

The Welfare State and Strategies Towards Fiscal Sustainability in Denmark*

Torben M. Andersen, Svend E. Hougaard Jensen
and Lars Haagen Pedersen[†]

Abstract

Existing welfare arrangements in Denmark are shown to suffer from a problem of fiscal sustainability. This assessment is fairly robust to a number of demographic changes, but changes in life expectancy are shown to have an important impact. The sustainability problem is also found to vary considerably with respect to changes in the interest rate and the GDP growth rate. The paper questions the appropriateness of the current long-term fiscal strategy of pre-funding ("Denmark 2010"). This criticism applies both in relation to the plan's implications for inter-generational distribution and the ability to cope with the inherent uncertainty.

Keywords: Fiscal Policy, Ageing, Welfare Reform, Denmark.

JEL: E62, H66

*This paper has been prepared for the CESifo-LBI conference on "Sustainability of Public Debt", held in Munich, Germany, October 22-23, 2004.

[†]Andersen: University of Aarhus and CEPR; Department of Economics, University of Aarhus, Universitetsparken, DK-8000 Aarhus C; E-mail: tandersen@eco.au.dk. Jensen: CEPR and SDU; Centre for Economic and Business Research (CEBR), Copenhagen Business School (CBS), Porcelaenshaven, Building 65, DK-2000 Frederiksberg, E-mail: shj.cebr@cbs.dk. Pedersen: The Danish Welfare Commission, Landgreven 4, DK-1301 Copenhagen K, E-mail: lhp@velfaerd.dk. Andersen is chairman of the Danish Welfare Commission (www.velfaerd.dk) and Pedersen is head of the Commission's secretariat. However, the views expressed in this paper do not necessarily reflect the position of the Commission.

1 Introduction

Denmark has a large public sector which offers a wide range of welfare services and income replacement schemes to the population. The Danish welfare model builds on universality, that is, individuals have basic rights to welfare arrangements like health care, old age care and pension benefits independently of their ability to pay, labour market history etc.¹ These welfare arrangements are tax financed, and since the level of welfare services is high and income replacement schemes are extensive, this implies that the tax burden is high (about 50 per cent). It is an implication of this system that there is a strong pay-as-you-go (PAYG) element in the sense that individuals on average are net-recipients as young and old, while they are net-contributors when active in the labour market. Consequently, changes in the age composition of the population can have dramatic consequences for public finances. Under a balanced budget requirement this would translate into substantial changes in either taxes or welfare services. To the extent that neither of these options is politically acceptable, the issue arises how to maintain the same welfare opportunities to different generations without causing substantial inter-generational redistribution, yet ensuring that the system is fiscally sustainable.

The outset for considering this challenge is rather favourable. Unemployment is down to 6 per cent of the labour force; prices are fairly stable; there has been a surplus on the current account each year since the late 1980s; and a high degree of fiscal discipline has been demonstrated by governments of different colour over the last couple of decades. In fact, the surplus on the government budget was slightly above one per cent of GDP in 2003, and the gross public debt-GDP ratio has been gradually brought down from 81 per cent in 1993 to 46 per cent in 2003.² However, even though demographic changes

¹See Esping-Andersen (1990). Note that although there are strong elements of universality in the Danish welfare model, there are also substantial deviations from this principle. For example, entitlement to unemployment benefits and early retirement benefits requires that contributions have been paid in advance, though not fully financing these schemes.

²Debt figures are defined according to the Growth and Stability Pact (GSP). The definition has been changed recently, implying that the new figures are approximately 3 percentage points higher than those based on the previous definition. The debt target is set according to the previous definition.

in Denmark are not dramatic by international standards, the implications for public finances may be substantial due to the extended form of the welfare state.

To cope with this challenge, a medium-term strategy - the plan “DK 2010” - has been launched. The plan includes an intermediate target of a reduction in the debt-GDP ratio to 25 per cent by year 2010. The basic idea of “DK 2010” is to consolidate public finances so as to be able to finance an unchanged supply of welfare arrangements with constant taxes. Constant taxes are both consistent with tax smoothing arguments and concerns for inter-generational distribution.

The aim of this paper is to provide an assessment of the consolidation strategy implied by “DK 2010”. Since there is substantial uncertainty about key variables over the time span in which the demographic changes unfold, it is essential to assess the robustness of the strategy to such uncertainty. Uncertainty is inherent in demographic projections, and experience has shown that they may be prone to radical changes, even within relative short periods of time.³ There is also uncertainty concerning other key variables, including the interest rate and the GDP growth rate. In the presence of uncertainty it is also important to assess the implications of a given strategy for the sharing of risk across time and generations. Moreover, issues of political implementability and the implications for inter-generational distribution have to be taken into account.

The analysis is conducted using the CGE-OLG model DREAM, which has been developed with the purpose of evaluating medium-to-long term effects of fiscal policy in Denmark.⁴ This model is thus quite appropriate for assessing issues of fiscal sustainability and to evaluate the sensitivity to changes in key variables.

The main findings of the paper are that maintaining current welfare arrangements leaves a substantial problem of fiscal sustainability. It is found that the sustainability is ensured by an increase of about 9 percentage points in the base direct income tax rate, corresponding to a need for a permanent increase in income taxation of approximately 4 per cent of GDP. Interestingly the fiscal

³See, e.g., Alho and Spencer (1985) and Lee and Tuljapurkar (2001).

⁴DREAM is an acronym for Danish Rational Economic Agents Model. Details on the model are available in Knudsen, Pedersen, Petersen, Stephensen and Trier (1998, 1999), and Pedersen, Stephensen and Trier (1999). General information on DREAM can be found at <http://www.dreammodel.dk>.

position is fairly robust to a number of demographic changes, with the important exception of changes in longevity. An expected increase in longevity is thus one of the important reasons for the fiscal sustainability problem. Moreover, the fiscal position is relatively sensitive to changes in the interest rate and the GDP growth rate. The fact that increases in life expectancy and uncertainty play such a substantial role raises a fundamental question as to whether a funding strategy is appropriate. This applies not only in relation to its implications for inter-generational distribution but also for the ability to cope with the inherent uncertainty.

The paper is organised as follows. Section 2 offers a brief account of the public sector activities and fiscal policy in Denmark, including details of the medium-term strategy “DK 2010“. Section 3 presents a demographic projection, followed by an analysis of whether current fiscal policies are sustainable. Given the sustainability problems associated with current policies, section 4 studies how sustainability can be achieved through pre-funding. Finally, section 5 suggests an alternative strategy based on a stronger link between old-age pension rules and changes in life expectancy.

2 Trends in fiscal performance and design

In this section we first portray some aggregate patterns in the recent behaviour of public finances in Denmark. We then try to identify some fiscal strategies followed since 1960, emphasizing the expansion of the welfare state in the 1960s and 1970s and the reform programmes since the early 1980s.

2.1 Public expenditures, revenues and debt

In most industrialised countries, the magnitude of government involvement has increased significantly over the last century (Masson and Mussa, 1995; Tanzi and Schuknecht, 2000). In Denmark, the growth in public expenditures has been particularly extensive over the period 1960-80, see table 1. In fact, prior to that period, the share of public expenditures to GDP in Denmark was below the average share in other OECD countries, but during the 1960s and 1970s the public expenditure share grew by nearly twice as much as in these other countries.

– Table 1 about here –

One noteworthy point is that the growth in public expenditures up to the mid-1970s was driven by increasing public consumption, whereas increases in transfer incomes have been the major driving force thereafter. This is of course partly a reflection of the increase in unemployment, which took place in the mid-1970s and which brought unemployment up to a persistently higher level. Reductions in unemployment during the 1990s have lowered transfer payments, but not in the same proportion as unemployment has been reduced. The reason for this is that unemployment figures are also affected by various leave schemes etc., which reduce the labour supply.

The total revenue as a share of GDP has risen steadily since 1960, constituting 53,5 per cent in 2003. Since the expenditure share has fallen since the early 1990s, the rise in the revenue share over the last decade shows that a fiscal consolidation programme has been followed.

