have to turn into a surplus not before 2005 and the required size and prolongation of the surplus is slightly less drastic.

Table 15 Yearly budgets with a sustainable policy, 1995-2060

	1995	1998	2020	2040	2060
	% GDP				
Defence	1.9	1.7	1.7	1.9	1.8
General government	10.2	9.8	9.6	10.5	10.2
Infrastructure	1.7	1.8	1.8	1.9	1.9
Health	8.9	8.4	9.8	13.2	12.9
Education	4.7	4.5	4.0	4.2	4.1
Social Security					
- old age benefits	5.2	5.1	7.1	10.5	9.5
- other benefits	11.2	9.4	9.6	9.3	9.5
Subsidies	2.3	1.8	1.7	1.9	1.8
Transfers abroad	2.4	2.4	2.3	2.5	2.4
Interest payments	6.0	5.0	0.7	-0.4	1.8
Total public expenditures	54.4	49.9	48.2	55.6	56.0
Income tax + social security contributions	25.8	24.2	25.2	26.4	26.0
Corparate tax[a]	3.7	4.2	4.2	4.7	4.6
Other revenues[a]	17.1	16.8	20.0	21.8	21.3
Revenues from capital, including gas[a]	3.8	3.0	2.4	2.2	2.0
Total revenues	50.3	48.2	51.8	55.1	53.8
Budget deficit	4.0	1.7	-3.6	0.5	2.1

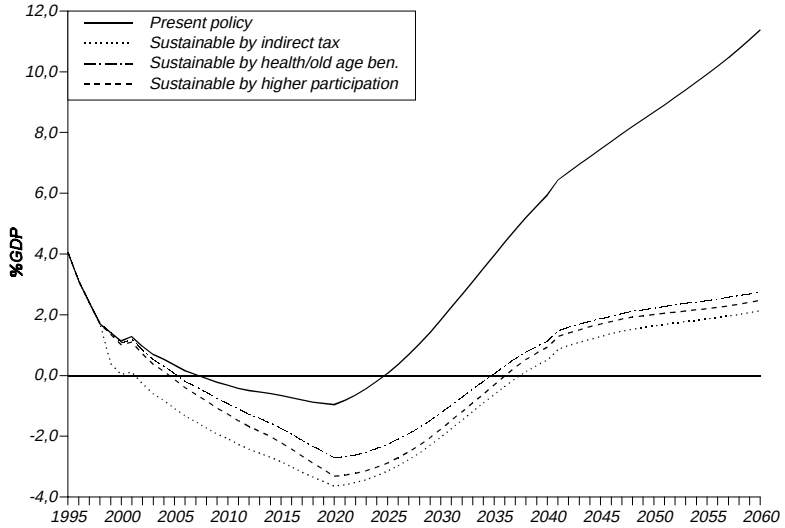
[a] The content of the budget items are explained in table 1.

The required deficit adjustments in the next decades are also reduced if sustainability is arrived at by reducing the costs of the aging of the population. Chart 5 illustrates the course of the deficit if the growth of old age benefits and health care costs for the old aged is curtailed in the period until 2020 to render the system sustainable. This entails a 0.4% slower growth of these expenditures per year so that age-specific expenditures rise with 1.6% per year until 2020.[17]

[17] After 2020 the age specific expenditures rise with 2% per year again.

Chart 6 shows the course of government saving[18] in the coming decades in the three sustainable scenarios of chart 5. It reveals that, due to the aging of the population, substantial amounts of government saving are necessary to arrive at sustainability[19]. This conclusion contrasts with the golden rule of finance. This rule advocates that an equitable distribution of benefits and burdens is achieved with a government saving level of zero. Appendix 4 will show that, also in a steady state situation, the golden rule only leads to a sustainable system under special conditions.

