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Fiscal Sustainability and Generational Burden Sharing in Denmark**

Based on generational accounts and a simple welfare calculus, this paper studies two alternative scenarios of sustainable fiscal policy in Denmark. A strategy of tax smoothing is found to provide a fairly even intergenerational distribution of the financial burden associated with population ageing. While tax smoothing causes a relatively sharp increase in public debt along the transition path, a strategy of debt smoothing is shown to pass a larger part of the financial burden onto current generations but without changing the intergenerational distribution profile in any dramatic way. A comparison based on a social welfare function indicates a marginal superiority of tax smoothing. JEL: E62, H66

The macroeconomic development in Denmark has been favourable since 1993, where unemployment peaked at 12 per cent of the labour force and the public deficit reached 3 per cent of GDP. By 2000, unemployment had fallen to 5 per cent, and the surplus on public finances amounted to almost 3 per cent of GDP. The recovery began in 1994 and was kick started by a minor fiscal stimulus of 1 per cent of GDP, a temporary

reduction of income taxes combined with measures to stimulate activity in the construction sector.

Despite strong growth since 1994, inflation has remained modest, at levels consistent with a policy of keeping a fixed exchange rate vis-à-vis the German mark and, since 1999, the euro. Furthermore, the long period of economic expansion has not resulted in massive current account deficits,

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unlike past experience in Denmark. This suggests that the structural reforms undertaken during the 1990s have been quite successful, although it is difficult to disentangle the effects of substantial structural reforms from the effects of cyclical factors.

Denmark has decided not to participate in the final stage of EMU. However, macroeconomic policy has been conducted according to a commitment to the principles of nominal convergence and fiscal discipline. The position of the Danish government is to adhere strictly to public debt reduction. The gross public debt-GDP ratio has already been brought down from almost 80 per cent in 1993 to 48 per cent in 2000. And the official target set by the current government involves a further reduction in the debt-GDP ratio to 24 per cent by year 2010.

While the current state of the Danish economy thus appears strong, the purpose of this paper is to examine whether similarly optimistic conclusions can be drawn about the medium-to-long term. Our major concern is the future stance of public finances. Among the questions we try to answer are the following: Is current fiscal policy sustainable? If not, what is the magnitude of the fiscal imbalance? To what extent are we passing fiscal burdens onto future generations? How would alternative fiscal strategies impact on the macroeconomy and the distribution of welfare across different current and future generations?

There are several reasons why we think these questions deserve addressing: First, the process of changing demographics is likely to lead to a substantial increase in the number of elderly, a phenomenon which will undoubtedly put upward pressure on public expenditures. Second, the long-term trend for people of working-age to wish more leisure could continue. Third, a further tendency towards a shorter working life could be

observed. This would reinforce the budgetary pressure caused by population ageing.

Other challenges, mainly some associated with "globalisation" and/or "Europeanization", could be added. For example, one could envisage that it will be increasingly difficult to raise the revenues needed to sustain the financial viability of the welfare state. Increased mobility within Europe may induce some members of the labour force to flee to lower-tax jurisdictions, thereby eroding the tax base. A similar problem concerning corporate taxation may arise. Public finances could also come up against the fiscal prudence criteria of the Growth and Stability Pact (GSP), according to which EMU members should produce a medium-term budgetary position of close to balance or in surplus.

We conclude that the *sustainable* tax rate is around 1 percentage point above the relevant benchmark tax rate, corresponding to a need for a permanent increase in income taxation of approximately 0.75 per cent of GDP. Therefore, in strict sense current fiscal policy is not sustainable, but there is no indication of a dramatic fiscal imbalance. The results thus underline the importance of bringing public debt down now when there is demographic breathing-space, rather than postponing the adjustment until the ageing of the population starts.

If preferences for generational fairness are heavily weighted, a policy of tax smoothing would be wise. However, during the transition period a policy of that kind would produce public debt-GDP ratios that might be in conflict with the GSP. Hence we consider an alternative scenario where the public debt-GDP ratio is held constant throughout ("debt smoothing"). Using the tool of generational accounts, we find that all currently living generations would suffer if fiscal policy is conducted in terms of debt rather than tax smoothing.

While neither of these fiscal scenarios produce particularly alarming outcomes, there *is* a trade-off between temporary (excessive?) debt accumulation and (unfair?) generational redistribution. We address this dilemma by formulating a social welfare function and find that there is a one-off social welfare gain of 0.6 per cent of GDP in factor prices by implementing pure tax smoothing instead of pure debt smoothing. The relatively modest gain from tax smoothing suggests that the costs of complying with the GSP requirements are small. And, since this result does not imply that tax smoothing is *optimal*, it might well be more sensible to adopt a *mixed* regime. For example, this could take the form of an increase in the financial burden on current generations implemented through lower transfer payments. This would also reduce the size of government and thereby pave the way for a lower tax burden in the future.

From here we proceed as follows. The next section offers a brief overview of some recent macroeconomic trends. Section 3 presents a unified framework for generational accounting and intertemporal simulation modelling. Sections 4 and 5 then show some macroeconomic, budgetary and generational effects of alternative fiscal policies. Section 6 concludes.

Recent macroeconomic trends

Two major *tax reforms* have been implemented during the 1990s, both aiming at bringing down marginal tax rates on personal income by broadening the tax base and switching towards green taxes. The tax reforms have been motivated by a need for improving not only the incentives to work but also to strengthen households' savings in order to improve the current account, traditionally the Achilles' heel of the Danish

economy. The tax value of the deductible interest expenses will be brought down from 52 per cent in the early 1990s to 33 per cent in 2002. Hence the incentive to save has increased significantly. Although the highest marginal tax rate on income has been brought down from 69 to 63 per cent, and the average marginal tax rate of full-time employed people is expected to fall from 59.3 per cent in 1993 to 54.4 per cent in 2002, the economic incentives to become employed for unskilled workers are still low. The tax system has also been modified in view of the increased international mobility of capital. The nominal corporate tax rate has been brought down from 50 per cent in 1990 to 30 per cent in 2001, thereby making the tax system more robust with respect to profit shifting of international firms. As the reductions have been financed by tightening depreciation allowances, the marginal effective tax rate has, however, remained fairly constant.