The Danish tax structure differs in several respects from the structure in other OECD countries in that (i) a relatively large share of the (high) tax revenue stems from personal income taxation, unlike other European countries which rely more heavily on social security contributions; (ii) consumption taxes are used to a larger extent in Denmark than in other OECD countries; and (iii) wealth, property and corporate taxes are used on a relatively smaller scale in Denmark.

Of particular interest is the relatively high marginal tax rates faced by medium-to-high income earners. A recurrent theme in policy debates is the effects of such high marginal tax rate on labour supply decisions both at the intensive and extensive margin (working hours and labour force participation). Moreover, the combination of the taxation system with the social assistance system implies that the economic incentive to be working is low for some groups. A further important aspect is the robustness of the current tax system to further globalisation.

It is important for the current debate that Denmark experienced a debt crisis in the early 1980s. Public debt was growing rapidly due both to persistent budget deficits reaching 10 per cent of GDP but also very high interest rates. There was a growing recognition that the development was not sustainable, and a major policy shift took place in the early 1980s. This policy shift had many ingredients, including a fixed exchange rate policy, abolition of wage indexation and fiscal consolidation via both expenditure control and tax increases (mainly on pension funds). This policy shift had important short-run implications, including a dramatic fall in inflation and interest rates, higher activity and

lower unemployment, but also increasing current account deficits. Moreover, public finances improved dramatically. The primary budget thus changed from a deficit of about 6 per cent in 1982 to a surplus in 1986 of 8 per cent. This shift was partly due to discretionary policy changes and partly due to automatic budgetary reactions following from booming activity.

2.2 Welfare policies and reforms

It is beyond the scope of this paper to give a detailed account of the mechanisms which led to the development and expansion of the Danish welfare model. For the present purpose it suffices to note that the aim of ensuring a social balance and egalitarian outcome has very broad support in the Danish population. Moreover, the model has a particular blend of state intervention and liberal policy. There has always been a concern for ensuring a competitive private sector, since Denmark after all is a small and open economy. An illustrative example of this is the flexibility of the Danish labour market with very flexible hiring and firing rules. The flip side of this is the relatively generous unemployment insurance scheme which is largely tax-financed, i.e. the welfare state plays a key role in diversifying risk. In assessing welfare arrangements it is thus important to have an eye to both the incentive and the insurance effects.

During the 1980s and 1990s a number of important changes have been made in the taxation system. With the background of persistent current account deficits and the implied “savings deficit”, a motivation for reforms has been to improve savings incentives. Moreover, the implication of high marginal tax rates for the labour market is a recurrent policy theme and several changes to the tax system have been implemented since 1985. The marginal tax rates on personal income have been reduced, by broadening the tax base and switching towards green taxes. The tax system has also been modified in view of the increased international mobility of capital, by bringing down the nominal corporate tax rate, and thereby the tax system has been made more robust with respect to profit shifting of international firms.

The incentives to save have been improved through substantive cuts in the tax value of the right to deduct interest expenses. Whereas interest rates in the early 1990s could be deducted at a maximal rate of 73 per cent, as a result of a sequence of reforms it has now been reduced to about 30 per cent.

An important initiative in the labour markets has had crucial effects on

pension saving, namely the gradual expansion of the negotiated but mandatory labour market pension scheme. These schemes had existed previously, but they became much more widespread from the late 1980s and early 1990s. While the schemes can be said to break with the universality principle, they solve a problem in relation to income support for pensioners. The schemes are fully-funded, defined-contribution pension schemes. The contribution rate of blue-collar workers is now being increased to typically 10.8 per cent of the wage income, but for white-collar workers and public employees rates are 12-15 per cent. The contributions amount to 6.8 per cent of GDP (2004). At present, the total wealth of private pension funds is about 100 per cent of GDP, but is expected to reach a level of almost 200 per cent of GDP in 2050. It is interesting that these schemes have emerged without direct government intervention, but in negotiations between labour unions and employers' confederations. From a fiscal point of view, it is important to note that the contributions to pension funds are deductible from income tax, whereas payments from the funds are taxed. Thus, since contributions are still high compared to what the funds are paying out, the tax base is increasing over time as the pension funds mature. This automatic increase in the tax base is a feature that is unique in the EU for Denmark and the Netherlands (European Commission, 2000).

The 1990s have also witnessed several welfare reforms, including important changes in labour market and social policy. A very important change is the so-called "activation" policy. This essentially means that passive claiming of unemployment benefits and social assistance becomes more difficult, since entitlement can only be maintained if the recipient is involved in work or education programmes. Moreover, the entitlement period for claiming unemployment benefits has been reduced. Previously, it was effectively open-ended - participation in labour market programmes counted as fulfilment of the work requirement - but now there is a maximum of 4 years. Without changing the level of compensation in unemployment benefits or social assistance, the incentive structure has thus been changed substantially. For young persons there has also been made a reduction in the compensation level, since "normal" compensation can only be claimed for 6 months, and thereafter it is reduced by 50 per cent.

With the aim of increasing labour supply, initiatives to postpone the retirement decision have been taken. For example, 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, by offering a pre-

mium to people who abstain from using the scheme. Since this reform, there has been no major reform initiative.

2.3 “DK 2010”: a medium-to-long-term strategy

Danish fiscal policy has been conducted according to a medium-to-long-term strategy since 1997. The overall objective is to ensure fiscal sustainability, by smoothing the fiscal adjustments in order to avoid dramatic policy changes in a more distant future. The current plan, “DK 2010”, was originally formulated in 2001 by a centre-left government led by the Social Democrats, but the current centre-right government adopted the plan when it took office by ultimo 2001. The plan is therefore effectively accepted across a broad political spectrum in Denmark. The objectives of the plan define a benchmark for assessing the government’s performance on economic policy.

The original plan included the following objectives:

- Annual surpluses on the public budget of 2-3 per cent of GDP over a period of 10 years
- Reduction in the gross public debt-GDP ratio to 35 per cent in 2005 and 20-25 per cent in 2010
- A limit on the annual real growth rate of public services at 1 per cent from 2002 to 2005 and 0.5 per cent in the following years
- Tax reductions in selected areas
- Low and stable inflation
- An increase in employment of 3.5 per cent of the labour force, the major part before 2005
- An increase in the labour force of 2.8 per cent
- A reduction in the rate of unemployment to 4.5 per cent of the labour force.

The current government has added a so-called tax-freeze to the plan, meaning that no current tax rate is allowed to increase.⁵ Since debt reduction is

⁵The residence tax rate and some indirect tax revenues are gradually eroded in real terms.

the main priority, this has to be achieved either through structural reforms to expand the labour supply, or through tight control of public spending. In the absence of structural reforms, the necessary fiscal adjustments must be implemented through tight targets on expenditures to public services, since public expenditures to transfers are more or less given by commitments *not* to reduce welfare benefit rates (transfer payments per recipient) and by guarantees that these rates will grow in line with the growth in real wages. The underlying indexation scheme has since 1990 been defined by law (statutory provision).

While much attention has been drawn to the government's ability to fulfil the medium-term targets of the plan, much less attention has been given to the connection between the medium-term targets and fiscal sustainability. The basic premises for the plan is that if the medium-term targets are fulfilled by 2010, then a fiscal policy where the same supply of welfare arrangements are available to future generations as to current generations will be consistent with fiscal sustainability. In this sense the fiscal policy adjustment is "front-loaded", as the adjustment takes place in the period until 2010.

The Danish government has recently estimated that the remaining necessary increase in employment corresponds to app. 1.9 per cent of the labour force, meaning that more than half of the original target remains to be achieved (Ministry of Finance, 2004). Furthermore, the real growth of public services in 2004 is reduced to 0.7 per cent, while the average annual growth rate in the remaining period until 2010 is targetted at 0.5 per cent.

While acknowledging the positive impact on fiscal discipline of "DK 2010", this paper focuses on some other aspects of the plan, including (i) whether it is robust with respect to uncertainty in key demographic and economic variables; (ii) the implications for intergenerational distribution and risk-sharing; and (iii) if the plan is credible in a political economy sense. Before turning to these questions, we examine whether current fiscal policy is sustainable.