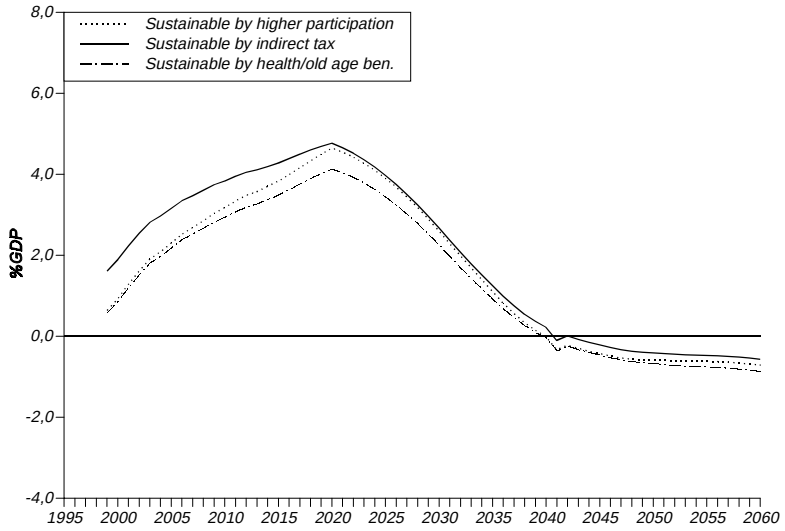
Chart 5 *Budget deficits with present policies, sustainable policies and sustainable participation*



[18]Government saving equals net investment minus net revenue from selling and purchasing land minus (financial) depreciation of gas resources minus the budget deficit.

[19]The discontinuity in 2040 is caused by the assumed ending of revenues from gas.

Chart 6 *Government saving with sustainable policies and with sustainable participation*



6. Strengths and weaknesses of generational accounting

the strengths

In determining the intergenerational stance of present policies GA has a number advantages over the more traditional tools, like the budget deficit, public debt or net government wealth. One is that it focusses directly on the policy effects on *generations* and therefore provides a better measure for intergenerational equity. The effect of policies on generations - or on an average person of a generation- provides more relevant information for political decision making because it offers an explicit equity choice. A second advantage is that it is *forward looking*. It allows one to take account of future developments, like the aging of the population and the rise of labor participation.

This relevance of testing fiscal policy on its intergenerational effects gains weight in the light of the declining role of another fiscal policy objective, stabilization. The increased

openness of economies renders macro-economic demand management less effective (see e.g. Bovenberg (1991) and SER (1992)). This increases the scope for basing decisions on the deficit and public capital formation on their intergenerational effects.

A further quality of GA is its *comprehensiveness*. All benefits and burdens from the public sector are included. This allows one to take account of the full effect of the interaction of fiscal policy and likely future developments. This is a distinguishing feature relative to other studies on the aging of the population that are limited to projecting the future developments of only old age benefits or health care.

The combination of these properties makes GA a suitable test on the *sustainability* of policies.

the weaknesses

One of the weaknesses of GA is that it requires many *assumptions*. These involve scenarios for future developments (like the ones treated in section 4) and the assigning of benefits of public expenditures and taxes over age groups. The margins of error may therefore be relatively large. Another weakness is that it does not take account of *behavioral responses* to policies. Such responses can generate shifts over generations in the ultimate burden of certain measures[20].

A further problem is that the discount factor used in assessing the present value of benefit and burden streams coincides with the interest rate on government debt. The uncertainty of these streams, however, could justify the use of a risk premium, or even of several risk premiums.[21] Buiter and Haveman point out that also the informativeness of GA is reduced if the private sector shows a compensating (Ricardian) reaction to

[20]Fehr and Kotlikoff (1995) compared the effects of policy measures on GA's to the effects of these measures on generations' utility levels within the framework of a general equilibrium model. They concluded that the GA's generally provide fairly good approximations. Buiter (1995), however, is more sceptical. He concludes that under certain assumptions, particularly in the case of a high rate of intertemporal substitution, GA can generate misleading results.

[21]This point has been brought forward by Haveman (1994)

intergenerational tranfers by the public sector or if the private sector is faced with liquidity constraints.

A limitation of GA is that it does not take account of intergenerational tranfers taking place outside the public sector. Tranfers of know how or of environmental pollution to future generations are not included. The same holds for the intergeneratio-nal redistribution performed by supplementary, occupational pension schemes or by direct transfers in money (inheritance) or kind (family care).