The 1990s have also witnessed several *about market reforms*. Some aggregate evidence reported by the OECD points towards a substantial fall in structural unemployment, from 8.4 in 1993 to 6.3 in 1999. A major characteristic has been an increased use of active labour market policies, including compulsory activation of the unemployed after one year of unemployment. Microeconomic evidence shows that the probability of finding a job goes up as the point for compulsory activation is approaching, suggesting (but not implying) that the ALMPs have lowered unemployment (Ministry of Labour, 2000). Moreover, availability requirements have been tightened, eligibility criteria have been strengthened and the generosity of certain benefits have been reduced. For example, the maximum duration of unemployment benefits has been reduced from 9 to 4 years, and the so-called "youth package" reduced unemployment benefits for

people aged below 25 by 50 per cent after 6 months of unemployment. The effect of the latter reform has been a significant reduction in the youth unemployment.

With the aim of increasing labour supply, two reforms concerning the retirement decision have been implemented. First, the so-called transitory retirement scheme for long term unemployed persons in the age-groups from 50 to 60 years has been abandoned. Second, the early retirement benefit scheme allowing people to retire at the age of 60 was reformed in 1998. This reform makes retirement before the age of 62 less attractive and offers a premium to people who abstains from using the scheme. Furthermore, entitlement to these benefits requires that a contribution rate has been paid at least 25 years prior to retirement. Despite these initiatives, the number of working-age people who are outside the labour force and receives public transfers remains high. Undoubtedly, further reforms are needed if a significant reduction in the labour force is to be avoided.

Another major structural change in the Danish economy is that there has been a dramatic increase in private, fully-funded pension schemes, see below. The contribution rate of blue-collar workers is now being increased to typically 9 per cent of the wage income, for white-collar workers and public employees rates are 12-15 per cent. The contributions amount to almost 5 per cent of GDP. At present, the total wealth of private pension funds is 75 per cent of GDP but is expected to reach a level of almost 200 per cent of GDP in 2050.

Since the public sector is relative large in Denmark, it is not surprising that the government budget is very sensitive to the business cycle. However, a significant part of the recent improvement might be of a more structural nature. Indeed, based on the standard technique of applying relevant

revenue and expenditure elasticities to the output gap, the structural balance has been estimated to 2.6 per cent of GDP in 2000, an improvement of almost 6 per cent of GDP since 1993 (European Commission, 2001). Hence, a part of the improvement of public finances reflects structural factors, among which the fall in the structural rate of unemployment is dominant.

By international comparison, it is remarkable that Danish politicians, even with surpluses of almost 3 per cent of GDP, have resisted the temptation to implement unfinanced tax cuts similarly to what has recently been seen in Germany, the Netherlands, France and Sweden. The strategy of debt-reduction has led to a fall in the gross debt-GDP ratio from 80 per cent in 1993 to 53 per cent by the end of 1999 and is expected to be only 44 per cent by the end of 2001. Taking into consideration the assets of the funded supplementary public pension fund ATP, net debt is at present only 16 per cent of GDP.

Public expenditures on transfers have decreased (mainly due to the decreased number of unemployed) in recent years. However, public consumption has continued to increase beyond the targets set out by the government. The official target is to reduce the real growth of public consumption to 1 per cent a year. However, based on budgets for 2001, real public consumption will on average grow by 2 per cent from 1997 to 2001. The increase cannot be explained by shifts in demography affecting age-related spending; rather, it reflects an increase in the standards of public service. Indeed, the repeated overruns have been made possible by the fact that two thirds of public consumption take place at the level of local governments, thus beyond the direct control of the central government. When measured as a percentage of GDP, public consumption has remained

relatively constant throughout the period. However, by international comparison the level of public consumption is high. In the euro-area, for instance, public consumption is only 20 per cent of GDP, compared to 25 per cent in Denmark.

Generational accounting and GE modelling – an integrated approach

This section seeks to evaluate the sustainability of fiscal policy in Denmark within a unified framework of generational accounting and dynamic general equilibrium modelling. For that purpose we employ the DREAM model, which is an OLG-CGE model of the Danish economy formulated in the spirit of Auerbach and Kotlikoff (1987).¹ Here we focus on how the age-specific profiles of public expenditures and revenues, the underlying demographic projection and the pension system in Denmark have been incorporated into the model.

Age dependent public expenditures and revenues

Public consumption

Following the methodology of generational accounting, public consumption is split into two parts: individual and collective. The former is defined as those parts of public consumption that are attributed directly to individuals. This includes strictly rival goods, such as medicare and residential homes for elderly people, as well as goods that are partly non-rival goods such as education and libraries. For each of these types of goods the total expenditures have been distributed

across individuals of a given generation according to each generation's use of the particular good, based on behaviour in 1998. It is assumed that this distribution remains unchanged throughout the projection period. In 1998 two thirds of the total public consumption were defined as individual public consumption. Its real value (per individual of a given age) is assumed to grow in line with real GDP. In a steady state with a stationary population this assumption implies that the individual public consumption constitutes a fixed proportion of GDP. However, along the transition path to the steady state, the individual public consumption may grow faster than real GDP due to changes in the demographic composition of the population.²

The real value of the collective part of public consumption, consisting of pure non-rival goods such as defence and police, is assumed to grow in line with real GDP. In the generational accounts presented below these expenditures are distributed across generations according to the number of adults in each generation. The demographic changes along the transition path of the economy affects the level of collective public consumption per adult.

