Fiscal Sustainability, Aggregate Savings, and Occupational Pensions*

Michael Andersen, DREAM
Lars Haagen Pedersen, DREAM†
Svend E. Hougaard Jensen, CEBR

MAY 2002

Abstract

The occupational pension system in Denmark is found to have significant impact on the sustainability of Danish fiscal policy. Reducing contributions by 50 percent increases the sustainable income tax rate by 1.3 percentage points. The lower contributions reduce total social welfare by 2.7 percent of GDP in 1998. Although all future generations receive lower welfare, the generational accounts are improved for these generations. There are three main distortions, which accounts for the effects: Danish public tranfers are indexed to the wage rate net of contributions to the occupational pension system, capital income in the occupational pension system is subsidised relative to personal capital income, and finally, the occupational pension savings are not perfect substitutes to private savings due to both the construction of the occupational pension system and to imperfections in the capital market. The size of the effect of each of the three elements per se is analyzed.

Keywords: Fiscal Policy, Generational Accounts, Ageing, Pension Reform, Denmark.
JEL: E62, H66

*Financial support from the EPRU Network is gratefully acknowledged.
†Corresponding author: lhp@dreammodel.dk

1 Introduction

During the 1990s most European countries have witnessed an increase in the contributions to funded pension schemes. In Denmark there has been a substantial increase in the contributions due to the introduction of occupational pension sch emes for blue collar workers in the private sector. By 1995 occupational pension contributions was included in all bargaining agreements in Denmark. Contribution rates for blue-collar workers are still increasing. Currently contributions for this group of employees are 7 percent of the wage and are expected to increase to 9 percent in 2004.

The present paper first analyses to which extend the funded pension system contributes to a reduction in the financial burden of the demographic ageing of the society. Secondly, we focus upon the effect of the funded pension system on the intergenerational distribution of the fiscal burden for a given economic policy using a generational accounting system for future generations. This is compared to the effect on the intergenerational distribution of welfare from the funded pension system using a standard equivalent variations measure. Finally, we apply a social welfare function, defined as the sum of discounted equivalent variations for all future generations, to determine whether an expansion of the occupational pension system generates an increase in overall welfare.

The analysis is conducted using the dynamic OLG-CGE model, DREAM (Danish Rational Economic Agents Model), which is constructed to generate a path of temporary perfect foresight equilibria converging to a steady state from an initial non-steady state temporary equilibrium. The focus of DREAM is the behaviour of the agents in the economy given that representative families evolve according to an exogenous demographic forecast.

A base scenario is constructed. In this scenario the occupational pension system in Denmark gradually matures given a minor increase in current contribution rates. The government follows a tax smoothing policy from 2008 and chooses a permanently fixed vector of tax rates. The tax rates are chosen to maintain the structure of current income taxation in Denmark and the level of the income tax rates are set so that the government fulfils its intertemporal budget constraint. See Jensen, Nødgaard and Pedersen (2002) for a presentation of the base scenario.

The base scenario is compared to a "counterfactual" scenario where the average contribution rate of the employees in the economy is reduced by 50 percent in 2008. This almost amounts to a complete removal of the occupational pensions of blue collar workers. However, those generations who has contributed to the pension funds from the 1990s will collect the actuarially

fair pensions based on these contributions as they retire. For future generations, on the other hand, the counterfactual is comparable to a situation without the recent expansion in contributions. In the counterfactual scenario the government smooths taxes from 2008 and follows the same expenditure policy as in the base scenario. The result is that for fiscal policy to be sustainable in the counterfactual case the income tax rates has to increase by an additional 1,3 percentage points compared to the base scenario. Thus the first conclusion is that the expansion of the funded pension system contributes significantly to reduction in the financial burden of the demographic ageing.

The distribution of the financial burden is affected as well. As will be explained, the reduction of the contributions to occupational pension schemes - by construction in DREAM - reduces the overall savings rate in the economy. Therefore future generations are poorer in the counterfactual than in the base scenario. This implies that in the counterfactual the tax smoothing policy does not shift the financial burden of the dramatic demographic change from 2020 to 2040 on to future generations in the same proportion as is the case in the base scenario. The reduction in the financial burden of the public debt of the future generations implies that these generations have higher generational accounts in the counterfactual than in the base scenario. Currently living young generations and generations born in the near future are hit by the extra increase in the sustainable tax rates and their generational account are lower in the counterfactual than in base scenario. Finally, the generations who become retirees in 2008 and later obtain an increase in their generational accounts in the counterfactual compared to the base scenario. This is due to the indexation rule of Danish social security benefits - including social pensions. These are indexed to the wage rate net of contributions to occupational pension schemes. Therefore the reduction in the contribution rate increases social security pensions and this is sufficient to dominate the negative effect from the increased sustainable tax rate for these elderly generations.

The distribution of welfare gains across generations as measured by the equivalent variations differ significantly from the distribution gains in the generational accounts. As already noted future generations are poorer in the counterfactual scenario and therefore the utility of these generations is lower than in the base scenario leading to a negative EV measure. The foreseen lower increase in wealth of future generations in the counterfactual also affects currently living generations as the less prosperous expectations are capitalized into the a lower price of the fixed factor, land, which in combination with dwellings generates the durable good, housing. Generations

who are middle-aged in 2008 when the "unforeseen" reduction appears, are net-buyers of the housing good. Therefore, they obtain a "capital gain" from the reduced prices on housing. For four of these 5-year age-groups the gain is sufficiently large to dominate the negative effect on welfare from the increased sustainable tax rates and therefore these generations experience a positive EV measure. Finally, generations who are elderly in 2008 are net sellers of the durable housing good. Thus they experience a "capital loss" due to the lower prices on housing goods. This capital loss is sufficient to dominate the net gain from increased indexation of social security pensions. Elderly generations therefore experience a negative EV measure.