GA also does not provide an answer to *intra*generational aspects of fiscal policy. Fiscal policy can distort decisions, creating an efficiency loss, or can have an impact on income distribution. Both are factors that have to be taken into account when designing policies.

7. Summary and conclusions

This Research Memorandum serves two purposes. The first is that it computes generational accounts for the Netherlands to assist public decision making. Traditionally, intertemporal aspects of fiscal policy are assessed on the basis of the budget deficit, public debt and net government wealth. Generational Accounting offers a more direct and explicit measure of the intergenerational effects of present fiscal policies. It has the advantage of being forward-looking, thereby enabling us to incorporate future developments, and to test the present system of public expenditures and taxes for sustainability. This approach is of particular interest because after 2010 Dutch public finances will be heavily burdened by the aging of the population. Opposed to this, the coming decades are expected to show rising labor participation rates and taxable pension incomes from funded private sector schemes. These factors will help to alleviate this burden by generating extra tax revenues, making the outcome uncertain.

The calculations indicate that the present system of benefits and taxes, if continued, is unsustainable in the long run. However, the necessary adjustment to ensure sustainability can be considered quite small in the light of the size of the aging of the population. Both alleviating factors are expected to help offset the higher future costs of old age benefits and health care.

The Generational Accounts can also be transformed into the corresponding future yearly budgets. These show that an early implementation of a sustainable system implies

that the present (small) budget deficit in the Netherlands turns into a surplus in the course of the coming decade, as the costs of aging will not start to rise before 2010. The alleviating factors enable this to take place with relatively small policy changes. The later occurrence of the population aging creates the opportunity of a sharp reduction of government debt and interest payments and helps to finance the future rise of the age related expenditures, thereby mitigating the costs for future generations of tax payers. In this way, future costs are partly tranferred to the present.

These results have to be interpreted with care. The calculations require many assumptions about future developments. Section 4 showed that the outcomes are sensitive to some of these assumptions. Behavioral responses to fiscal policy changes are not captured by the calculations. Furthermore, it has to be considered that the Generational Accounting does not include intergenerational redistributions that occur outside the government sector, like environmental externalities, redistributions performed by supplementary pension schemes, inheritances within families and tranfers of know how. Moreover, other factors are relevant in determining public debt policy.

The second purpose of the Research Memorandum is that it presents some extensions to the standard Generational Accounting methodology as developed by Auerbach, Gokhale and Kotlikoff. It does this in two ways. The first is that it incorporates prospective changes in the economic environment in the form of an increasing participation rate, higher pension incomes, higher pension contribution rates and a flatter age-earnings profile. In this way, one can better measure generational balance and the sustainability of the present system of government expenditures and taxes. The second extension is that we distinguish between public consumption and public investment.

References

Auerbach A.J., Gokdale J. and Kotlikoff L.J.: Generational Accounts - a meaningful alternative to deficit accounting NBER - working paper no. 3589. (1991)

Auerbach A.J. and Kotlikoff L.J.: Dynamic fiscal policy, Cambridge University Press (1987)

Generational Accounting: A meaningful way to evoluate fiscal policy in Journal of Economic Perspective, Winter 1994.

Besseling P.J. and R. Zeeuw: The financing of pensions in Europe: challanges and opportunities, CPB-researchmemorandum 111

Bovenberg A.L.: Affluence and discomfort (in Dutch: Overvloed en onbehagen), 1991.

Bovenberg A.L., Broer D.P. and Westerhout E.W.M.T.: Public pensions and declining fertility in a small open economy: An intertemporal equilibrium approach, in Public Finance, volume 1993-1948 supplement.

Broer D.P. and Westerhout E.W.M.T.: Taxation in an intertemporal general equilibrium model of a smalle open economy, in Economic Modelling (january 1993).

Buiter W.H.: De generational accounts reveal the effect of the budget on savings and intergenerational distribution?, NBER-working paper 5087.