Public transfers

Gross public transfers to individuals constituted 21 per cent of GDP at factor prices in 1998. Almost all transfers to individuals are subject to income taxation and net transfers are therefore significantly lower. Here transfers are divided into one part that is determined endogenously and another part

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1. DREAM is an acronym for Danish Rational Economic Agents Model. Details of the model are available in Knudsen, Pedersen, Petersen, Stephensen and Trier (1998, 1999) and Pedersen, Stephensen and Trier (1999). General information on DREAM is available at <http://www.dreammodel.dk>.
 2. This is indeed the case in the present projection, where the individual (age-dependent) public consumption increases from 21 per cent of GDP at factor prices in 1998 to a peak of 24 per cent of GDP in 2038.

based on exogenous projections. We assume that the labour force (measured in number of persons) is determined by the demographic projection. The fraction of the population of a given age, gender and origin (native or immigrants) that is in the labour force in 1998 is assumed to remain constant throughout. Changes in the composition of the population (with respect to age, gender and origin) would thus lead to changes in the labour force.³ Since employment and unemployment are determined endogenously, publicly financed unemployment benefits are also determined endogenously. Unemployment in the model is for simplicity distributed across age, gender and origin groups in the labour force such that the unemployment rate for each group is identical to the overall rate of unemployment.

The public transfers to persons outside the labour force are determined by the following procedure: The distribution of persons receiving public transfers in 1998 is taken from a register of all persons in Denmark where individuals are classified according to the type of income they receive. From this register the fraction of a given age, gender and origin group that receives a specific transfer payment is obtained for a given year. In the projection it is assumed that these fractions remain constant through time. Given the demographic projection this generates the development in the number of persons receiving the public transfers. The public transfers are indexed to the wage rate and, as wage determination is endogenous, indexation of transfers is also endogenous.⁴

The remaining part of public expenditures, most notably public investments and interest payments on public debt, are determined endogenously and have not been allocated to generations in the reported generational accounts.

Public revenues

Public revenues are generally endogenous in DREAM. The tax revenue from personal income taxation is collected from the tax payments of the households in the model. In the generational accounting system these taxes are distributed across generations simply by using the endogenous tax revenue from the generation in question. Various types of personal income are taxed differently in the Danish tax system. Since the model reflects this fact, a given level of personal income may lead to different levels of taxation depending on the composition of income. Similarly, revenue from indirect taxation is collected from the indirect tax payments associated with the private consumption of the individual generations of households. These revenues are also used directly in the generational accounting system. Revenues from direct and indirect taxation of firms, most notably corporate taxes, are distributed to generations according to the number of adult-equivalents in each generation. The same procedure is used for the revenue from taxation of capital income in the fully funded pension system.

3. Origin is included since immigrants have a significantly different labour market behaviour than the rest of the population. This fact, combined with the fact that the present number of immigrants is very low and therefore increasing over time for any reasonable projection of annual immigration, imply that the development in both the labour force and public transfers to individuals are affected by the development in relative size of the number of immigrants.

4. In addition to these main public transfers there exists a group of transfers, which goes to both persons in the labour force and persons outside the labour force. These transfers are distributed to the different generations using a procedure similar to the one applied to individual public consumption.

A comparison to previous studies

The procedure outlined above differs somewhat from the standard generational accounting methodology (Auerbach, Gokhale and Kotlikoff, 1991) that was used in two previous studies of the generational stance of fiscal policy in Denmark, see Jensen and Raffelhüschen (1997, 1999). First, in the present study we distribute both individual and collective public consumption across generations, whereas in the previous studies only individual public consumption was distributed. Second, while in this study both direct and indirect taxes paid by firms and insurance companies are distributed across those generations that are active in the period where the taxes are paid, this was the case only for the personal direct and indirect taxes in the previous generational accounts for Denmark. Finally, in this study childhood is excluded in the sense that public consumption allocated to children below the age of 17 years is distributed to their mothers' generations. In the previous studies, however, also children were assumed to have an economic life. This simplification is made in order to obtain consistency with the construction of households in the DREAM model.

Demographic projections

The underlying demographic projection is based on Statistics Denmark (1999) and Petersen (1999). Two age groups are of special interest, namely those of working age and the elderly. The former (aged 15-64) is projected to increase slightly until 2010, whereupon it starts shrinking and remains below the current level throughout this century. Labour market participation rates are assumed constant, but

changes in the demographic composition of the labour force magnify the reduction that follows from the reduction in the total number of persons in that age group. The number of working hours per individual is reduced by 2 percent until 2002 to account for the reduction in working hours in the recent bargaining agreement in the private sector. After 2002 the number of working hours per individual is assumed to remain constant. These assumptions taken together imply a fall in the number of working hours of around 7.5 per cent from 1998 to 2038. Thereafter, the labour force is growing slightly; yet it remains 5 per cent below the 1998 level throughout the century.

The number of persons aged 60 and above is increasing throughout the first half of the century, implying that by 2040 this age group has grown by almost 50 per cent compared to 1998.⁵ Also the number of persons aged 80 and above is expected to increase by 45 per cent in the same period ("double-ageing"). From 2040 the number of persons aged 60 and above stabilises at the new level. However, the number of persons aged 80 and above continues to increase, meaning an expected rise by around 60 per cent over the next five decades.

Against the prospect of a falling workforce and a rising group of retirees, a growing demographic burden is inevitable. The so-called *corrected dependency ratio*, defined as the number of persons who are not in the labour force divided by the labour force measured in the number of working hours, is projected to increase by 30 per cent from 1998 to 2038. In the remaining period the corrected dependency ratio stabilises at a level

5. The official retirement age in Denmark is currently 67, but falling to 65 by year 2005. However, the existence of the early retirement benefit scheme, reserved for persons aged 60-66, implies that the effective retirement age is relatively close to 60 years.

of 25 per cent higher than in 1998. This indicates that the expected increase in expenditures related to the demographic development is not just a temporary phenomenon related to the large postwar generations, but a permanent shift.