Comparing the changes in the generational accounts for the individual generations between the two scenarios with the EV measures of the generations, one obtains the striking result that for the vast majority of generations the two measures have different signs. This contradicts the widely held view that changes in the generational accounts may act as a proxy for welfare effects. In our case wealth and capital gain effects dominate the effects from generational accounts, making the latter a very poor indicator of welfare.

Our final result is that the total welfare measured by the social welfare function is *2.7* percent of GDP in factor prices lower in the counterfactual than in the base scenario. We may therefore conclude that the total financial burden of the demographic ageing is reduced and the total welfare is increased by the recent expansion of funded pension systems.

From here we proceed as follows. The next section offers a presentation of the Danish pension system and the modelling of occupational pension in DREAM. Section 3 presents the change in the macroeconomic, budgetary and generational variables given a 50 percent reduction in the contributions to occupational pension schemes. Section 4 presents a decomposition of the effects, and finally, concluding remarks are found in section 5.

2 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.[1] Social pensions - and other social benefits - are indexed to the wage rate net of contributions to the occupational pension schemes. Second, a mandated

[1]The social pensions are a combination of a flat-rate and an income-dependent part, which constitutes around 40 per cent of the average social pension in 1998. This indicates that only a minor fraction of the pensioners in 1998 had pension payments from the funded pension system.

funded general labour market pension scheme (ATP) covering all persons in the labour force.[2] Third, fully funded contribution-defined occupational 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.

2.1 Modelling occupational pensions

The occupational pension system in Denmark consists of a number of pension schemes that are specific for a given labour market segment defined by a collective bargaining agreement. Danish labour market pensions schemes are a combination of contribution and benefit defined systems. Retirement pensions are contributions defined whereas disablement, spouse, and child pensions are benefit defined. Retirement pensions are annual pensions paid to the person in question as long as the person remains alive. Retirement pensions are collective life insurance systems, so that any remaining stock of savings is property of the pension fund in case of a member's death. Contributions are part of the outcome of the wage bargaining in the labour market segment and therefore exogenous to the individual households. As a consequence, different labour market segments have different occupational pension schemes.

Historically, the occupational pension schemes were initiated within the labour market segments of academic employees during the 1950s. These schemes have contribution rates of 15 percent of the wage income and support the following types of pensions: retirement, disablement, spouse and child pension. In the 1960s, the occupational pension schemes were introduced to public employees with middle-range training, for instance teachers, nurses and nursery school teachers. These schemes typically have contribution rates of 12 percent of wage income and support the same types of pensions as the pension funds of academic workers. In the 1990s, the occupational pension schemes have been extended to cover all parts of the organised labour market. The large segments of blue collar workers currently make contributions of 7 percent to occupational pension schemes, but the rates are expected to reach 9 percent by 2004. Presently only retirement pension is offered by these pension schemes.

In general the occupational pension system in Denmark is non-matured,

[2]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.

as only the oldest pension schemes have pensioners who have paid (full) contributions through their entire working life. In the present model simulation the occupational pension system is not expected to mature until around year 2070. The non-mature status of the labour market pension systems in Denmark, also have 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.[3]

Both young pension funds with low contribution rates and more mature pension funds with higher contribution rates are modelled within DREAM as a unique collective occupational pension fund. We make the following assumptions: the contribution rate is equal to the average contribution rate (defined as total contributions relative to the relevant wage sum), all employed persons are members and all new entries to the pension schemes take place at the age of 22 (which on average may be considered a somewhat low entry age). The resulting pensions should therefore be interpreted as pensions of the average person within a given generation. DREAM's pension fund supports three types of pensions: retirement, disablement and spouse pension.

The collective life insurance nature of the retirement pensions system implies that a pension fund has the following budget constraint: the discounted value of total net-contributions to the retirement pension from a given birth cohort has to be equal to the discounted value of the total pension payment to the birth cohort in question.[4] Consider the intertemporal budget constraint of a birth cohort who is $y < A_R$ years old. For this age-group we may write the constraint in the standard form, stating that the difference between the discounted value of the total expected pension payment and the discounted value of the total expected future contributions is equal to the accumulated

[3]Observe that the positive effect on the public budget from the fact that the pension system becomes mature 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 pensions 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.

[4]In this presentation we ignore the actuarially fair insurances against disablement and death (spouse pensions). For a full documentation of the behaviour of the occupational pension funds in DREAM see Pedersen, Stephensen & Trier (1999).

stock of net contributions.

$$K_{y,t+y-A_0} = \sum_{x=A_R}^{120} M_{x,t+x-A_0} f^{RP}_{x,t+x-A_0} \prod_{s=t+y-A_0}^{t+x-A_0} (1+\tilde{r}_s) - \sum_{x=y+1}^{A_R-1} M_{x,t+x-A_0} I_{x,t+x-A_0} \prod_{s=t+y-A_0}^{t+x-A_0} (1+\tilde{r}_s) \quad (1)$$

where $K_{y,t+y-A_0}$ is accumulated stock of net-contributions of the cohort in question, A_0 is the entering age of the cohort in question, A^R is the retirement age, $M_{x,t+x-A_0}$ is number of members who are x years old at time $t+(x-A_0)$ (i.e. the cohort enters at time t), $I_{x,t+x-A_0}$ is average contribution per member of age x, $f^{RP}_{x,t+x-A_0}$ is average annual retirement pension per member of the given cohort, $\tilde{r}_{t+x-A_0}$ is after tax interest rate. By assumption the cohort in question is extinct at the age of 120 years.