CBS: The Dutch economy 1995 (in Dutch: De Nederlandse economie 1995), 1996

CBS: The personal distribution of wealth (In Dutch: De personele vermogensverdeling 1984)

CBS: The personal distribution of income 1991-1993 (In Dutch: De personele inkomensverdeling 1991-1993, 1994

CBS: Statistics of municipal accounts 1994 (In Dutch: Statistiek der gemeenterekening 1994)

CBS: Statistics of the finances of provinces (in Dutch: Statistiek der provinciale financien 1994)

CBS/CPB: Population and labor supply until 2020: three scenarios until 2020 (In Dutch: Bevolking en arbeidsaanbod: drie scenario's tot 2020), SDU, 1997

CPB: Central Economic Plan 1997 (In Dutch: Centraal economisch plan 1997), 1997.

CPB: Netherlands in triplo, a scenario study of the Dutch economy (in Dutch: Nederland in Drievoud, een scenariostudie van de Nederlandse economie, 1992.

CPB: Working Paper 67, Public expenditures in the period 1950-1990 (in Dutch: De collectieve uitgaven in de periode 1950-1990)

CPB: Working Paper 89, Long term environmental scenarios 1995-2020 (in Dutch; Omgevingsscenario's Lange Termijn Verkenning 1995-2020)

CPB: CPB-report 1996/3, pages 10-15

Deelen A.P.: The development of the long term spread in income in the Netherlands, (In Dutch: De ontwikkeling van de inkomens-verdeling op lange termijn) CPB-researchmemorandum 121, 1995

Felderer B.: Public Pension Economics, Springer Verlag (1993)

Fehr H. and Kotlikoff L.J.: Generational accounting in general equilibrium, NBER-working paper 5090 (1995)

Haveman, R.: Should Generational Accounts replace Public Budgets and Decifits? in Journal of Economic Perspectieves, Winter 1994.

Koopmanschap M.A., van Roijen L. and Bonneux L.: Costs of illnesses in the Netherlands (In Dutch: Kosten van ziekten in Nederland), MGZ en iMTA, Erasmus Universiteit Rotterdam (1991)

Kotlikoff L.J.: Generational Accounting; Knowing who pays, and when, for what we spend. The Free Press (1993).

Kempen E.J. van: Will the baby pay for the boom? 1996 (in Dutch: Betaalt de baby the boom?), ESB 1996, pages 724-728

Ministerie van Financiën: Miljoenennota 1995

OECD: Ageing population, pension systems and government budgets: Simulations for 20 OECD countries.

Rele, H.J.M. ter: The depreciation of the gas stock (In Dutch: De vermogens-intering op de gasvoorraad), in Openbare Uitgaven, 26e jaargang 1994, nr. 6

SCP: Social and Cultural Report 1994 (In Dutch: Sociaal en Cultureel Rapport 1994)

SER: The national saving surplus (In Dutch: Het nationale spaaroverschot), SER 92/11 (1992)

Zant W.: Health care in the long term, (In Dutch: Zorg op lange termijn) CPB-researchmemorandum 93, 1992

Appendix 1 The construction of the age profiles

The age profiles of burdens

constructing the age profiles for 1995

For 1995 the age profiles of the burdens are based primarily on data underlying CPB-Research Memorandum 121, which in turn drew its data from a large household survey ('Woningbehoefteonderzoek') performed by Statistics Netherlands (CBS). These data provide information on the distribution over age groups of gross incomes, net incomes and taxes paid for a number of income sources: a) labor income, b) benefits from social security excluding the old aged and c) incomes from old aged benefits and compulsary occupational pension schemes.

These data do not include incomes from non-compulsary pension schemes and capital income from non-institutional savings. Therefore incomes and estimated taxes paid from these sources had to be based on additional information drawn from the 'National Accounts' of CBS. Its distribution over age groups is based on the CBS-publication 'De personele inkomensverdeling 1990'.

Because the data on the distribution over age groups do not refer to 1995, they are only used to determine the relative sizes of the various income sources and taxes. The total amounts of the various taxes in 1995 are based on their realizations. Chart 7 shows the resulting age profiles of income taxes paid (including social security premiums) from incomes from these various sources.

Chart 8 shows the age profile of indirect taxes[22] paid from expenditures from the various sources. Net incomes were used as an indication of spending and indirect taxes paid[23].