Finally, from a modelling perspective, a novelty here is that the demographic projection is incorporated directly into the household structure of the model.⁶

The pension system in Denmark

The Danish pension system consists of four pillars: First, a pure pay-as-you-go pension system that distributes pensions to all persons aged 67 and above.⁷ Second, a fully funded general labour market pension scheme (ATP) covering all persons in the labour force.⁸ Third, fully funded contribution-defined labour market pension schemes that are negotiated between trade unions and employers' federations as part of the wage bargain. Fourth, fully funded individual pensions. In addition to these schemes a number of public employees are entitled to civil servants pension.⁹

While the PAYG scheme is likely to remain a crucial part of the Danish welfare system, future pensions in Denmark will increasingly

be based on funded systems. This structural shift has two major effects. First, total pension payments per pensioner is expected to increase at a much higher speed than the growth of income for an employed person. Second, and most importantly, this shift will tend to reduce the intergenerational redistribution effects associated with changing demographics. Indeed, it is well-known that the economic impact of changing demographics depends crucially on the pension system being in operation (Sandmo, 1992). In a small, open economy with free capital mobility, a pure fully funded pension system implies that each generation pays for its own pension and no intergenerational effects are present in the absence of tax distortions. Contrariwise, a pure pay-as-you-go system implies that each working generation pays the pension benefits to the overlapping generations of retirees. Therefore, this system involves intergenerational transfers and the size of these transfers are affected by the relative sizes of the generations.

The funded pension systems in Denmark are relatively young, as reflected in low levels of present average pension payments relative to the level of contributions. For the blue collar part of the labour market the funded labour

6. See Knudsen, Pedersen, Petersen, Stephensen and Trier (1998) for a detailed description of the construction and the behaviour of the households in DREAM.

7. While basically a flat-rate system, there are some exceptions. First, there are reductions in the pension for persons who have been living in Denmark for less than 30 years after becoming 18 years old. Second, in addition to the flat rate pension benefit there is an income-dependent part which constitutes around 40 per cent of the average social pension in 1998. Given the rules this indicates that only a minor fraction of the pensioners in 1998 had pension payments from the funded pension system.

8. The Danish system of national accounts defines ATP as a public pension system. Therefore, contributions to the system are modelled as income to the public sector, and pension payments from ATP are treated as public expenditures.

9. In DREAM pension funds of type three and type four are modelled as endogenous non-matured actuarially fair non-profit insurance companies with a behaviour determined by a set of rules approved by the Danish authorities, see Pedersen, Stephensen and Trier (1999) for details of the modelling of pension funds. The contribution rates are assumed to be fixed at the current levels, except for a slight increase due to the agreed increases in the contribution rate for blue-collar workers until 2004 and a shift in the composition of the public employment from persons with civil servants pension to employees with a funded pension arrangement.

market pension system was initiated in the beginning of the 1990s. The level of contributions as a percentage of the annual wage is expected to reach the long run level of 9 per cent in 2004. Therefore, this pension system needs a full life time of a generation to reach a situation where all pensioners receive pensions based on the long run level of contributions in their entire working-life. This implies that the funded system is not expected to be fully matured before around year 2070.¹⁰

The non-mature status of the funded pension systems in Denmark also has major effects on the tax base of the personal income tax in the transition period. This is due to the fact that contributions to pension systems are deductible in the personal income tax whereas pension payments from the pension funds are taxable at the personal income tax rate. This feature implies that the personal income tax base is low in an economy with a non-matured pension fund (due to the high contributions and the low pension payment from the fund), and the tax-base is increasing through time as the pension fund matures.¹¹ This automatic increase in the tax base as the pension funds mature is a feature that is unique in the EU for Denmark and the Netherlands (European Commission, 2000). The increase in the tax base of course implies that for a given initial position of the public debt the financing of the expected increase in the age-burden may require a smaller accommodation in these countries than in others faced with the same type of problems.

In sum, the shift towards larger dependence on funded pension systems will reduce the impact on future shifts in the demographic composition on the inter-generational distribution of income. However, the conversion came too late to significantly redress the budgetary effects of the expected increase in the old-age burden from 2020 to 2040.

Fiscal policy and the foreign sector

The existence of an equilibrium with perfect foresight requires that *all* agents in the economy fulfil their intertemporal budget constraints. Therefore, we need a specific policy reaction function to ensure that the government's intertemporal budget constraint is met. Public expenditures are given by the demographic development, the age-dependent public consumption and public transfers and the indexation rules. We assume that the tax structure remains stable and that all indirect tax rates (measured in VAT-equivalents) remain fixed.¹² To fulfil the intertemporal budget constraint we adjust the base tax rate of the personal income tax system. More precisely, we define the *sustainable* tax rate as the lowest possible constant (or permanent) level of the base tax rate of the personal income tax system which is sufficient to fulfil the intertemporal budget constraint. The sustainable constant tax rate is set such that the growth and inflation corrected value of the primary surplus on the public budget is equal to the growth and

10. Labour market pension schemes for white-collar workers and public employees are older systems. These systems were started in the 1950s and 1960s, and they are therefore expected to mature earlier.

11. The positive effect on the public budget as the pension system matures does not apply to the ATP pension system in DREAM. Since this system is treated as a part of the public sector, contributions are similar to taxes whereas pension payments from the fund are similar to public pensions. Therefore the non-mature ATP-pension system has a positive effect of the public budget which is reduced as the system matures.