Occupational pension funds in Denmark are regulated by the authorities. The pension fund calculates the pensions given the following principles of precaution:[5] **Low interest rate**. In its forecasts, the pension fund uses a *base interest rate,* $\bar{r}$, that is lower than the after tax interest rate $\tilde{r}_t$. A maximum level of $\bar{r}$ is approved by the authorities. This reduces the risk of promising too high pensions based on lower future interest rates than predicted. Each year a correction of the pension undertaking is made to take account for the fact that the achieved interest rate after tax in the specific year deviate from the base interest rate. **Constant future contributions.** The pension fund assumes the future contributions to stay at the present level. Each year a correction of the pension undertaking is made to take account for the fact that the achieved contributions in the specific year deviate from the contributions of the previous year. **Constant future pension undertakings**. In the forecasts the pension fund assumes constant pension undertakings over time. Forecasts are corrected each year according to the rules stated above.

Inserting the principles of precaution and considering a cohort that is $y < A_R$ years old the budget constraint for this cohort at time $t+(y-A_0)$

[5]In addition to the precautionary principles listed below actual pension funds also apply precautionary principles with respect to the forecast of age and gender specific death and disablement probabilities. The present analysis assumes that these propabilities are forecasted correctly.

may be written as

$$\begin{aligned} f^{UP}_{y,t+y-A_0} &= \frac{K_{y,t+y-A_0}}{\sum_{x=A_R}^{120} M_{x,t+x-A_0}\left(1+\bar{r}\right)^{x-y}} \\ &\quad + I_{y,t+y-A_0}\frac{\sum_{x=y+1}^{A_R-1} M_{x,t+x-A_0}\left(1+\bar{r}\right)^{x-y}}{\sum_{x=A_R}^{120} M_{x,t+x-A_0}\left(1+\bar{r}\right)^{x-y}} \end{aligned} \tag{2}$$

where $f^{UP}_{y,t+y-A_0}$ is the pension undertaking of the cohort that is y years old at time $t+y-A_0$.

By assumption the pension fund has perfect foresight with respect to the demographic development and is therefore able to foresee the evolution in the stock of members. Given knowledge of the initial age distribution of the stock of pension savings and the initial contributions of each generation, the relation (2) generates a distribution of initial pension undertakings across generations. Observe that pension undertakings for new member are found by letting $y = A_0$.

Pension undertakings are updated each period according to the forecast rules listed above. Using these rules and leading relation (2) one period implies that the updating rule may be given as the following difference (See Pedersen, Stephensen & Trier (1999) for the derivation)

$$\begin{aligned} f^{UP}_{y+1,t+y+1-A_0} &= \left(1+g_{t+y+1-A_0}\right) f^{UP}_{y,t+y-A_0} + \\ &\quad \xi^{I}_{y+1}\left(I_{y+1,t+y+1-A_0} - \left(1+g_{t+y-A_0}\right) I_{y,t+y-A_0}\right) \end{aligned} \tag{3}$$

where

$$\begin{aligned} g_{t+y+1-A_0} &\equiv \frac{\tilde{r}_{t+y+1-A_0} - \bar{r}}{1+\bar{r}} \\ \xi^{I}_{y+1,t+y+1-A_0} &\equiv \frac{\sum_{x=y+1}^{A_R-1} M_{x,t+x-A_0}\left(1+\bar{r}\right)^{x-y}}{\sum_{x=A_R}^{120} M_{x,t+x-A_0}\left(1+\bar{r}\right)^{x-y}} \end{aligned}$$

The updating of the pension undertaking in relation (3) corrects for the two types of forecast errors of the pension fund. First, $g_{t+y+1-A_0}$ corrects for the difference between the base interest rate used in forecast calculations and the actual interest rate net of taxes obtained by the pension fund in the updating period. Second, the last term in relation (3) updates the net-contributions to the current level of contributions. Since this level is fixed in the forecast of the remaining part of the working life, the age dependent fraction $\xi^{I}_{y+1,t+y+1-A_0}$ accounts for length of the remaining part of the working life. These two revisions ensures that the pension fund continuously fulfils

its intertemporal budget constraint given the assumption of perfect foresight of the demographic development.

Observe that at the retirement age the pension undertaking is identical to the retirement pension received from the pension fund. For retirees the last term in relation (3) vanishes and the annual growth in pension receipts is given by the difference between the interest rate net of taxes obtained by the pension fund and the base interest rate.[6]

One may compare the behaviour of the pension fund to the behaviour of intertemporally optimizing consumers. In a perfect foresight model the consumers chooses the initial level of consumption so that the intertemporal budget constraint is fulfilled. The level of consumption is updated using the standard "Keynes-Ramsey" rule (or Euler equation). Therefore relation (3) corresponds to the Keynes-Ramsey rule.

2.2 Effects on individual behaviour of occupational pension schemes

How does the incorporation of occupational pension schemes affect the behaviour of individual households? In a textbook model with perfect foresight, perfect capital markets, no differences in taxation of various types of savings, and absence of collective life insurance in pension saving, the answer is clear - there will be no effect on total savings as the individuals reduces the "free" savings to completely off-set the savings in the occupational pension system.