[22]'Indirect taxes' here also include some other government revenues. This is explained in table 1.

[23]Childs allowances are assigned to the children because this provides a better indication for future expenditures, thus enhancing the measuring of sustainability.

Chart 7 Income taxes from various sources in 1995

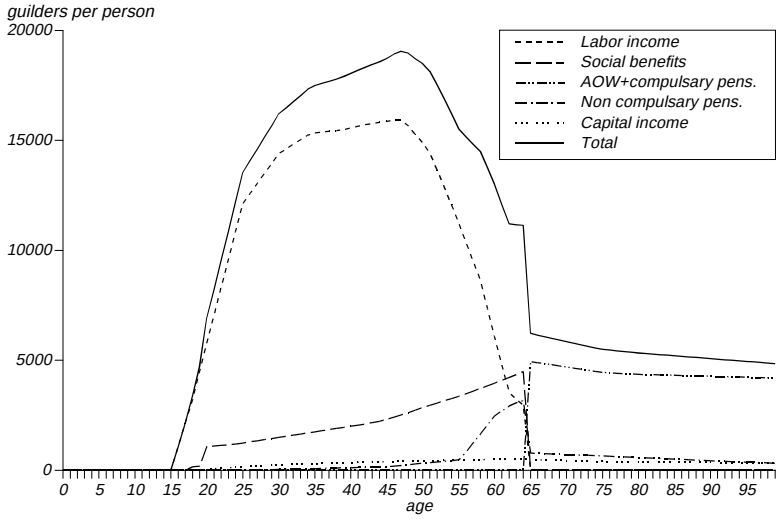


Chart 8 Indirect taxes from various sources in 1995

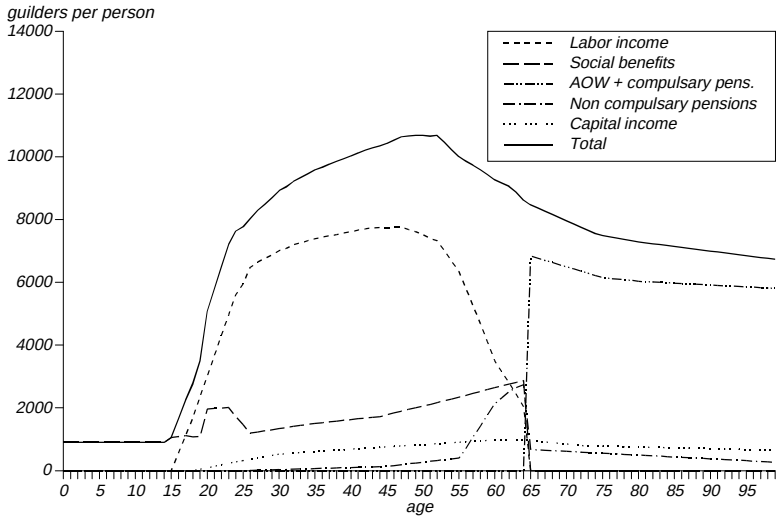
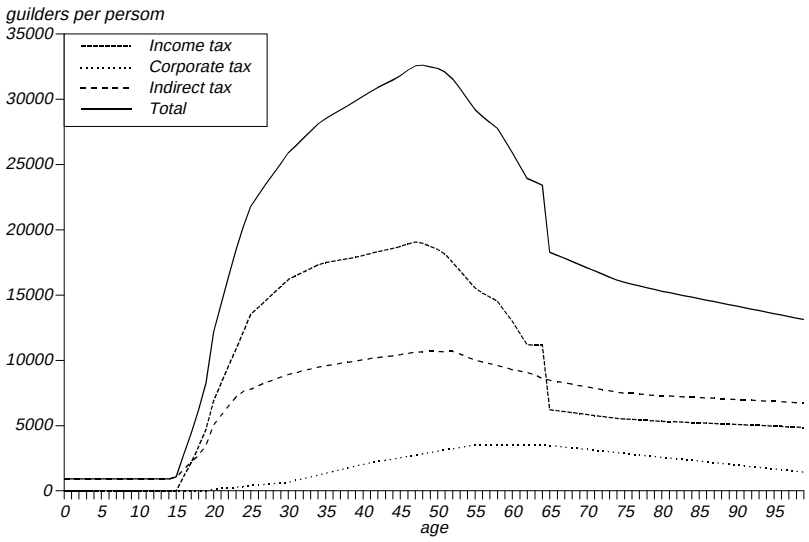