12. This implies that the potential pressure from international tax competition on, e.g., corporate taxation and capital income taxation is ignored. The same is true for the cross-border trade effects on indirect tax rates.

inflation corrected interest payments on the public debt in the steady state.

The (announced and actual) economic policy, including the announced reduction in the tax rates, is assumed to follow what has already been legislated. This means that tax rates are exogenous until 2003, from which year the policy of the sustainable tax rate is introduced. Two things should be noticed here. First, the difference between the sustainable tax rate and the basic tax rate in 2003 serves as an intelligible indicator of sustainability: if the former is higher than the latter, a fiscal tightening of that magnitude is required, and vice versa. Second, the introduction of the sustainable tax rate implies that the government follows a policy of perfect tax smoothing, which identifies our baseline fiscal policy framework.

The foreign sector is modelled as "neutral" as possible. This implies that the rate of foreign inflation is constant at a 1.5 per cent level, the rate of growth of foreign demand for domestic export grows – for given relative prices – at the rate of Harrod-neutral technological progress in the domestic country, which also is assumed to be 1.5 per cent. The nominal foreign interest rate is kept constant through time at a level of 5.56 per cent, amounting to a real interest rate of 4.0 per cent. These assumptions are made to dampen the effects on the domestic economy in order to isolate the effects of the domestic demographic ageing. These assumptions imply that any effects of demographic ageing on the world economy are ignored.

Tax Smoothing

Macroeconomic performance

The assumption of perfect financial capital markets and the constant international rate of interest combined with the fixed tax rates in the corporate sector imply that the user cost of capital, and therefore the (long run) K/L ratios in the production sectors and the wage rates are relatively fixed. Hence total production is closely linked to the development of the labour force. However, this fundamental supply side property of the model is modified by the presence of, first, endogenous terms of trade which generate (minor) changes in the user cost of capital and, second, installation costs of capital which imply that the K/L ratios only gradually approach their long run levels. These phenomena are reflected in the development of real GDP at factor prices, see table 1.¹³ The real growth-corrected value of GDP is gradually reduced from 2008 to 2038 where the level is 3 per cent below the level in 1998 and approximately 6 per cent below the level in 2008. This reflects the drop in the labour force by 7.5 per cent from 1998 to 2038. The effect of the falling the labour force is modified by the fact that the new long run K/L ratio is higher than in the initial equilibrium. Furthermore, there is a minor reduction of approximately 1 percentage point in the unemployment rate.

The sustainable tax rate is 1.1 percentage point higher than the tax rate under current legislation. Since the tax base of the general income tax is about 75 per cent of GDP, this amounts to raising taxes by 0.75 per cent of

13. In all tables the levels of real values are measured in so-called growth-corrected units, meaning that actual real numbers are deflated by an annual growth rate of 1.5 per cent (equal to the Harrod-neutral technological change). Similarly, nominal values are measured in so-called inflation- and growth-corrected units which means that the actual nominal numbers are deflated by an annual growth rate of approximately 3 per cent (equal to 1.5 per cent inflation and 1.5 per cent real growth).

Table 1.
Macroeconomic behaviour under tax smoothing

	1998	1998	2008	2018	2038	2058	∞
	Level (bill. DKK)	Growth and inflation corrected index, 1998=100 except where noted					
Private consumption	475,1	100	96,6	98,2	99,0	99,8	104,0
Real GDP at factor prices	986,0	100	103,2	101,3	97,0	98,9	102,2
Employment		100	99,4	97,7	93,6	95,7	99,2
private production sector		100	98,7	96,1	89,7	91,7	93,9
construction sector		100	97,4	100,1	95,0	98,5	101,9
public sector		100	101,2	100,5	101,3	103,4	109,7
Capital in private production sector		100	114,6	111,8	105,5	107,0	109,5
Capital in construction sector		100	98,9	101,6	98,1	101,0	104,2
Capital in public sector		100	94,8	93,7	94,7	96,8	102,4
Foreign assets *	-280,0	-0,3	0,2	0,5	0,7	0,7	1,0

* Index is foreign assets to nominal GDP at factor prices

GDP. Therefore, current fiscal policy is not sustainable, but the necessary adjustment is relatively small.

The substantial improvement of the net foreign asset position is another remarkable feature of the dynamic adjustment. This reflects the fact that the K/L ratios are fairly fixed. Clearly, as the labour force is falling quite dramatically, real investments must also fall, and savings have to be directed towards accumulation of foreign assets. This effect is enhanced by an assumed net saving effect from the labour market pension schemes, see also Ministry of Economic Affairs (2000).¹⁴ This effect also explains why private consumption in the new steady state has increased by 4 per cent compared to 1998.

The public budget

Changing demographics are reflected in the public expenditures. First of all, the increased old-age dependency ratio that peaks in 2038 leads to an increase in the expenditures to

social pensions relative to GDP at factor prices by 2.4 percentage points. The total effects on expenditures relative to GDP from public transfers amount to an increase by 3.9 percentage points. Hence other transfers have increased, mostly increased pension payments from the (public) labour market pension fund (ATP).

From 1998 to 2038 the value of the age-dependent public consumption relative to GDP at factor prices increases by 2.7 percentage points, and total public expenditures relative to GDP increase by 8.6 percentage points. The increase in the non-age-dependent public expenditures is due to an increase in the public investments to keep a constant capital output ratio in the public production and an increase in the interest payments on public debt.

Total revenues relative to GDP at factor prices increase by 4.3 percentage point from 1998 to 2038. The automatic increase in the tax base of the personal income taxation from

14. This effect is included in the model to account for the possibility that mainly young households may be rationed in the capital markets. As DREAM assumes perfect capital markets, this effect appears technically in the sense that the planning horizon of the household is shorter than the expected lifetime used by the actuarially fair pensions funds.