The collective life insurance aspect of the occupational pension saving implies that even in a perfect capital market pension savings is not a perfect substitute to individual savings. The reason is that occupational pension savings are not private property of the individual and therefore the individual is unable borrow against the accumulated stock of savings in the pension fund. This implies that one should not expect the perfect neutrality of the textbook model to hold even with perfect capital markets. Rather one should expect an increase in aggregate savings. In addition the non-perfect nature of financial markets may imply that especially young families and families of blue collar workers may be credit rationed and therefore unable to increase liability to offset the increased savings in the occupational pension system.

A second effect on the aggregate savings rate from the contributions to occupational pension schemes is due to the indexation rule of social pensions

[6]Actual pension funds smooths the growth rate of pension by running a precautionary stock of non-distributed interest payments from years with high interest rates. This is ignored in DREAM.

in Denmark. The pensions are indexed to the wage rate net of contributions to occupational pension schemes. Increasing contributions lower indexation and therefore future social pension. This is foreseen by the agents who, therefore, increase savings to compensate for the reduction in social pension.

Finally, the Danish tax system subsidizes pension savings by taxing interest income in pension funds at a rate significantly less than the tax rate of positive personal capital income. For these reasons one should expect that increasing the contribution rate of occupational pension schemes will generate a positive effect on the general savings ratio in the economy.

In DREAM there is one representative household in each generation. This fact in combination with the intertemporal budget constraint of the occupational pension funds, relation (1), implies that for each household the discounted value of contributions to the pension scheme is equal to the (with certainty) expected discounted value of future pension payments - i.e. the savings effect from the collective life insurance institution is aggregated away by the construction of the representative household. Since capital markets are perfect in DREAM the only stimulus to aggregate saving from occupational pension savings is due to the tax subsidies of interest income from pension savings.

To reintroduce the savings effect of the collective life insurance institution a reduction in the planning horizon of individual households is introduced. At the entry into the economy at the age of 17 years the household has a planning horizon of 60 years. The size of the representative household is affected by the exogenous age and gender specific death rate and the exogenous age specific birth rate, but the representative household as a decision unit exists with certainty only until it reaches the age of 78 year. At this point in life the household leaves a foreseen bequest to their children. Persons who are older than 77 year are assumed to optimise intratemporarily and to spend their entire income in each period. The generation remains in the economy until it is extinct according to the demographic forecast. This division of a given birth cohort into households that are intertemporally optimising when younger than 77 years and not intertemporally optimising when they become 78 implies that the young household only takes into account the part of the total discounted value of the pension payments that accrue until the generation reaches 78 years. From the point of view of the intertemporally optimising household the part of the savings that finances the remaining pension from occupational pension fund is equivalent to a tax. Therefore the planning household only partially reduce the individual savings when the occupational pension savings are increased, and thus, the aggregate savings

ratio is increased.

Section 5 presents a decomposition of the total effect on aggregate savings to each of the three listed elements that affect savings. .

3 Assessing the role of occupational pensions

The counterfactual scenario is obtained by reducing the average contribution rate to occupational pension schemes by 50 percent permanently from 2008.

The reduction in the rate of contribution to occupational pension schemes has only indirect effects on the supply side of the economy. By assumption the labour supply in DREAM is independent of the distribution of the total wage bill into contributions to occupational pension schemes and current income.[7] The indexation of social benefits to the wage income net of contributions to occupational pensions schemes generates a negative indirect effect on labour supply through an increase in .the rate of unemployment benefits. This reduces the incentive to employment from the point of view of the unions and generates an "upward shift" in the wage curve. The outcome is higher wages and reduced employment. Gradually the capital stock is reduced to maintain the long run capital labour ratio. On impact, GDP at factor prices is, therefore, reduced by 0.5 percent compared to the base scenario. In the long run the reduction in GDP at factor prices is increased to 0.7 percent.

The effect on private consumption is also negative in the entire period. On impact, there is a small reduction of 0.1 percent compared to the base scenario. This reduction is explained by a reduction in the disposable income due to an increase in the sustainable tax rate, which dominates the effect on consumption from the increase in the current income due to the reduced contributions to occupational pension funds and the increased social benefits. The long run reduction is larger: The aggregate private consumption is reduced by 1.4 percent compared to the base scenario. This effect is both due to the increased taxation and the permanent lower level of net-aggregate savings.

Macroeconomic effects of the reduction in contributions are shown in Table 1.

[7]This is the net-effect of two opposed effects: First tax subsidy to interest income of pension savings implies that the discounted value income in the form of contributions to occupational pension schemes is higher than the value of the amount paid as current wages. However, the fact that the individual household household considers only a part of the total discounted value of the increase in pension receipts as income. For simplicity it is assumed that the two effects counterbalance each other.