Chart 9 displays the age profile of the total burden. It is the sum of the burden from income taxes (the total of chart 7), from indirect taxes etc. (the total of chart 8), from (very small) seignorage and from taxes of which the age profile is strongly related to personal wealth.[24]. This latter information is based on the CBS-publication 'Statistiek van de personele vermogensverdeling'.

Chart 9 Total burden in 1995, by its three main components



extrapolating from 1995 to 2020

The method for extrapolating the age profiles of taxes to 2020 depends on the income source. The standard practice of GA is to extrapolate age specific burdens (and benefits) with productivity growth (productivity growth is assumed to equal income growth). Here, we will deviate from this practice for most income sources. Labor incomes (and taxes from labor incomes) are extrapolated by not only taking account of productivity growth, but also the effect of the expected rise in labor participation and of the flattening

[24]These are corporate tax, taxes on personal wealth and taxes on dividends. Corporate tax is assumed to be paid by the shareholder.

of the future age-earnings profile. Taxes on labor income are allowed also to react to tax deductable pension contributions, which are expected to rise due to lower pension fund returns on investments. Except for this last factor, the age-specific tax to income ratios are implicitly assumed to remain unchanged.

Taxes paid from social security benefits are generally extrapolated in conformity with the standard practice. An exception is made for the taxes on unempolyment benefits and on disability benefits. In these cases, participation growth is added as an additional factor because more persons are assumed to draw from these regulations. Also, the growth of the sum of old age benefits and compulsary pensions are affected by an extra factor. In this case, the additional rise is caused by the increasing share of the old aged that will have an income from funded occupational pension provisions. In the EUR-scenario of CPB-Reseach Memorandum 121, which we focus on, the cumulated additional rise of the incomes from old age benefits and compulsary pensions is about 22%.

Taxes from capital income – which largely consist of corporate income tax – are extrapolated in line with GDP, which in turn grows with both productivity and participation. The non-compulsary pensions are extrapolated in the same way.

After 2020 all burdens are extrapolated conform with the standard practice. All factors affecting the age profile are thus assumed to have fully taken effect by then.

The age profiles of benefits

constructing the age profiles for 1995

Benefits from health care are assigned to age groups on the basis of information of Koopmanschap et. al. (1991). Expenditures on the various forms of social security are assigned to age groups on the basis of information of SCP (1994). Benefits from the other expenditures (defence, general government, subsidies, transfers abroad) and benefits from the public capital stock are distributed evenly over all living persons. The

size of the latter benefits are computed as the sum of depreciation[25] and the product of interest rate and public capital stock. Benefits from education are divided evenly over the 5 to 24 year olds. The lower participation in tertiary education roughly compensates the higher cost per student.

Because the data on the age distribution of health care and social security do not refer to 1995, this information was only used to determine relative sizes. The total 1995 expenditures are based on its realization.

The construction of the budget items is performed in the same way as in CPB Working paper 67. It involves a rearrangement of National Accounts data of CBS.

the extrapolation from 1995 to 2020

Benefits are mostly extrapolated conform the standard practice of GA. In case of the social security benefits for the unemployed and the disabled, the growth of participation was added as an additional factor (as with the taxes over these benefits). Legislated measures curbing survivor benefits (ANW) and disability benefits are also taken account of. Another exception is that benefits from the public capital stock are computed to rise in line with the size of the stock (as implied by investment flows).

After 2020, public spending and all social security benefits rise in the conventional GA-fashion. The benefits from the public capital, however, continue to rise in line with its stock. The growth of the capital stock is computed as gross investment minus depreciation minus net government revenues from selling and purchasing land. This last item is positive because the government adds value to the land by means of part of investments in infrastructure.