3 Assessing fiscal sustainability

This section examines whether the promise to provide future generations with the same supply of welfare arrangements as current generations is consistent with fiscal sustainability. We first present some details of the underlying demographic projection, and then some budgetary and macroeconomic outcomes are reported.

3.1 The demographic projection

Demographic projections are based on assumptions concerning future fertility, mortality and migration. The uncertainty associated with the projection of each of these determinants is significant, and the evolution of the total population becomes highly uncertain in longer run projections. However, what really matters in relation to fiscal sustainability is the robustness of the demographic dependency ratio with respect to changes the underlying population flows. In the following, we discuss the effect of permanent changes in each of the three population flows on the dependency ratio. The analysis is based on the demographic forecast of the Welfare Commission (2004).⁶

The projection of future *fertility* is based on estimation of age-dependent fertility rates for different population groups based on the origin of the individuals (immigrants from less developed countries, immigrants from more developed countries, descendants of these two groups of immigrants, and individuals of Danish origin). This leads to a projection of the total fertility of the whole population that is almost constant at the current level of 1.7. The assumptions underlying the projection of *net-immigration* imply a fairly constant level of net-immigration corresponding to 0.13 per cent of the population. For example, we have assumed - in line with Boeri and Brücker (2001) - that immigration from new EU countries accumulates to a level of 1 per cent of the population.

As changes in *mortality* are by far the most important determinant of fiscal sustainability, we need to be more detailed here. Life expectancy in Denmark was among the highest in the world in 1960, but this picture has changed dramatically. Indeed, with an average, annual growth rate of life expectancy of 0.1 year in Denmark, only Slovakia and Hungary (for men) among the OECD countries have experienced slower growth in life expectancy than Denmark over the past four decades (OECD, 2003). The slow growth implies that life expectancy for men in Denmark in 2000 is in the lower half of OECD countries ranked by life expectancy, and for women life expectancy is in the lowest third. However, according to more recent Danish statistics, the current annual growth rates are app. 0.2 year, which is closer to the European average.

Using the methods suggested by Lee and Carter (1992), Haldrup (2004)

⁶The Danish Welfare Commission is an independent advisory body to the Danish Government. The task of the Commission is to consider reforms of the Danish welfare state that ensures fiscal sustainability and a fair inter- and intragenerational distribution.

estimates age and gender specific mortality rates for Denmark using data from 1900-2002. These estimates imply that the average annual future growth rates in life expectancy are in the range from 0.08 to 0.09 years for both men and women. However, even those new estimates imply that the growth rate in life expectancy remains app. 50 per cent below the average growth rate for Western Europe over the next 50 years (United Nations, 2004). In any case, this suggests that uncertainty with respect to life expectancy may be significant.

The projection shows a fall in the size of the population (from 5.4 million today to 5.0 million in 2070), and the number of working-age persons (15-64) is reduced by 10 per cent from 2002 to 2040 and by 16 per cent from 2002 to 2080. Over the same two periods, the number of elderly citizens (65+) increases by 52 per cent and 47 per cent, respectively. Consequently, the demographic dependency ratio increases by 27 per cent from 2002 to 2040 and by 28 per cent from 2002 to 2080. This indicates that the increase in the dependency ratio during the next 35 years is not a phenomenon that is isolated to the echo effects of the large post-war generations. Rather, it is a permanent shift to a higher level.

Compared to previous, yet very recent, demographic forecasts, the shift in the dependency ratio is qualitatively different. Figure 1 compares the current dependency ratio to the dependency ratio based on the 2001 demographic forecast (the year when "DK 2010" was launched). In the 2001 forecast, the dependency ratio has a global peak around 2040, but the ratio is then reduced to a level which is in between the current level and the peak in 2040. This suggests that the demographic ageing problem has both a temporary and a permanent component. The current demographic projection implies that the ageing problem is almost entirely a permanent phenomenon.

– Figure 1 about here –

Since this change in the characteristics of the demographic projection may have serious implications for the design of fiscal policy, it is important to consider the robustness of the dependency ratio with respect to changes in fertility, migration and mortality. We therefore examine how the dependency ratio responds to a permanent change in each of these factors. The shocks are quantified such that the long run effects on the *total* population are similar. The accumulated increase in the total population is in the range from 4 to 5 per cent after 75 years for all three analyses. Figure 2 shows the dependency ratio in the baseline and given the three different permanent changes. The

result is very clear: the dependency ratio is robust with respect to changes in fertility and immigration, whereas the change in life expectancy has a major impact.

– Figure 2 about here –

The reason why increases in future life expectancy has qualitatively different effects from increases in fertility and migration is that the two last-mentioned affect individuals in all phases of life, whereas increases in life expectancy only tend to increase the number of individuals aged 60+, the major part of whom have retired in any case. This also explains why fertility and immigration only have minor effects on the demographic dependency ratio: These changes tend to affect both the numerator and the denominator of the ratio whereas increased life expectancy only tends to affect the numerator.

3.2 Is current fiscal policy sustainable?

The plan "DK 2010" assumes that all generations face the same supply of welfare arrangements. This may be interpreted as aiming at having both a defined-benefit and a defined-contribution scheme in the sense that benefit and contribution rules should be the same across various generations. It is also assumed that the gains from expected future productivity growth accrue to future generations. This corresponds to extrapolating the fact that current generations benefit from the historical growth in productivity.

The Danish welfare state provides transfers and public services financed almost exclusively by general tax collection. The PAYG nature of the Danish welfare state is reflected in the distribution of age-specific net-contributions per individual to the public sector, as shown in Figure 3. The figure displays that children and elderly citizens are net-receivers of public expenditures, whereas working-age people are net-contributors to the public sector.

– Figure 3 about here –

Population ageing implies that the density of the age distribution of the population moves from the net contributors of working-age to the net recipients of elderly. This creates an upward pressure on public expenditures relative to public revenues and therefore a potential problem of fiscal sustainability.

Using the CGE-OLG model DREAM, the macroeconomic consequences of "an unreformed welfare system" have been analysed, see Table 2. The

development in GDP is driven by the exogenous technological progress and the development in the labour force.⁷ Technological progress is assumed to be 2 per cent per year, which corresponds to historical experience. The labour force is reduced by 12 per cent from 2002 to 2041 and by 19 per cent from 2002 to 2081. This reduction is, by assumption, only due to the change in the demographic composition of the population. As a benchmark it is assumed that labour market participation rates and average annual working hours for a given age, gender and origin group remain constant at the current level. Therefore, the three major determinants of the reduction in the labour force are the reduction in the number of working-age individuals, a relative increase in the number of immigrants (with a lower labour market participation rate), and a tendency towards higher average age in the labour force.

– Table 2 about here –

The GDP effect of a falling labour force is more than offset by the increase in productivity, implying that real GDP (at factor prices) grows by 83 per cent from 2001 to 2041. Similarly, real private consumption is more than doubled over that period, so private consumption per capita is increased even more because of the reduction in the total population. So if the effects of population ageing are assessed in terms of (changes in) the *absolute* level of wealth available to the entire economy, the phenomenon cannot be said to pose a dramatic problem. At least not if the historical record of technological progress continues. Rather, the problem is about the intergenerational *distribution* of wealth.

Moreover, population ageing implies that current fiscal policy is unsustainable, see Table 3. Total primary public expenditures increase gradually from the current level around 50 per cent of GDP to around 60 per cent of GDP in 2061. Until around 2041, the increase in expenditures is distributed equally between public transfers and public services. After 2040, the additional increase is mainly a result of increases in expenditures to public services. This reflects the fact that the “double ageing” phenomenon is intensified after 2040 due to the assumed growth in life expectancy. The higher proportion of very

⁷A fixed exchange rate, perfect capital markets, and a constant international rate of interest tend to generate a fixed ratio between capital and labour measured in productivity units. The relationship is modified by, e.g., sluggish capital adjustment and changes in the real exchange rate.

old within the group of retirees means an increase in the average expenditures to health care per retiree.⁸

– Table 3 about here –

The assumption of constant tax rates seems to imply that the public revenue-GDP ratio is fairly constant. The gradual reduction until 2011 is mainly due to the current tax cut and the assumed duration of the current “tax freeze”. The latter reduces the revenue from property taxes and some specific indirect taxes. The gradual increase in the following years is due to the (taxable) pension payments from the funded pension schemes. The development in the expenditures and the revenues imply that the current fairly large primary surplus is gradually eroded and turned into a deficit around 2020. After that, the ageing of the population is intensified which tends to boost the primary deficit. From around 2030 the total deficit exceeds the 3 per cent GSP limit.