Table 2.
Public expenditures and revenues under tax smoothing

	1998	1998	2008	2018	2038	2058	∞
	Level (bill. DKK)		Percentage of nominal GDP at factor costs				
Expenditures	559,6	56,8	58,4	60,6	65,3	64,7	64,6
Social pensions *	102,6	10,4	10,8	11,7	12,8	11,8	11,9
Civil servants pension, ATP and LD	17,3	1,8	2,6	3,4	3,2	3,1	3,0
Agedependent public transfers	87,8	8,9	8,4	8,4	8,9	8,8	8,8
Agedependent public consumption	206,6	21,0	21,6	21,8	23,6	23,6	24,5
Total of age dependent	414,3	42,0	43,3	45,3	48,6	47,2	48,1
Other expenditures	145,3	14,7	15,1	15,3	16,8	17,5	16,5
Tax revenues	573,1	58,1	57,9	59,5	62,4	62,7	63,5
Social pensions *	26,6	2,7	2,7	2,9	3,2	2,9	2,9
Civil servants pension, ATP and LD	7,2	0,7	1,0	1,4	1,3	1,3	1,2
Labour market pensions	8,1	0,8	0,9	1,3	2,6	3,5	3,7
Private pensions	6,8	0,7	0,7	0,8	1,4	1,1	1,2
Pension funds	3,9	0,4	0,9	1,3	2,0	2,1	2,2
Other taxes	520,6	52,8	51,8	51,8	52,0	51,9	52,2
Net debt	253,3	25,7	19,4	24,6	56,7	66,1	41,7

* Early retirement benefits, early retirements pensions, transitional benefits and public age pensions

pension payments from the funded pension system accounts for 2.5 percentage points of this increase in revenues. The taxation of capital income in the pension funds accounts for 1.6 percentage points.¹⁵ The combined effect of the reduced labour force and the increased tax rate keeps the remaining tax revenues fairly constant.

Two features are particularly noteworthy. First, we find that the increase in taxation from the pension funds finances almost half of the increase in the expenditures due to the change in the demographic composition of individuals. Therefore, the financial burden is significantly reduced by the tax base effect. Second, the increase in the public revenue constitutes only half of the increase in the expenditures (both measured relative to GDP). In other words, generations living until 2038 only finances half of the demographic

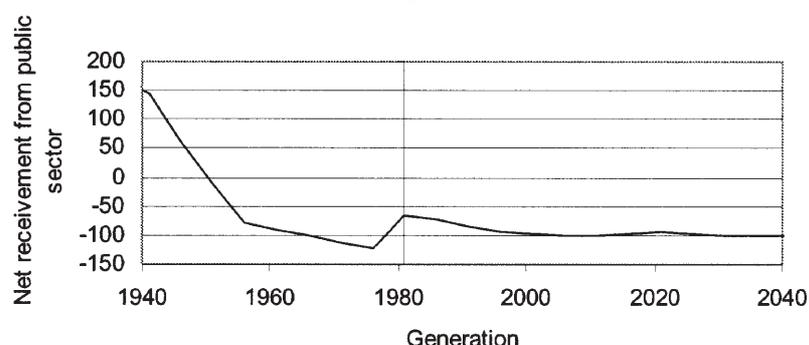
burden, and the rest is left for future generations through a huge increase in public debt. Indeed, the net public debt-GDP ratio increases from 25 per cent in 1998 to 57 per cent in 2038. It peaks at approximately 67 per cent around 2060 and is hereafter gradually reduced to a steady state level of 42 per cent.

Moreover, table 2 shows that the increase in the tax revenue from the automatic increase in the tax base continues until 2058 and therefore contributes to generate public surpluses that gradually reduce the public debt to the steady state level. Again, this indicates that the introduction of funded pension schemes in the Danish economy came too late to fully match the increase in the public expenditure driven by the ageing of the large postwar generations.

So, although the public sector fulfils its intertemporal budget constraint, several years

15. This is a gross effect. Private savings are reduced to partially offset the increase in pensions savings, which tends to reduce the revenue from the personal capital income tax.

Figure 1.
Generational accounts under tax smoothing. Thousand DKK per adult



during the transition period will be characterized by budget deficits and associated debt accumulation. Is this a matter of concern? It is hard to say, but as a participant in the EMU (though not the final stage), economic policy in Denmark is somehow restricted by the Maastricht fiscal criteria.¹⁶ If these criteria are repeatedly violated over the next five decades, a strategy of tax smoothing could not only upset Denmark's partners in the EU but also run into problems such as higher costs of financing public debt (Alesina, De Broeck and Tabellini, 1993).

Generational accounts

We now turn to an examination of the (inter)generational properties of a strategy of tax smoothing. For that purpose we construct individual generational accounts, here reported as the discounted value of the sum of public transfers and public consumption net of the discounted value of the sum of direct and indirect taxes paid during the

remaining lifetime of a representative member of each (current and future) generation.

Figure 1 portrays the absolute value of the generational account for current and future generations, presented in growth and inflation corrected units. To the right of the vertical line the accounts of generations born after 1981 are shown.¹⁷ These generations experience a full lifetime as economic active agents over 17 years from the base year in 1998.

The generational accounts do not distribute interest payments on public debt and public investments across generations. As these public expenditures are of significant size in each period, the result is that all generations who have a full lifetime in the economy will end up with a negative account. Note that the differences in the accounts for these generations are small. The negative value of generations that are born in the period after the major change in the demographic composition of the population stabilises around -100.000 DKK. The generation born in 1981 is better off with a negative account

16. These well-known criteria are that the gross public debt-GDP ratio must not exceed 60 per cent and that the annual public deficit-GDP ratio must not exceed 3 per cent.