[25]The depreciation measure used here differs from the depreciation measure in the National Accounts. In line with international guidelines, the National Accounts assume no depreciation on infrastructure. Because this seems unrealistic, we conformed to the practice used by the Department of Finance (see appendix 10 of the 'Miljoenennota') and decided on a depreciation on infrastructure that equals 1% of the stock. This is added to the National Accounts measure of depreciation which included only depreciation on buildings and schools.

Appendix 2 Determining the size of government assets and liabilities

The size of physical assets is calculated by an addition of the assets of central government, provinces and municipalities.

The determination of the value of *financial assets* and of *groundrents* is based on its revenues. In 1995 these revenues were ƒ 10,2 bln. They can be subdivided into ƒ 5.7 bln interest revenues (of which ƒ 1.5 bln from the central bank), ƒ 3.2 bln from participations in companies and ƒ 1.3 bln from groundrent. Interest yields are nominally fixed and therefore the asset value is obtained by dividing by the nominal interest rate. Revenues from participations usually do grow with inflation and therefore these revenues are divided by the real interest rate. The third source, groundrent, might even be expected to depend on both inflation and economic growth. Under the assumption of a real interest rate of 4% an inflation rate of 2% and a productivity growth of 2%, this leads to the following valuation of financial assets:

interest yielding assets:	5.7/(0.04 + 0.02) =	ƒ 95 bln
shares:	3.2/0.04 =	ƒ 80 bln
present value of groundrents:	1.3/(.04-.02) =	ƒ 65 bln

Government sales of gas involve an exchange in return and therefore this revenue stream should not form part of the net benefit concept. These revenues do raise future net benefits. Consequently, the right to this revenue stream can be considered as government assets. Its value is determined by the present value of the revenue stream. In the European Coordination scenario this is ƒ 135 bln. Total government liabilities in 1995 was ƒ 505 bln.

This leads to the following summation of assets and liabilities:

Determining net government wealth (estimation for 1995)

Physical assets[a]:	
Central government (excluding Defence)	110
Provinces	5
Municipalities	50
	165
Financial assets:	
interest yielding	95
shares	80
	175
Present value of groundrents	65
Gas stock (discounted at 4%)	135
Total governments liabilities (-/-)	505
Net government wealth (W^g)	35

[a] Physical assets from central government are based on appendix 10 from the `Miljoenennota' (the account of the central governments yearly budget). Physical assets from provinces are based on `Statistiek van de provinciale financiën' and physical assets from municipalities on `Statistiek der gemeenterekeningen'.

The ƒ 35 bln net government wealth from this calculation differs from the ƒ 180 bln that CBS found for 1990[26], (see CBS 1996). Apart from diverging government liabilities, due to different dates of measurement, the deviations are located in both the physical assets and the assets of which the value is determinated here by the discounted value of the future revenue stream. Differences in valuation principles explain this gap. The correct figures have still to be decided upon. The sensitivity analysis for measurement errors in

[26]This value is adjusted for depreciation on infrastructure. International guidelines have recently been changed, allowing for this adjustment.

valuing assets, performed in section 4, is meant to capture the possible incorrectness of the figures used here.

Appendix 3 The depreciation of the gas stock

The future depletion of the government gas resources justifies a seperate treatment of yearly revenues from gas. It entails a capital depreciation component in these revenues. This depreciation will be expressed in financial terms. For period t it is calculated as follows:

$$G_t = GI_{t+1} + \frac{GI_{t+2}}{1+r} .....$$

$$G_{t-1} = GI_t + \frac{GI_{t+1}}{1+r} + \frac{GI_{t+2}}{(1+r)^2} .....$$

$$\Delta G_t = -GI_t + r\left[\frac{GI_{t+1}}{1+r} + \frac{GI_{t+2}}{(1+r)^2} .....\right]$$

$$= -GI_t + r\left[G_{t-1} - GI_t\right]$$

waar:

GI_t = gas revenues in t

G_t = value of gas recources by the end of t

The first term on the right hand side are gas revenues in t. The second term is the revaluation (in financial terms) of the gas revenue stream occurring after period t and is a consequence of the shortening of its realization period by a year. This approach

enables a decomposition of gas revenues in t into two components: a depreciation component $GI_t - r(G_{t-1} - GI_t)$ and a real revenue component, $r(G_{t-1} - GI_t)$.