The fact that the primary deficit is increasing after the temporary peak in the dependency ratio in 2040 (cf. Figure 1) reflects the fact that the demographic ageing problem is not a temporary phenomenon. The current public surplus obviously reduces public debt and, interestingly, the public sector in Denmark is currently being turned into a position as a net creditor.⁹ However, the large public deficits after 2025 rapidly change this picture, and around 2060 the net public debt has accumulated to the same level as the annual GDP.

In sum, a fiscal policy which promises the same supply of welfare arrangements regardless of what generation the individual belongs to is found to suffer from a serious problem of fiscal sustainability. This clearly raises the question of how to change the economic policy to ensure long run solvency of the public sector.

⁸The assumption that health care expenditures increase with age is not uncontroversial. If increased life expectancy is mainly associated with increased health, then health care expenditures may be related to expected-time-to-death instead of age. On the other hand, if increased life expectancy mainly reflects technological progress in medical treatment, then age-dependency of health care expenditures may underestimate the growth in these expenditures.

⁹The net-public debt in Table 2 follows current definitions of Danish National Accounts - and is therefore not comparable to the GSP debt measure. This figure includes the ATP pension fund, which is a compulsory fully financed labour market pension fund. Due to a change in the legislation regulating the ATP fund, the accumulated wealth in the fund will be registered as private wealth from 2005. This also affects the primary surplus since net-contributions to the ATP fund is currently included in the surplus.

Before addressing this question within a truly intertemporal framework, it is useful to consider the benchmark case where the budget is balanced each period. This case with PAYG financing of welfare arrangements clearly captures the so-called intergenerational (or social) contract, whereby young and middle-aged persons finance expenditures allocated to older members in society, expecting that future generations will do the same. Focusing on the generational aspect one can in very broad terms say that the benefits accruing from this include income transfers, health care etc., and the contributions are made in the form of tax payments when young or middle-aged.¹⁰ This is reflected in the age-distribution of net-contribution profile shown in Figure 3.

Under a balanced budget any change in, e.g., the age distribution would have to be absorbed by either current young or old generations, and it is well known from the literature that defined-benefits and defined-contribution schemes imply different distribution and risk profiles (see e.g. Bohn 2001). Under a defined-benefit scheme variations in the age distribution will be born by young and middle-aged generations, while with defined-contribution the old generations will face the consequences.¹¹

An implication of a PAYG system is thus that various generations may end up being treated differently. From an efficiency point of view this reflects that all possibilities for risk diversification across generations have not been fully exploited. The implied intergenerational distribution profile may also be politically unacceptable. This can be circumvented by using the public budget as a buffer, since accumulation (or decumulation) of public debt can be used to change both the intergenerational distribution and risk-sharing profile (Gordon and Varian, 1988). Obviously, the intertemporal budget constraint for the public sector is still a constraint on these possibilities.

Against that, we next study the requirements to realise a combined defined-benefit and defined-contribution scheme by using the public budget as a shock absorber. We also look at the efficiency and distributional consequences of such a policy.

¹⁰The Danish welfare state also involves the “reverse” generational contract in respect to the financing of child care and education.

¹¹Alho et al. (2003) proposes an indexation scheme where benefits are indexed to the wage bill rather than the wage rate to ensure that risks associated with population changes are shared between young and old generations.

4 Achieving fiscal sustainability through pre-funding

The strategy considered in this section is also one of front-loading the fiscal adjustment. In the extreme case, one may consider an initial once-and-for-all change in benefits or contribution rules to ensure fiscal sustainability. Such permanent adjustments guarantee that benefit and contribution rules can be maintained for all future generations. The adjustment may run via tax increases, cuts in public consumption or a smaller share of the population receiving income transfers (either fewer recipients or lower transfers). Here we consider an adjustment involving a permanent increase in the base income tax rate, which is gradually phased in during the decade from 2011 to 2021.

4.1 Budgetary effects

To obtain fiscal sustainability it is necessary to increase the base income tax rate by no less than 8.7 percentage points.¹² This large adjustment implies that the tax revenue-GDP ratio increases by 5.6 percentage points from 2011 to 2021. This should be compared to the 0.5 percentage point increase in the previous case of constant tax rates. Expenditures also rise relative to GDP due to a contractionary effect on GDP from reduced labour supply as a consequence of the increase in the marginal tax rate. However, the resulting positive effect on the primary budget is significant. In 2021 the primary budget increases from a deficit of 0.7 per cent of GDP in the absence of a tax increase to a surplus of 3.3 per cent of GDP in the presence of a tax increase. Even in 2040 where the dependency ratio has a local maximum, a primary surplus of 0.3 per cent of GDP prevails. After 2040 expenditures grow relative to GDP due to the mentioned effect of double ageing, whereas the growth rate of revenues relative to GDP is gradually reduced. This turns the primary public budget into a deficit, which is maintained throughout the time horizon of the analysis.

– Figure 4 about here –

The long period of primary surpluses that lasts until around 2060 generates

¹²If fiscal sustainability is to be achieved by a reduction in public spending that is phased in during the same ten year period, the necessary permanent reduction amounts to 3.7 percent of GDP.

an accumulation of public wealth. By 2061, the net public wealth amounts to 115 per cent of GDP and it is almost stabilised at that level.

The demographic change implies an increasing expenditure profile relative to GDP, whereas revenues as a share of GDP are relatively constant. Hence, since the change is permanent it follows that the wealth accumulation during the initial period has to be significant to generate sufficient interest income to permanently finance the gap between revenue and expenditures.

The extent to which such pre-funding makes sense depends both on the demographic changes and their cause. If the demographic change is “temporary”, the funding creates a buffer fund by ensuring some consolidation prior to the demographic change, and allowing for some debt accumulation afterwards. Thereby the burden of the demographic changes is shared between current and future generations.

However, if – as in the present case – the change is of a more permanent kind, the needed consolidation is not only larger, but it also implies that current generations to a large extent contributes to the financing of future welfare arrangements. The latter raises important equity issues. Since the major reason for a change in the demographic composition of the Danish population and hence the fiscal sustainability problem is an increase in life expectancy, it is not clear from an equity point of view whether the pursuit of a savings strategy is particularly wise. This is so since it essentially implies that current generations are going to contribute to the financing of the longer lives of future generations.

4.2 Robustness

A pre-funding strategy is based on forecasts of future expenditures and revenues that by nature are highly uncertain. This section discusses the robustness of the strategy with respect to essential demographic and economic variables, see Table 4.

– Table 4 about here –

Demographic changes We have seen that changes in life expectancy tend to generate significant effects on the dependency ratio, whereas changes in fertility and migration have less significant effects. This is expected also to be the case with respect to the necessary adjustment in the base tax rate to

ensure fiscal sustainability. The results in Table 4 are consistent with these findings.

The needed increase in the base tax rate becomes 16,0 percentage points if the annual increase in life expectancy is doubled from 0.1 year annually to 0.2 years, i.e. if it is assumed that the future growth rate in life expectancy in Denmark corresponds to the average growth rate for Western Europe.

The large effect of an increase in life expectancy on fiscal sustainability appears because the dependency ratio increases by 10 per cent in the long run compared to the baseline, cf. Figure 2. This implies that also the expenditure-GDP ratio gradually grows to a higher level. The necessary pre-funding therefore increases significantly. Compared to the baseline, the stock of public wealth needs to be increased by 100 per cent of GDP in 2060. This implies that public wealth is twice as large as GDP in this scenario.