17. The figure presents the account for five year groups, such that the observation in 1981 represents the average of the generations born in 1981 to 1985. The observation in 1986 represents the average of generations born in 1986 to 1990, and so on.

of -65.000 DKK. The primary explanation of this difference is that generations born in the future will be living in a period, where the public debt is permanently higher due to the smoothing of the financial burden. Therefore, a larger part of their tax payments goes to public debt service. Moreover, persons who are living in the initial period are faced with a lower tax burden than those generations who become active after the policy of the sustainable tax rate has been introduced.

Concentrating on the generations that experience less than a full lifetime as active economic agents (generations to the left of the vertical line in figure 1), the picture resembles standard pictures of generational accounts. First, we observe that the generation born in the period from 1976 to 1980 is worse off than the generation born in the period after. This is so because the accounts only measure net payments from the public sector for the part of the life that remains after 1998. This implies that the generational account of the generation born in 1976 start counting from the age of 22 years. However, the period from 17 to 21 years is a period where the generations receive a positive net transfer from the public sector. For the generation born in 1971 the account is slightly more favourable than the account for those born in 1976, the reason being that for the age-groups from 22 to 27 years the net transfer from the public sector is negative. The same is true for the remaining generations in the work force and therefore the generational accounts are increasing with the age of the generation in 1998.

Debt Smoothing

The macroeconomy and public finances

The aim of this section is to consider the trade-off between intergenerational burden sharing and the accumulation of public debt.

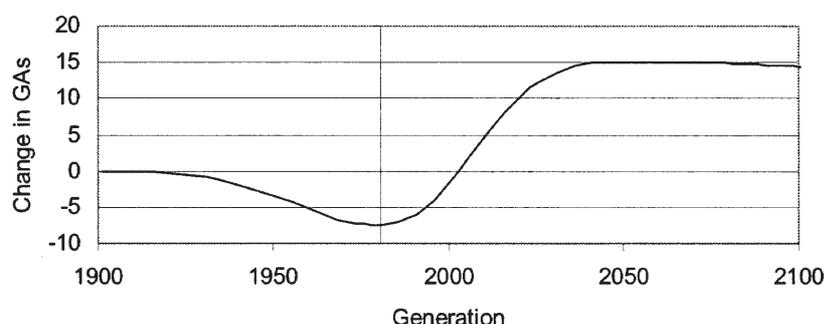
The policy rule discussed in the previous section is therefore contrasted with a policy rule that keeps the growth-corrected value of the public debt constant ("debt smoothing"). This policy goal is obtained by adjusting the base tax rate of personal income.

As noted already, the change in the demographic dependency ratio after 2040, combined with the fact that tax revenues from pension payments from the funded pension system is growing faster than the rest of the economy until 2070, imply that the long run financial burden of the demographic change is lower than the temporary burden around 2040. Therefore, the tax rate of the personal income tax system is higher under debt smoothing compared to tax smoothing throughout the first half of this century. Thereafter the picture is reversed, which of course is due to the lower interest payment on public debt in the debt smoothing scenario. The base tax rate peaks in 2038 at a level 3.5 per cent higher than the announced base tax rate in 2003, which is 2.4 percentage points higher than in the tax smoothing case. In 2058 the tax rate falls slightly below the smooth tax rate, and in the long run the base tax rate falls to a level similar to the announced tax rate for 2003.

The macroeconomic consequences of this change in the tax policy are very small on the supply side of the economy, whereas the level of aggregate consumption is reduced relative to the tax smoothing scenario in the period where the tax rate is higher than the smooth tax rate. In 2058 aggregate consumption is identical in the two scenaria and from this point on the private consumption is higher in the debt smoothing scenario. This pattern of consumption simply reflects the pattern of the tax rate in the two scenarios.

In the debt smoothing scenario the total expenditures relative to GDP at factor prices increase by 7.3 percentage points from 1998

Figure 2.
Absolute difference in generational accounts (debt smoothing vs. tax smoothing)
Thousand DKK per adult



to the peak in 2038. This is 1.3 percentage points lower than in the tax smoothing scenario. The difference is entirely due to a reduction in the interest payments on public debt. Total public revenues increase by 5.4 percentage points. The reason why this is sufficient to keep the public debt ratio constant, even if the expenditures increase by 1.9 percentage point more, is that there is a public surplus in 1998. This is turned into a deficit to keep the debt growing at the same rate of GDP.

Generational accounts and equivalent variation

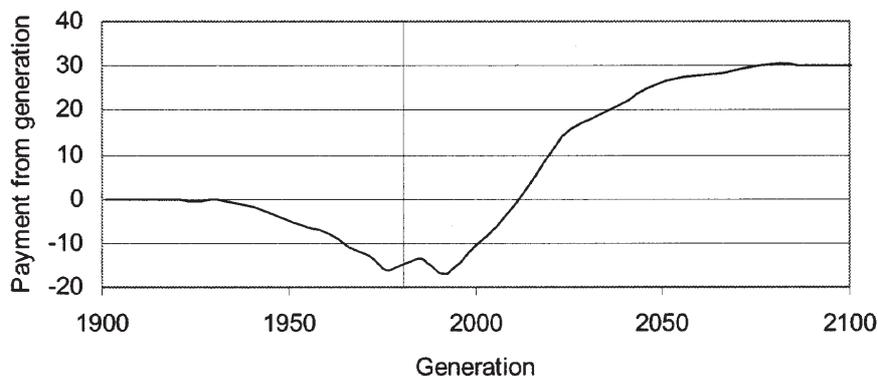
As reported in the previous subsection the only major macroeconomic consequence of the policy change is the reduction in the public debt and the increase in the tax rate. Therefore, the change in policy may be considered as a pure change in the trade-off between intergenerational burden sharing and the development in the public debt.