A more extensive description of this decomposition can be found in ter Rele (1994).

Appendix 4 The relation between government savings and generational balance in a steady state situation

In this appendix we assume a steady growth of productivity and of the population by a factor y and n respectively. We'll work with a two period model. Everybody lives two periods. In a generational balance situation – in the sense described in section 2 – the intertemporal budget restriction can be expressed as follows:

$$W^g = a_{-1}^{-1}\, lpr_0^{-1} + \sum_{t=0}^{\infty} a_0^0 \left(\frac{1+y+n}{1+r}\right)^t \left(lpr_0^0 + \frac{lpr_1^0}{1+r}\right) \tag{9}$$

The first term of the right hand side of (9) is the net benefit in period 0 of the generation born in the previous period. The second term is the sum of net benefits of the generations born in period 0 and later periods under the restriction of a continuous generational balance. The left hand side is net government wealth. We also assume that every generation faces the same (relative) age profile in the course of its live, or that the relation between lpr^t_t and $lprt_{t+1}$ remains unchanged. This entails that second-period benefits grow as follows:

$$a_t^t lpr_{t+1}^t = (1+y+n)^t\, a_0^0 lpr_1^0 \tag{10}$$

Assuming that (10) starts from t=–1, or that the elderly of period 0 also fall under this growth pattern of second period benefits, equation (10) can be used to rearrange (9):

$$W^g = \sum_{t=0}^{\infty} \left(a_0^0 lpr_0^0 + a_{-1}^{-1} lpr_0^{-1}\right) \left(\frac{1+y+n}{1+r}\right)^t \tag{11}$$

We know by definition that:

$$\left(a_0^0 lpr_0^0 + a_{-1}^{-1} lpr_0^{-1}\right) = PR_0 \tag{12}$$

Substituting (12) into (11)

$$W^g = \sum_{t=0}^{\infty} PR_0 \left(\frac{1 + y + n}{1 + r}\right)^t \tag{13}$$

Consequently:

$$W^g = \sum_{t=0}^{\infty} PR_0 \left(\frac{1 + y + n}{1 + r}\right)^t \tag{14}$$

Equation (14) is the relation between net government wealth and `permitted' net benefit in period 0 if sustainability is persued. Combining (14) with equation (7) from section 2.4[27] enables the deviation of net wealth formation that leads to sustainability (VV_{SU}):

$$VV_{SU} \approx (y + n)\ W^g \tag{15}$$

Equation (15) shows that continuous sustainability in a steady state situation can be achieved only if net government wealth formation (government savings) equals the product of real growth (y+n) and the stock of net government weatlh. The well known `golden rule' of finance which prescribes a net wealth formation of zero (and is often considered a norm producing an equitable distribution of benefits and burdens over

[27]Equation (7) in section 2.4 expresses the relation between net wealth formation, net benefit and the net wealth stock.

generations), therefore only seems to generate a sustainable system if (y+n) or W^g is zero. Another norm than the one under (15) entails a continuous rise or fall of net benefit relative to lifetime income, rendering the norm unsustainable in the long run.

Abstract

After 2010 the aging of the population will start to form a sizable burden for public finances. On the other hand, some shifts in the private sector, such as the increase of labor participation, are expected to generate higher tax revenues. These contrasting developments raise the question whether the present system of public arrangements is sustainable in the long run or will, on balance, result in a unfavorable treatment of future generations. This paper, that assigns net public sector benefits to generations, indicates that the present arrangements are unsustainable when indexed to productivity growth. However, the required policy adjustment can be considered small. Because the alleviating factors will occur before the bulk of the aging, implementing a sustainable system does imply a sharp reduction of the budget deficit in the coming decades.

The paper applies, and in some ways extends, the standard Generational Accounting methodology as developed by Auerbach, Gokhale and Kotlikoff.