If on the other hand no increases in life expectancy are assumed, then Danish fiscal policy is almost sustainable. In this case, the necessary increase in the base tax rate is as low as 1.4 percentage point. Similarly, pre-funding becomes very low and almost no increase in the stock of public wealth is required. Thus, a policy based on pre-funding is highly sensitive to the growth in life expectancy.

Increases in the total fertility and immigration were found to have only marginal effects on the dependency ratio. This is reflected in the economic results where fiscal sustainability is found to be rather insensitive to these changes. Increasing total fertility by 0.1 implies that the increase in the base tax rate necessary to ensure fiscal sustainability is 8.9 percentage points, which is only 0.2 percentage point higher than in the baseline. Thus, an increase in the birth rate does not appear attractive from the perspective of fiscal sustainability.

Increased immigration from more developed countries is often seen as a possible solution to the fiscal sustainability problem. However, an increase in this type of immigration by 33 per cent is almost neutral to the Danish sustainability problem. The necessary increase in the base tax rate to ensure fiscal sustainability is 8.6 per cent in this case, which is 0.1 percentage points less than in the baseline case. The improvement is less than one would expect from the impact on the dependency ratio. This is mainly due to the fact that the labour market participation rate for female immigrants from more developed countries is significantly lower than for females of Danish origin. Therefore the net-contribution from an average immigrant from a more developed country is

lower than for an individual of Danish origin.¹³

Changes in economic variables The pre-funding strategy combined with the permanent nature of the ageing problem implies, as shown above, that a public stock of wealth is accumulated such that the interest payments partly finance future expenses. Therefore fiscal sustainability becomes highly sensitive to changes in the interest rate.¹⁴ A permanently higher interest rate implies that interest payments on the public stock of wealth increases and furthermore, the same is true for the interest payments on the accumulated stock of pension savings in private pension funds. Since pension payments from the funds are taxable, approximately half of the accumulated wealth in the funds is deferred taxes. So both future public revenues and future public interest income is increased in case of a higher rate of interest. In addition to these direct effects, the traditional indirect effects on economic activity of an increased rate of interest appear. It reduces the capital labour ratio and also the wage rate in the economy. This reduces both public revenue and public expenditures (through the indexation to the wage rate). These parallel changes in revenues and expenditures imply that the indirect effects on the public budget are minor compared to the direct effects of the higher interest rate. If the interest rate is increased by 1.0 percentage point, the necessary increase in the base tax rate to ensure fiscal sustainability is reduced to 5.0 percentage points which is a reduction of 3.7 percentage points compared to the baseline. Thus, sustainability is highly sensitive to the rate of interest. This is, however, only partly due to the pre-funding. Another, and more important, reason is that a significant part of the accumulated assets in private pension funds are deferred taxes.

Similarly, the fiscal sustainability is highly sensitive to changes in the growth rate of productivity. At the outset, this sensitivity is reduced by the fact that public expenditures are indexed to the wage rate.¹⁵ Therefore, an in-

¹³A similar, but less pronounced, reduction in the labour market participation rate is found for female descendants of immigrant from more developed countries.

¹⁴The relevant measure here is the growth-adjusted real rate of interest. This rate is 0.9 percent in the projection. This is based on an average over the period 1924-1999 (Nielsen and Risager, 2001). In addition, a real risk premium of 3.0 percent on share is used. The growth adjusted yield after tax of a pension fund with 40 percent of the wealth in shares is 1.2 percent.

¹⁵More precisely, public transfer payments (pension benefits, unemployment benefits, cash

crease in productivity tends to increase both expenditures and revenues. Two effects of the change in productivity growth remain. First, higher productivity growth reduces the growth-adjusted real rate of interest. Second, since ageing implies a future reduction in the labour force (and therefore a fall in future tax revenues) and an increase in the number of pensioners (and therefore a rise in expenditures), there is a “double loss” for the public sector following an increase in productivity growth. Both effects work in the same direction, and the sensitivity of fiscal sustainability with respect to growth is considerable - and even higher than with respect to the interest rate. An increase in productivity growth of 0.5 per cent implies that the necessary increase in the base tax rate to obtain fiscal sustainability becomes 12.8 percentage points. This is 4.1 percentage points higher than in the baseline.

Fiscal sustainability is also highly sensitive to the assumption concerning the future annual number of working hours. The baseline of this analysis is based the combined assumption of constant age, gender and origin distributed labour market participation rates and of constant annual working time per average employed individual distributed across the same groups. Contrary to this assumption, average annual working time has been reduced by 0.3 per cent annually over the last 25 years. Assuming that annual working hours are reduced by 0.15 per cent each year for the next 100 years implies that the necessary increase in the base tax rate to ensure fiscal sustainability becomes 15.1 percentage points, compared to the 8.7 percentage point in the baseline case. This significant increase in the necessary adjustment is due to the fact that the growth in the public provision of services is not reduced when the number of working hours and therefore the tax base is reduced. Public benefits, on the other hand, are indexed to annual salary and the growth rate in these expenditures is therefore reduced along with the number of working hours.

In sum, no substantial fiscal sustainability problem exists if life expectancy remains constant. Pursuing a pre-funding strategy becomes increasingly difficult with increasing growth in life expectancy, since the ageing problem not only has a temporary component but also a permanent effect on the dependency ratio. This implies that the accumulated fund has to finance expenditures in excess of revenue throughout the time horizon. Fiscal sustainability is also highly sensitive to the interest rate and to productivity growth. In

benefits etc.) are indexed to changes in real wages. This scheme is given by law ("satsreguleringsloven"). Also, the salaries of public employees grow in line with salaries of employees in the private sector.

both cases, pursuing a pre-funding strategy increases the sensitivity of fiscal sustainability. Finally, if productivity growth and the associated increase in wealth leads to a reduction in the labour supply, this increases the sensitivity of fiscal sustainability with respect to productivity growth. This additional sensitivity is not affected by a pre-funding strategy.

4.3 Risk sharing

As already pointed out, the design of fiscal policy may have important implications for risk sharing. To discuss this issue further it is essential to distinguish between the trend and the risk in, e.g., demographic projections. How to cope with the trend change in, say, lifetime is basically a question of intergenerational distribution. As concerns risk, the question is how to exploit the scope via the public budget of diversifying risk across various generations.

A key problem for the savings strategy is to assess the needed consolidation, since the strategy aims at making it possible for future generations to have the same benefit and contribution rules.¹⁶ It is obvious from the previous subsection that both demographic projections and calculations of fiscal sustainability are highly uncertain. To determine the needed consolidation it is necessary to base policy on a particular projection. This raises various problems.

First, if e.g. demographic projections change frequently there would be frequent changes in benefits and/or contribution rules, but this runs counter to the main objective of this strategy, namely to keep these rules stable across different generations. The importance of this point is substantial, as seen by the large change in the demographic projections from the beginning of the century till the latest population forecast, i.e. since the formulation of “DK 2010”. The need for pre-funding is thus much larger today than it was perceived just a few years ago.

Secondly, policy changes are irreversible in the sense that the effects on past generations cannot be undone. With an analogy to the investments literature it is thus possible to argue that there is a value of waiting to accumulate further information before policy changes are undertaken. Auerbach and Hassett (2002) consider a situation where there are political impediments to frequent policy change. They show that this leads to inertia in policy and may imply

¹⁶Note that this would preserve the option for future generations possibilities of making a choice. If they choose something different it must be because they prefer this to maintaining the existing system.

that policy changes are “delayed”.