Table 1: Macroeconomic behaviour with reduced contribution to pension funds

	1998	1998	2008	2018	2038	2058	∞
		Indexes, baseline=100 except where noted					
Private consumption		100.0	99.9	99.9	99.7	99.2	98.6
Real GDP at factor prices		100.0	99.5	99.3	99.3	99.3	99.3
Employment		100.0	99.3	99.3	99.3	99.3	99.3
in private production sector		100.0	99.3	99.2	99.3	99.3	99.3
in construction sector		100.0	99.1	99.4	99.3	99.1	99.1
in public sector		100.0	99.4	99.4	99.3	99.3	99.2
Capital in private production sector		100.0	99.7	99.3	99.3	99.3	99.3
Capital in construction sector		100.0	99.6	99.5	99.4	99.1	99.1
Capital in public sector		100.0	99.7	99.4	99.4	99.3	99.2
Total households assets*		0.0	47.8	139.3	303.5	384.8	375.3
Total households financial assets*		0.0	52.0	146.1	317.6	409.1	409.2
Total pension assets*		0.0	-99.0	-292.9	-688.5	-951.5	-999.3
Foreign assets *		0.0	-4.2	-27.4	-86.0	-132.0	-152.9

** Difference (level) between counterfactual and baseline*

The sustainable tax rate is increased by 1.3 percentage points. Thus, the first conclusion of the counterfactual experiment is that the necessary fiscal adjustment to the demographic ageing is larger if contributions to occupational pension schemes is reduced.

The major reason why an increase in the sustainable tax rate is necessary is that the reduction in contributions to the occupational pension system generates an increase in public transfers due to the indexation rule. The increase in the total expenditures relative to GDP at factor prices until 2040 is 1.5 percentage points higher than in the base scenario. This figure is also affected by the reduction in GDP at factor prices due to the negative supply from increased unemployment benefits.

A second reason for the required increase of the sustainable tax rate is that current generations to a lesser extend are able to pass the increased financial burden of the economic ageing onto future generations through an increase in the public debt. The additional increase in the tax revenue relative to GDP at factor prices until 2040 is 1.8 percentage points compared to the base line.

The counterpart of this increased immediate financing of the increased expenditures in the period until 2040 is a significantly lower public debt in the counterfactual scenario. In the counterfactual scenario public debt increases to a maximum of 14.1 percent of GDP at factor prices. From 2038 the public debt is gradually reduced and in the steady state the tax-smoothing policy implies a positive public stock of wealth of 17.8 percent of GDP at factor prices. This should be compared to a maximum of 48.6 percent (in 2058) and a steady state level of debt of 23.2 percent of GDP at factor prices in the base scenario. Table 2 shows the evolution in public expenditures and public revenue relative to GDP at factor prices.

Table 2: Public expeditures and revenues with reduced contribution to pension funds

	1998	1998	2008	2018	2038	2058	∞
		Pct. of GDP at factor costs as Index (baseline=100) except where noted					
Expenditures		**100.0**	**102.2**	**102.4**	**102.5**	**102.4**	**102.4**
Social pensions *		100.0	105.8	105.9	106.0	106.1	106.1
Civil servants pension, ATP and LD		100.0	100.6	100.6	100.6	100.7	100.8
Age dependent public transfers		100.0	108.1	108.4	108.4	108.5	108.6
Age dependent public consumption		100.0	100.0	100.0	100.0	100.0	100.0
Total of age dependent exp.		**100.0**	**103.0**	**103.1**	**103.2**	**103.2**	**103.1**
Other expenditures		100.0	99.6	100.0	100.0	100.1	100.1
Tax revenues		**100.0**	**103.4**	**103.4**	**102.9**	**101.8**	**101.0**
Social pensions *		100.0	111.0	111.2	111.3	111.3	111.4
Civil servants pension, ATP and LD		100.0	103.6	103.6	103.7	103.8	103.9
Labour market pensions		100.0	74.2	76.0	76.2	63.4	55.9
Private pensions		100.0	100.0	101.0	103.4	105.6	107.1
Pension funds		100.0	99.3	89.9	78.2	69.3	67.9
Other taxes		100.0	103.6	104.1	104.7	105.0	104.8
Primary budget**		**0.0**	**7.2**	**6.2**	**2.9**	**-4.1**	**-9.1**
Interest payments**		0.0	0.0	-3.5	-11.4	-18.4	-20.6
Net debt**		**0.0**	**-36.0**	**-111.7**	**-277.0**	**-401.8**	**-428.2**

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

*** Difference (level) between counterfactual and baseline*

The reason for this large shift is best understood by considering the steady state version of the budget constraint of the public sector. It is given by

$$rB_T = (T - G) \tag{4}$$

where r is the growth adjusted real rate of interest, B_T is the growth adjusted value of the real public debt, T is total real tax revenue measured in growth adjusted units. G is total real public expenditures measured in growth adjusted units.

The public expenditures in the steady state are to a large extend determined by the size and composition of the population given the fiscal policy rules. The assumption of a perfect tax smoothing implies that the revenue depends on the constant level of taxation and the size of the tax base in the steady state. Therefore, the primary budget surplus is positively correlated with the size of the long run tax base. Relation (4) indicates that the long run level of public debt that is consistent with the intertemporal budget constraint is determined by the size of primary surplus in the steady state. Therefore, changes in the long run tax base shifts the sustainable level of the public debt.