Figure 2 reports the changes in the generational accounts of the different generations, when comparing the debt smoothing policy to the tax smoothing policy. Not surprisingly, the figure reveals that

generations currently alive and generations born before 2006 will end up having a lower (a more negative) net value of their generational account. Of course, this reflects that these generations are active in the economy in the period, where the tax rate is higher in the debt smoothing scenario. The generation that has the largest loss in net value is the generation that becomes active in 1998. The loss for this generation is 6.000 DKK per adult. Generations born after 2006 have a higher net value of their generational account in the debt smoothing scenario. These generations become active in the economy in 2023, which is at the time, where the public debt is rapidly increasing in the tax smoothing scenario. In the debt smoothing scenario the financing of the interest payments on public debt is lower and hence the tax rate needed to finance public expenditures is lower. This generates the increase in the net value of the generational accounts. For generations born after 2050 the increase stabilises around 15.000 DKK per adult measured in growth and inflation corrected units.

A different approach to measuring the intergenerational distribution is to compute the equivalent variation (EV) for each

Figure 3.
Equivalent variation. Thousand DKK per adult



generation. This measures the amount of money per adult that a generation is willing to pay (measured in the prices of the tax smoothing scenario) for a shift of policy to the debt smoothing scenario. A negative amount therefore means that the generation is worse off in the debt smoothing scenario.

EV may be reduced to a measure of the relative change in utility times the initial stock of financial and human capital of the household in question.¹⁸ The utility function of the households in DREAM is traditional in the sense that it is defined over the set of private consumption goods and leisure. The individual public consumption does therefore not affect the EV measure. However, the present policy change does not involve public consumption, and therefore EV may be considered a measure of "total" utility including individual public consumption *iff* the utility function is specified as additive separable in the individual public consumption.

As shown in figure 3, the similarity between the EV measure and the generational

accounts reported in Figure 2 is striking. The generations that are worse off according to the EV measure is approximately the same as the generations that experience a reduction in their generational account. This means that the generations that are currently active in the labour market and the generations born in the near future are worse off in the debt smoothing scenario, whereas generations born later in the future are better off in this scenario. Only the generations born between 2006 and 2016 experience a different evolution in the generational account and the EV measure. These generations have higher values in the generational accounts but are worse off according to the EV measure.

The reason for the similarity between the two measures is that in both cases the change is driven by the shift in the tax burden of the generation in question. An increase in the tax burden directly reduces the generational account, since the public consumption is (almost) unaffected by the policy change. In case of the EV measure, the increased tax burden faced by the generation implies that

18. For a derivation of the EV measure in DREAM, see Madsen (2000).

the after-tax value of income is reduced, and therefore, the total consumption bundle that the generation can afford over the life time is reduced. This in turn reduces utility and hence the EV becomes negative. The reason why the generations born in 2006 to 2016 experience an increase in the value of the generational account, and at the same time a decrease in the EV is that the bequest from the parent generations is lower because the parent generations are poorer, since they face an increased tax burden.¹⁹

Finally, a social welfare function is constructed to measure the total effect on society from the policy change. The change in the social welfare function is given as the discounted sum of the population weighted EV measures of each generation. The discount rate is assumed to be the international rate of interest.²⁰ Using this welfare function the tax smoothing policy is found to be preferable to society when compared to the debt smoothing policy. The one-off gain from implementing the tax smoothing policy amounts to 0.6 per cent of GDP in factor prices.

This result is in line with the standard argument in favour of tax smoothing, which is that convex distortionary effects of taxes make a smooth rate of taxation over time preferable to a fluctuating one (Barro, 1979). In DREAM the distortion of the base tax rate of the personal income taxation is low, due to the presence of an imperfectly competitive labour market, and the fact that all transfers including unemployment benefits are taxed according to the personal income tax system. The latter implies that a reduction in the base

tax rate, which leads to higher after tax wage income also leads to a higher income for the unemployed (since the tax rate on benefits is also reduced). Therefore the improvement in the incentive to become employed is very modest. Hence, the absolute value of the gain from the tax smoothing is also modest.²¹

Concluding remarks

The current macroeconomic position of the Danish economy is favourable, with a low rate of unemployment and significant surpluses on both the public budget and the current account of the balance of payments. Therefore, the initial position of the economy tends to be relatively good, when it becomes faced with the problem of the increased age burden in the near future. The structural shift towards higher dependency on fully funded pension schemes also has a significant positive effect on the Danish economy's ability to face the demographic challenges.

Structural reforms of the tax system have improved the incentives to save. This may be very important in the case of Denmark, as a low propensity to save historically has been a major problem. However, faced with the prospect of a reduced labour force, the structural improvements from lower marginal tax rates and from increased incentives for the unskilled to become employed are needed. Also, welfare reforms to increase the incentives to enter the labour force could further improve the position of the economy.

The first main conclusion of our analysis is that the fiscal policy in Denmark is almost

19. A minor reduction in the overall activity due to general equilibrium effects also pull the result in this direction.

20. The social welfare function may be criticized on the grounds that the discounting of each generations EV measure is ad hoc. The standard argument for using the international interest rate is that this represents the alternative costs for the public sector when transferring wealth between generations.

21. Even without these effects from the taxation of the alternative to employment, the gain from tax smoothing in CGE models tends to be small.

sustainable, in the sense that a smooth tax rate, which fulfils the intertemporal budget constraint of the public sector is only 1.1 percentage point higher than the announced base tax rate for 2003. The second main conclusion is that a policy of tax smoothing would not only smooth the financial burden of demographic changes across generations, but also cause a substantial increase in public debt from 2020 to 2040. However, we show that this latter effect can be avoided by following a policy of debt smoothing without jeopardizing an equal distribution of the tax burden. We finally demonstrate that the increase in the social efficiency loss from a policy of debt smoothing compared to a policy of tax smoothing is almost negligible.

Overall, we conclude that a precautionary fiscal policy that abstains from perfect tax smoothing and increases the financial burden of currently living generations relative to future generations may be advisable.

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