Finally, it is necessary to determine the needed consolidation or pre-funding. If the needed consolidation is calculated on a certainty equivalence basis it means that all risk is transferred to future generations. The only way current generations can participate in risk sharing with future generations is via precautionary savings, i.e. creating a buffer fund. Auerbach and Hassett (1999) show that sharing of productivity risks calls for precautionary savings when utility displays constant relative risk aversion. However, for the various types of risks involved, it is not clear whether an argument for precautionary savings is in general supported. The literature on precautionary savings leaves few unambiguous results (Lippman and McCall, 1981).¹⁷

4.4 Credibility

The savings strategy implies that public finances have to be tightly controlled, that is, public consumption growth should be kept low (to avoid increase in welfare levels, and thus even larger future burdens) and the budget should be kept in surplus for decades. Accordingly, the public accumulates wealth at the same time as politicians should convince the electorate that there is no financial room for welfare improvements. This is not an easy task and there is thus a fundamental credibility problem: will sufficient savings be accumulated, or will it induce expenditure increases? This problem can partly be solved if the savings takes places in a special fund with clearly defined rules for how funds can be used.

5 Conclusions and directions for an alternative strategy

The Danish medium-to-long-term fiscal strategy “DK 2010” has been very important and successful in obtaining fiscal discipline by formulating medium term goals for fiscal and structural adjustment.

¹⁷Another literature focuses on precautionary saving arising in a situation with capital market imperfections and risk (Aiyagari, 1994). A buffer stock motive for saving can also arise from the risk of facing a very low (eventually zero) income (Carroll, 2001). Consumers wanting to smooth consumption will in this case have an “aversion” against borrowing too much. In terms of fiscal policy this provides an argument for debt or deficit limits.

On the other hand, the formulation of the plan implies a front-loading of fiscal adjustment which may not be optimal for several reasons. First, even if current fiscal policy is not far from the medium-term goals, the present analysis found that a significant adjustment in fiscal policy is necessary to obtain fiscal sustainability by a front-loading strategy. The necessary permanent increase in the base tax rate is 8.7 percentage points. This shows that the strategy is very sensitive to the forecast used to formulate the medium-term goals. To explore this issue further, the paper considered changes in key demographic and economic variables. The results point to a major sensitivity with respect to the growth in life expectancy, interest rate, and rate of productivity growth. Second, intergenerational distribution is affected by the pre-funding strategy, since current generations generate very large public surpluses that are accumulated to a stock of public wealth which generates interest income that is distributed to all future generations. Third, the lack of robustness of the fiscal sustainability to key variables implies that there may be frequent changes in benefits and/or contribution rules, but this runs counter to the main objective of this strategy, namely to keep these rules stable across different generations. Fourth, is it credible to accumulate a large stock of public wealth while maintaining a tight fiscal policy in order to reduce future welfare increases?

A premise for the front-loading or savings strategy is that the same benefit and contribution rules should be maintained across generations. However, it is not obvious that this results in an acceptable distributional profile nor that it ensures an efficient diversification of risk.

An important question is thus which contingencies should be built into the benefit and contribution rule. Present rules include contingencies via income dependence (for the contribution side via tax payments and the benefit side via means testing of various pension supplements) which play a role in insuring both idiosyncratic and aggregate risks (Andersen and Dogonowski, 2002). More generally there are contingencies in the sense that the benefit side also includes needs-testing which is related to basic social insurance functions provided by the welfare arrangements.

One potential contingency would be to let benefits and contribution depend on changes in life expectancy. This is motivated by the issue, which has already been raised, namely that the major problem is the increased life expectancy of future generations and that it is questionable to what extent current generations should contribute to the financing hereof. Under the reasonable assumption that a longer life is considered welfare enhancing, the ar-

gument may go the other way. One way to separate distributional issues from risk diversification would be to let e.g. the pension entitlement be a fixed sum which is converted to an annual benefit depending on lifetime (possibly merged with an insurance arrangement), i.e. in present value terms all get the same pension regardless of life length. This type of adjustment is found in private pension contracts. However, this implies that all risk associated with life-time is carried by the individual and this scheme therefore has unfortunate implications for risk sharing.

Moreover, taking the broader perspective of an extended welfare state like the Danish one, it is important that the problem is not only confined to the benefit side but also to the contributions made over lifetime via tax payments. With existing rules, longer lifetime will imply an increase in the proportion of life for which the individual is a net-recipient from welfare arrangements, primarily because there are fixed age limits for eligibility to early retirement and pensions. It is possible to make both benefits and contributions contingent on expected life length by letting the age limits for retirement and pension (the early retirement scheme has an age limit at 60 years of age, and the public pension scheme at 65 years of age) follow expected lifetime. Since current demographic projections imply that future generations can expect longer lifetimes, it follows that such a scheme effectively means that age limits become systematically linked to the generation to which an individual belongs (higher for younger generations). If so, generations expecting to live longer would be net-contributors for a larger share of their life, since they will be active in the labour market longer and postpone the time when they are entitled to pension benefits. Thereby, a better balance is ensured between the number of years the person contributes to the system and benefits from the system. Without such a regulation, the share of life for which one is a net-contributor will fall as life expectancy increases.

Such a scheme still leaves risk diversification of unanticipated changes in lifetime, since the age limits are made dependent on expected lifetime and therefore unanticipated changes will be absorbed by the public budget. Part of the risk will also be resolved over time and it is therefore possibly at intervals - say every 10 years - to consider the appropriate adjustment. When adjustments to changes in projections of expected lifetime are made well in advance of the pension age, it follows that the risk arising from unanticipated changes is smoothed over current and future generations. Finally, it should be noted that such a scheme may still leave a financial problem, since the net financial

consequences of postponing labour market retirement by one year on average may not balance the total expenditures (transfers plus public services such as healthcare related expenditures) following from adding one more year to expected lifetime.

Indexing benefits and contributions to expected lifetime implies a gradual adjustment in the sense that it does not require a substantial pre-funding, but rather aims at an adjustment over time of net-expenditures of the welfare state so as not to produce a tendency towards systematic budget deficit in line with ageing and longer lifetime. As such, this strategy does not raise the same problems as the savings strategy. However, it is essential that the indexation scheme is introduced immediately to avoid sudden changes in welfare arrangements and to make clear how sustainable finances are ensured.

Finally, it should be pointed out that a policy announcement of subjecting the age limits for retirement and pension benefits to changes in longevity may also suffer from a credibility problem. The search for solutions to mitigate this problem seems to be an important task for future research.

References

- AIYAGARI, S. (1994): “Uninsured Idiosyncratic Risk and Aggregate Saving,” *Quarterly Journal of Economics*, 109, 659–684.
- ALHO, J., S. E. H. JENSEN, J. LASSILA, AND T. VALKONEN (2003): “Controlling the Effects of Demographic Risks: The Role of Pension Indexation Schemes,” Discussion Paper 2003-12, Centre for Economic and Business Research, Copenhagen.
- ALHO, J., AND B. SPENCER (1985): “Uncertain Population Forecasting,” *Journal of the American Statistical Association*, 80, 306–314.
- ANDERSEN, T. M., AND R. DOGONOWSKI (2002): “Social Insurance and the Public Budget,” *Economica*, 69, 415–432.
- AUERBACH, A., AND K. HASSETT (2002a): “Fiscal Policy and Uncertainty,” *International Finance*, 5(2), 229–242.
- (2002b): “Optimal Long-Run Fiscal Policy: Constraints, Preferences and the Resolution of Uncertainty,” NBER Working Paper 7036, National Bureau of Economic Research, Boston, Mass.