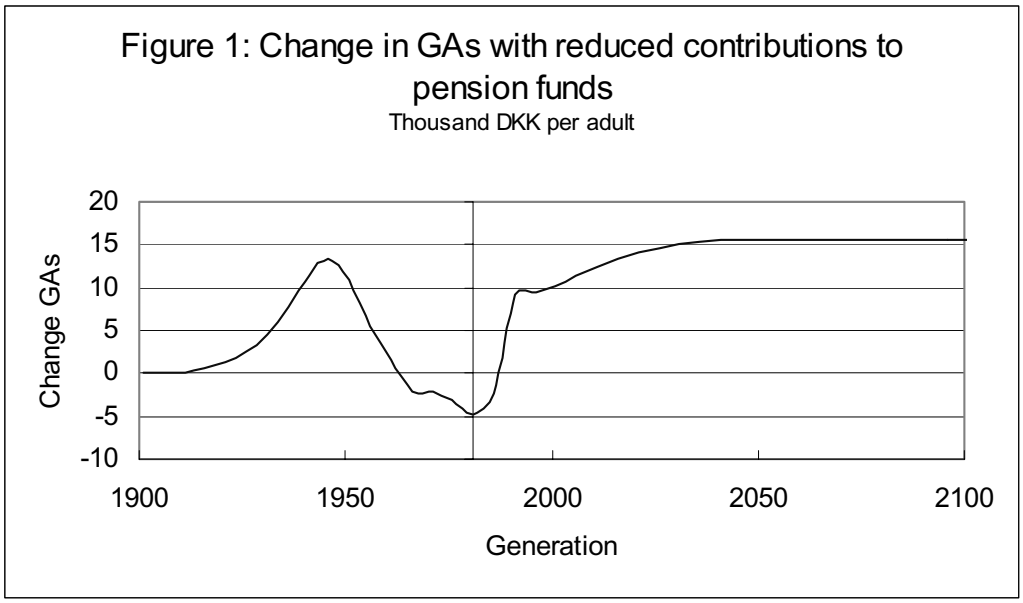
The long run primary surplus is reduced in the counterfactual scenario. This is due to effects on both the expenditure and the income side. On the expenditure side the increased indexation of social benefits leads to a permanent increase in public expenditures. On the income side the lower contributions implies a reduction in the future tax revenues due to the reduction in the total wealth in the economy, which is a consequence of the possitive effect on net-savings from increased savings in the occupational pension system. This

effects dominates the additional effect on the long run tax revenue, which is that the tax subsidized interest income of the pension savings is reduced and partially replaced by increased interest income on non-subsidized household interest income. The relative importance of these effects are investigated in section 5.

3.1 Generational accounts and equivalent variations

The effect on the generational accounts of the different generations is indeed a consequence of the significant change in the public debt. Generations born in the distant future have to service a much smaller or even no public debt. This significantly reduces the wedge between the taxes paid and level of public expenditures received by these generations. Therefore, these generations experience an improvement in their generational accounts even if the increase in the taxes (due to the higher sustainable tax rate) is higher than the increase in the received public expenditures. Figure 1 displays the quantitative effects for each generation. The increase in the generational accounts of the generations born in the distant future is approximately a one-off gain of 15500 DKK. per individual. For generations born between 1988 and 2050 the gain is gradually increasing from a level of approximately zero to the long run gain of 15500 DKK per individual.

The generations that are active in the labour market in the phase from the introduction of counterfactual and till 2040 (where the new demographic proportions are achieved) are losers measured by their generational accounts. These generations pay the higher sustainable tax rate and receive only a marginal increase in the public expenditures from the increased indexation. The extra tax burden is used to reduce the debt accumulation of the public sector and this has no positive effect on the generational accounts. The generations that are worst of are generations that enter the labour market at the time where the tax rate is increased, i.e. generations born around 1981-86. For these generations the reduction in the generational account is around 5000 DKK. per individual.



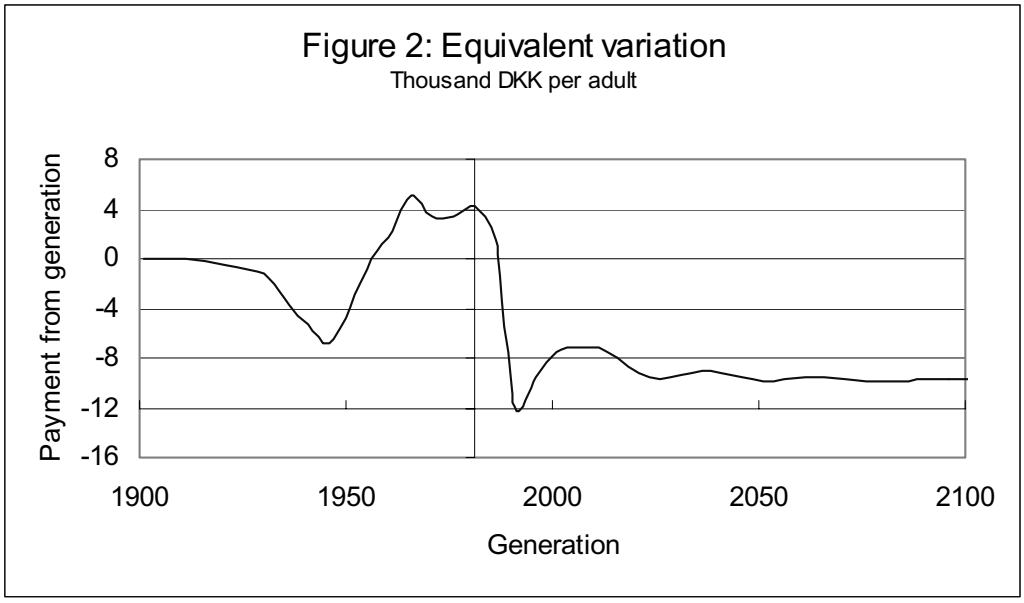
Generations that are elderly when the increase in the sustainable tax rate is introduced will experience a net gain in their generational accounts. This is due to the effect from the increase in social pension from the increased indexation. This effect dominates the negative effect from increased taxes for these generations.