- AUERBACH, A. J., AND K. HASSETT (2001): “Uncertainty and the Design of Long-Run Fiscal Policy,” in *Demographic Change and Fiscal Policy*, ed. by A. J. Auerbach, and R. D. Lee. Cambridge University Press, Cambridge, UK.
- BOERI, T., AND H. BRUECKER (2001): “Eastern Enlargement and EU-Labour Markets: Perceptions, Challenges and Opportunities,” *World Economics*, 2(1).
- BOHN, H. (2001): “Social Security and Demographic Uncertainty: The Risk-Sharing Properties of Alternative Policies,” in *Risk Aspects of Investment Based Social Security Reform*, ed. by J. Campbell, and M. Feldstein. University of Chicago Press, Chicago.
- ESPING-ANDERSEN, G. (1990): *The Three Worlds of Welfare Capitalism*. Policy Press, Cambridge, UK.
- EUROPEAN COMMISSION (2000): “The Impact of Ageing Populations on Public Pension Systems,” Progress report to the Ecofin council, EU Commission, Brussels.
- GORDON, R., AND H. VARIAN (1988): “Intragenerational Risk Sharing,” *Journal of Public Economics*, 37, 185–202.
- HALDRUP, N. (2004): “Estimation af middellevetider for mænd og kvinder i Danmark, 2002-2010, baseret på Lee-Carter metoden,” Arbejdsrapport 2004:3, Velfærdskommissionen.
- HANSEN, N. P., S. E. H. JENSEN, AND M. JUNGE (1999): “Government Solvency, Social Security and Debt Reduction in Denmark,” in *Macroeconomic Perspectives on the Danish Economy*, ed. by T. M. Andersen, S. E. H. Jensen, and O. Risager, chap. 7. Macmillan Press, London, UK.
- JENSEN, S. E. H., U. NØDGAARD, AND L. H. PEDERSEN (2001): “Fiscal Sustainability and Generational Burden Sharing in Denmark,” *Nordic Journal of Political Economy*, 28(1), 43–60.
- KNUDSEN, M., L. PEDERSEN, T. PETERSEN, P. STEPHENSEN, AND P. TRIER (1998): “Danish Rational Economic Agents Model - DREAM Ver. 1.2,” Working paper, www.dreammodel.dk, DREAM, Copenhagen.
- KNUDSEN, M. B., L. H. PEDERSEN, T. W. PETERSEN, P. STEPHENSEN, AND P. TRIER (1999): “Dynamic Calibration of a CGE-Model with a Demographic Application,” Working paper, www.dreammodel.dk, DREAM, Copenhagen.
- LEE, R., AND L. CARTER (1992): “Modeling and Forecasting the Time Series of U.S. Mortality,” *Journal of the American Statistical Association*, 87, 659–671.

- LEE, R., AND S. TULJAPURKAR (2001): "Population Forecasting for Fiscal Planning: Issues and Innovations," in *Demographic Change and Fiscal Policy*, ed. by A. Auerbach, and R. Lee, chap. 2. Cambridge University Press, Cambridge, UK.
- LIPPMAN, S., AND J. MCCALL (1981): "The Economics of Uncertainty: Selected Topics and Probabilistic Methods," in *Handbook of Mathematical Economics*, ed. by K. J. Arrow, and M. D. Intriligator, chap. 6. North-Holland, Amsterdam.
- MASSON, P., AND M. MUSSA (1995): "Long-Term Tendencies in Budget Deficits and Debt," in *Budget Deficits and Debt: Issues and Options*, ed. by T. Hoenig. Federal Reserve Bank of Kansas City.
- NIELSEN, S., AND O. RISAGER (2001): "Stock Returns and Bond Yields in Denmark 1922-1999," *Scandinavian Economic History Review*, 49(1), 63–82.
- PEDERSEN, L., P. STEPHENSEN, AND P. TRIER (1999): "A CGE Analysis of the Danish Ageing Problem," Working paper, www.dreammodel.dk, DREAM, Copenhagen.
- TANZI, V., AND L. SCHUKNECHT (2000): *Public Spending in the 20th Century - A Global Perspective*. Cambridge University Press, Cambridge, UK.
- UNITED NATIONS (2004): *World Population in 2300*. UN, New York.
- WELFARE COMMISSION (2004): *Fremtidens velfærd kommer ikke af sig selv*. Velfærdskommissionen, Copenhagen, Denmark.

Table 1: Public expenditures and revenues: 1971-2001

	1971	1976	1981	1986	1991	1996	2001
	-----Percentage of GDP-----						
Total expenditures	41,9	44,8	52,7	45,1	50,1	52,9	50,2
Transfer payments	11,0	13,1	17,2	15,1	18,4	19,8	17,3
Consumption	22,2	24,7	28,4	24,6	25,7	25,9	25,9
Other expenditures	8,7	7,0	7,1	5,4	6,0	7,2	7,0
Total revenues	46,9	44,1	48,5	53,5	51,6	54,7	54,5
Surplus	5,1	-0,7	-4,1	8,4	1,5	1,8	4,3
Net interest payments	0,0	-0,9	1,8	5,1	3,9	2,8	1,4
Gross debt	12,6	11,1	48,4	66,7	62,5	65,1	45,4

Note: The old definition of gross debt according to the Growth and Stability Pact.

Source: Own calculations on the DREAM-model.

Table 2: Macroeconomic projection with unchanged welfare arrangements

	2001	2001	2006	2011	2021	2041	2061
	-----Index in constant prices, 2001=100-----						
	Billion						
	Euro						
Private consumption	68,2	100,0	116,3	126,5	150,8	206,4	287,8
Real GDP at factor prices	153,1	100,0	109,8	119,3	138,4	183,2	254,6
Unemployment	0,7	5,2	5,1	4,7	4,8	4,9	5,1
Employment		100,0	100,2	98,6	95,6	86,9	82,5
Private sector		100,0	97,1	95,6	91,2	79,1	74,2
Construction sector		100,0	115,2	106,2	99,6	90,7	87,0
Public sector		100,0	102,5	102,8	103,6	102,4	98,8
Capital stock							
Private sector		100,0	111,2	121,4	141,3	182,7	251,7
Construction sector		100,0	131,2	140,1	160,1	217,3	307,0
Public sector		100,0	99,1	98,4	97,9	140,5	198,7
Foreign assets**	-31,5	-17,7	-13,8	-5,6	6,6	-12,9	-54,8

*Levels are in percentages.

**Index is foreign assets as a percentage of nominal GDP at factor prices.

Source: Own calculations on the DREAM-model.

Table 3: Public expenditures and revenues: 2001-2061

	2001	2001	2006	2011	2021	2041	2061
	Billion Euro		-----Percentage of GDP-----				
Total expenditures	89,5	50,2	49,9	51,3	53,8	58,7	59,4
Transfer payments	30,9	17,3	17,1	17,9	19,6	21,4	21,5
Individual public consumption	32,5	18,3	18,3	19,0	20,0	22,8	23,4
Collective public consumption	13,6	7,6	7,7	7,7	7,7	7,7	7,7
Other expenditure	12,5	7,0	6,8	6,7	6,5	6,8	6,8
Total revenues	97,1	54,5	53,1	52,6	53,1	55,2	55,5
Surplus	7,6	4,3	3,2	1,3	-0,7	-3,5	-3,8
Net interest payments	2,5	1,4	0,3	-0,6	-1,2	0,1	2,7
Net debt	11,5	6,5	-9,4	-17,4	-19,6	30,0	97,1

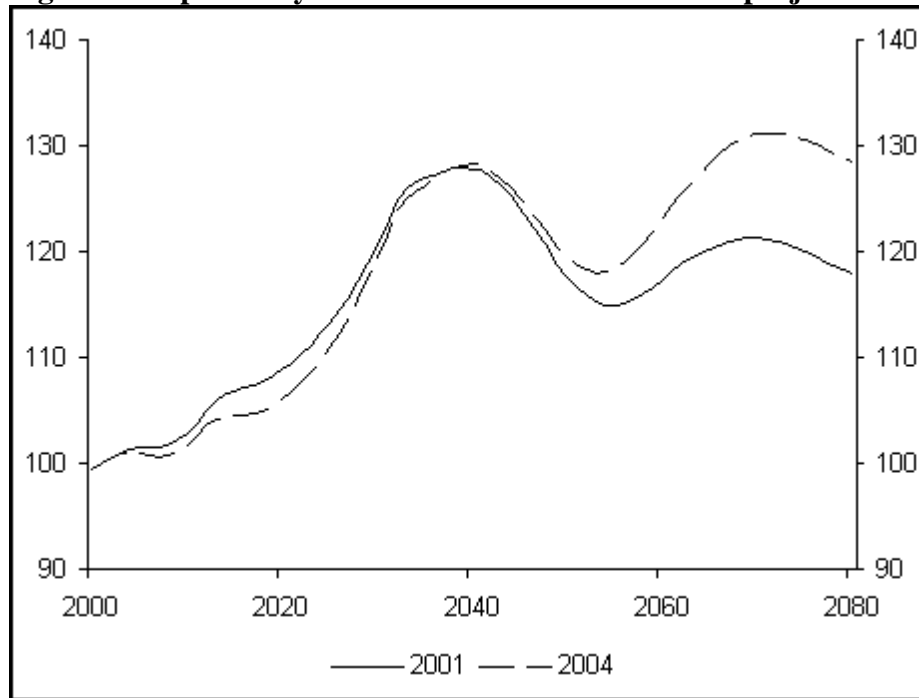
Source: Own calculations on the DREAM-model.

Table 4: Robustness of the necessary adjustment

	Tax increase in percentage points
The Danish Welfare Commission base scenario	8,7
Reduced problem	
Constant life expectancy	1,6
1 percentage point increase in real interest rate	5,0
Unchanged problem	
Higher birth rate, fertility + 0.1	8,9
Extra immigration, + 5000 from more developed countries	8,5
Increased problem	
UN life expectancy	16,0
Extra 0.5 growth in real GDP at factor prices	12,8
Extra working time reduction of 0.15 per cent per year	15,1

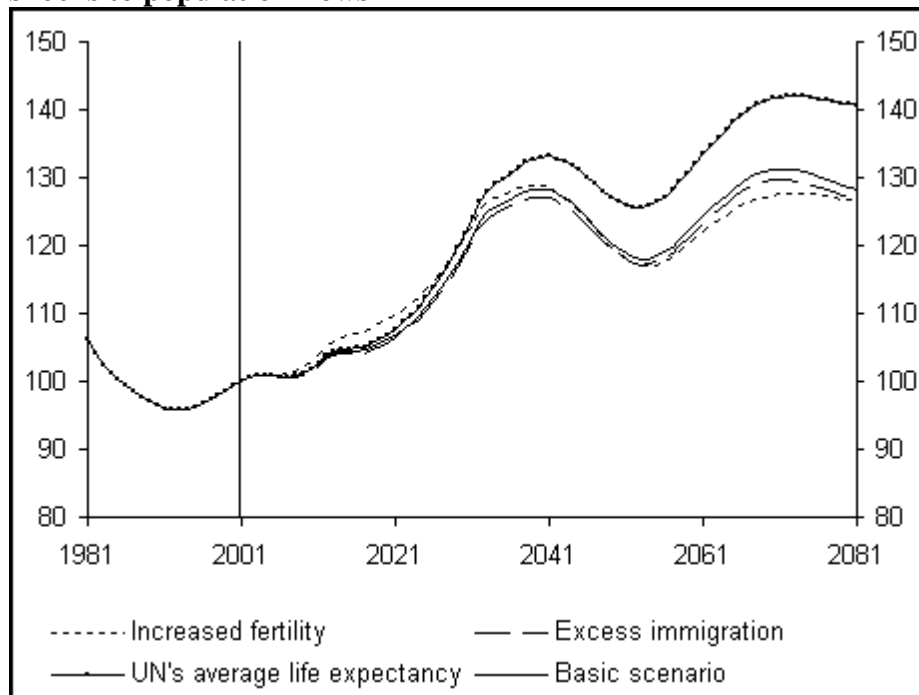
Source: Own calculations on the DREAM-model.

Figure 1: Dependency ratios in the 2001 and the 2004 projection



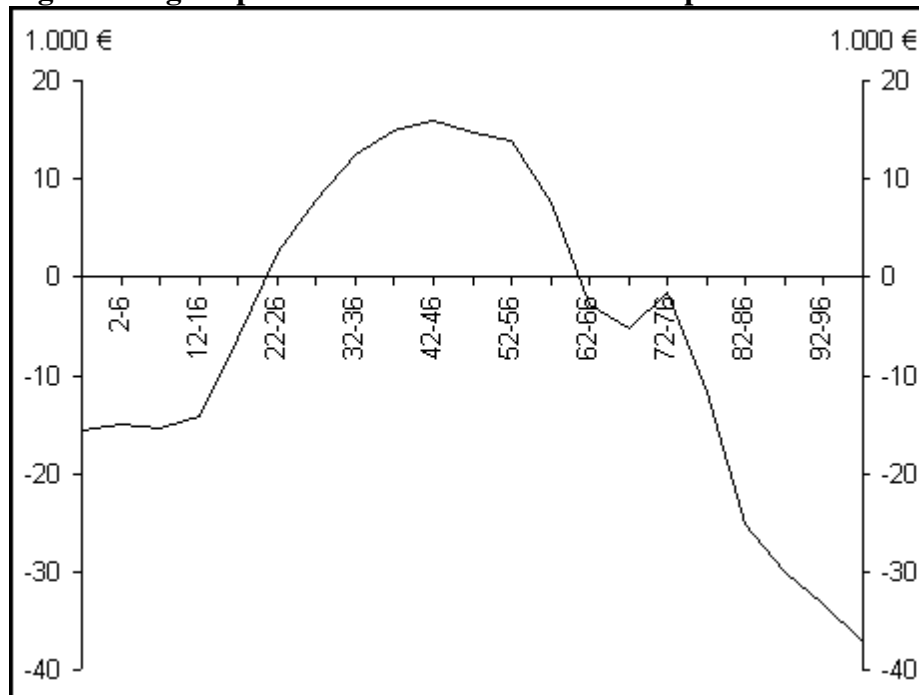
Source: The Danish Welfare Commission and DREAM.

Figure 2: The effects on the dependency ratio from permanent shocks to population flows



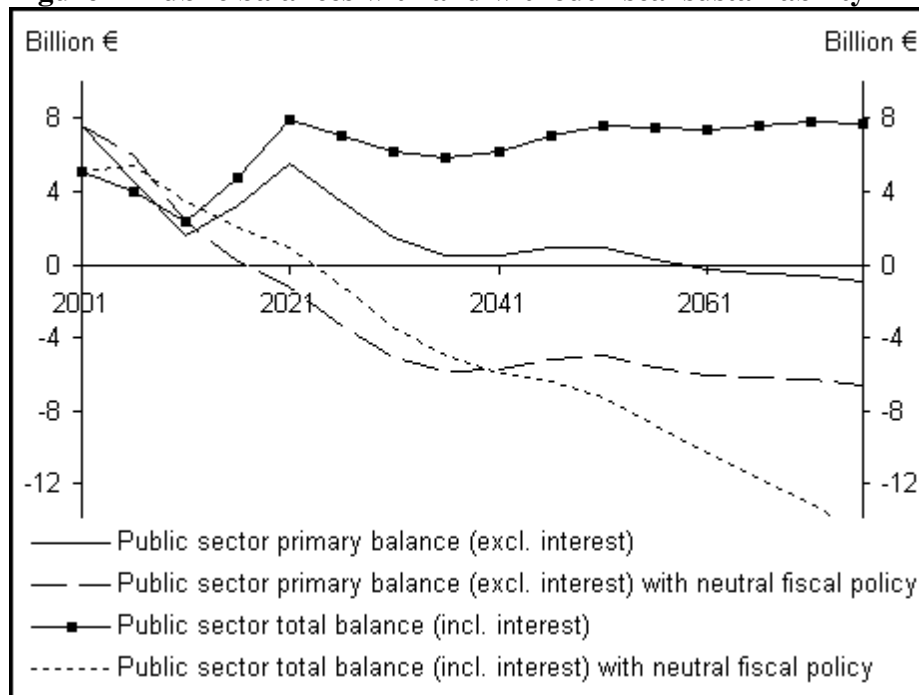
Source: The Danish Welfare Commission; DREAM and UN (2004).

Figure 3: Age dependent net-contributions to the public sector 2001



Note: The average net contributions by persons aged 67-76 are larger than the surrounding age groups due to technical assumptions in DREAM regarding tax on funded capital pensions and tax on bequests
 Source: Own calculations on the DREAM-model.

Figure 4: Public balances with and without fiscal sustainability



Source: Own calculations on the DREAM-model.