A different approach to measuring the intergenerational distribution is to compute the equivalent variation (EV) for each generation. This measures the amount of wealth per adult that a generation is willing to give up (measured in the prices of the base scenario) for a shift to the counterfactual scenario with lower contributions to the occupational pension schemes. A negative amount therefore means that the generation is worse off in the counterfacual scenario.

EV may be reduced to a measure of the relative change in utility times the initial stock of financial, physical capital (land and dwellings), and human capital of the household in question.[8] 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

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

utility function is specified as additive separable in the individual public consumption.



As shown in Figure 2, the difference between the EV measure and the generational accounts reported in Figure 1 is striking. The generations that are worse off in the counterfactual scenario according to the Generational Account measure is approximately the same generations that experience an increase in their EV measure. This indicates that using generational accounts as a proxy for a welfare measure may be seriously misleading.

In the Generational Account measure future generations experience an improvement in their account due to the fact that they have to service a lower public debt in the counterfactual scenario. However, the lower public debt is a derived consequence of the lower stock of wealth of the private sector in the counterfactual scenario when these generations are alive. The EV measure is therefore dominated by the reduction in wealth in the economy and the higher sustainable tax rate in counterfactual. This reduces the level of private consumption for the relevant generations and therefore the EV measure.

The perhaps most surprising fact of the EV measure is that the younger generations alive when the reduction in the contributions to occupational pension schemes is introduced in 2008 will be better off according to this measure. This happens even if these generations will be faced with an in-

creased cost of financing the demographic transition as measured by the reduction in their Generational Accounts. The explanation of the positive EV measure is that these generations benefits from the reduction in the relative price on durable goods - i.e. land and dwellings.

The reduction in the contributions to the occupational pension schemes implies that future generations will experience a reduction in their stock of wealth due to the reduced aggregate savings. This implies that future demand for durables will be reduced compared to the base scenario. The forward-looking agents in the economy foresee this future reduction in demand and a capital loss on durables is experienced when the counterfactual is revealed to the agents. Generations that are relatively young in 2008 when the counterfactual is introduced are net-buyers of durables and therefore gain from the reduction in the price of durables. The gain in utility from this ability to buy houses at a lower price dominates the loss from the increased taxation due to the higher sustainable tax rate.

The other side of the coin of the gain for households that are relatively young in 2008 is that households that are elderly in 2008 will experience a capital loss, as they are net-sellers on the housing market. This capital loss dominates the increase in the social pensions that is a consequence of the increased indexation due to a lower average contribution rate to occupations pension schemes.

In sum only four five-year age-groups gain from the permanent reduction in the contribution rate to occupational pension schemes. Both currently living elderly generations and future generations are worse off. Therefore, it is no surprise that total social welfare gain, measured as the population weighed discounted sum of equivalent variations of the individual generations, is negative. The one-off loss to society from the permanent reduction in contributions is 2.7 percent of GDP at factor prices in the base year 1998.

4 Decomposition of the effect on aggregate savings

As noted above the results of the analysis of the reduction in the contributions to occupational pension schemes hinge upon three main characteristics of the model reflecting important parts of the Danish economy: Firstly that social benefits are indexed to the wage rate net of contributions to occupational pensions, secondly that pension savings are subject to special tax rules that imply a discount to interest income on pension savings, and thirdly that there is a positive effect on total savings if compulsory pension savings is increased

because private saving and pension saving are not perfect substitutes from the point of view of consumers.

To put it another way: if one were to remove the indexation of social benefits, impose the same tax rates on private saving and pension fund saving and finally increase the planning horizon of households to include the entire life time, one would obtain the text book neoclassical result that the only effect of reducing the contribution rate to labour market pension would be an exactly off-setting increase in private saving[9].

This section analyses how each of these factor affects the results described above. In each of the three cases a new base scenario is constructed in a model in which only the factor in question is present[10]. Then the labour market pension contribution rate is halved and results are described and compared with the ones obtained above.

4.1 The indexation of social benefits

As noted above social benefits are indexed to the wage rate net of contributions to occupational pension schemes. This implies that a reduction in the contribution rate to occupational pension schemes will increase the wage rate net of pension contributions and thus increase public transfers. The effect of the reduced contributions in the model where this is the only factor affecting the aggregate savings is shown in Tables 3 and 4. The tables report results relative to the (new) base (and are therefore comparable with figures in tables 1 and 2).

[9]In practice this is not entirely correct because contributions to the pension fund are not subject to taxation at the time of contribution whereas private saving is taking place out of income net of taxes. This means that lowering the pension fund assets by lowering contribution rates will cause a net decline in assets held by households and pension funds together and therefore a decline in the demand for shares which will cause a drop in the value of shares. Because tax rates on income from shares and bonds are not the same this will have some, though very small, effects.

[10]A new base line is required because the removal of the last two effects have significant impacts on the economy. To single out the effect of reducing labour market pension payments a new base line is therefore needed.

Table 3: Macroeconomic behaviour with reduced contribution to pension funds

	1998	1998	2008	2018	2038	2058	∞
		Indexes, baseline=100 except where noted					
Private consumption		100.0	99.5	99.4	99.4	99.2	99.2
Real GDP at factor prices		100.0	99.5	99.2	99.2	99.2	99.2
Employment		100.0	99.2	99.2	99.2	99.2	99.2
in private production sector		100.0	99.3	99.2	99.2	99.2	99.2
in construction sector		100.0	98.7	99.2	99.2	99.2	99.2
in public sector		100.0	99.2	99.2	99.2	99.2	99.2
Capital in private production sector		100.0	99.7	99.3	99.2	99.2	99.2
Capital in construction sector		100.0	99.4	99.3	99.3	99.3	99.3
Capital in public sector		100.0	99.6	99.2	99.2	99.2	99.2
Total households assets*		0.0	47.0	143.4	299.8	374.4	389.2
Total households financial assets*		0.0	57.7	155.0	311.3	388.0	404.0
Total pension assets*		0.0	-114.2	-304.3	-631.8	-802.6	-832.7
Foreign assets *		0.0	12.8	16.4	9.8	4.1	2.4

** Difference (level) between counterfactual and baseline*

Table 4: Public expeditures and revenues with reduced contribution to pension funds

	1998	1998	2008	2018	2038	2058	∞
		Pct. of GDP at factor costs as Index (baseline=100) except where noted					
Expenditures		**100.0**	**102.3**	**102.5**	**102.6**	**102.6**	**102.5**
Social pensions *		100.0	105.9	106.0	106.1	106.2	106.2
Civil servants pension, ATP and LD		100.0	100.7	100.7	100.7	100.7	100.7
Age dependent public transfers		100.0	108.4	108.8	108.7	108.8	108.8
Age dependent public consumption		100.0	100.0	100.0	100.0	100.0	100.0
Total of age dependent exp.		**100.0**	**103.2**	**103.3**	**103.3**	**103.3**	**103.3**
Other expenditures		100.0	99.6	100.0	100.1	100.1	100.1
Tax revenues		**100.0**	**103.3**	**103.5**	**102.8**	**101.7**	**101.2**
Social pensions *		100.0	111.0	111.2	111.3	111.3	111.3
Civil servants pension, ATP and LD		100.0	103.9	103.9	103.9	104.0	104.0
Labour market pensions		100.0	82.3	83.3	79.9	62.2	51.7
Private pensions		100.0	100.0	100.1	100.1	100.2	100.1
Pension funds		100.0	99.7	82.3	48.5	9.3	2.5
Other taxes		100.0	103.6	104.5	105.6	106.0	106.0
Primary budget**		**0.0**	**9.9**	**7.4**	**0.9**	**-5.8**	**-8.7**
Interest payments**		0.0	0.0	-4.7	-13.3	-18.6	-19.7
Net debt**		**0.0**	**-49.7**	**-145.2**	**-310.0**	**-398.2**	**-410.2**

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

*** Difference (level) between counterfactual and baseline*

With pension and private saving considered as perfect substitutes by households the reduction in pension saving is almost off-set by increased private saving[11]. Since, in addition, taxation of capital income from private and pension fund savings is the same, then no direct effect on tax revenues from the change in savings is present. Therefore, as may be seen from table 6, the main effect is caused by the increase in public transfers and therefore in total expenditures, which implies a long run decrease in the primary budget. This requires a long run decline in public debt to reduce interest payments. The decline in public debt is obtained through an increase in the sustainable tax of 1.5 percentage points, which initially improves the primary budget and therefore decreases net debt and as a consequence, interest payments. As a result of the increase in the tax rate labour supply is slightly decreased,

[11]Total household asset are net of taxes, while pension fund assets are not because taxation is not taking place until time of payment from the pension fund.

which along with the resulting (gradual) decrease in capital decreases real GDP. Given the magnitude required increase in the sustainable tax rate, the indexation of social transfers in itself may explain the results obtained above regarding the sustainable tax rate.

4.2 Tax subsidy to pension saving

Danish tax rules imply a subsidy to pension savings since tax rates on capital income in the pension funds are lower than tax rates on household capital income. To avoid corner solutions due to infinite arbitrage pension savings are therefore modelled as exogenous fractions of income. There is nonetheless a direct effect from the tax subsidy to public tax revenues. This section singles out this effect by investigating, what happens in the model in which the tax subsidy to pension saving is the only departure from the purely "neoclassical model". Results are shown in tables 5 and 6 and should be compared with tables 1 and 2.

Table 5: Macroeconomic behaviour with reduced contribution to pension funds

1998	*1998*	*2008*	*2018*	*2038*	*2058*	*∞*
	Indexes, baseline=100 except where noted					
Private consumption	100.0	99.9	100.1	100.3	100.0	99.9
Real GDP at factor prices	100.0	100.0	100.1	100.1	100.1	100.1
Employment	100.0	100.1	100.1	100.1	100.1	100.1
in private production sector	100.0	100.1	100.0	100.0	100.1	100.1
in construction sector	100.0	100.1	100.2	100.1	100.0	100.0
in public sector	100.0	100.0	100.1	100.1	100.1	100.0
Capital in private production sector	100.0	100.0	100.1	100.0	100.1	100.1
Capital in construction sector	100.0	100.1	100.2	100.1	100.0	100.0
Capital in public sector	100.0	100.0	100.1	100.1	100.1	100.0
Total households assets*	0.0	77.3	214.7	434.0	549.9	575.2
Total households financial assets*	0.0	76.3	211.5	431.1	550.8	577.1
Total pension assets*	0.0	-101.0	-300.1	-685.0	-920.7	-967.9
Foreign assets *	0.0	2.2	1.9	-12.7	-24.3	-26.0

** Difference (level) between counterfactual and baseline*

Table 6: Public expeditures and revenues with reduced contribution to pension funds

1998	*1998*	*2008*	*2018*	*2038*	*2058*	*∞*
	Pct. of GDP at factor costs as Index (baseline=100) except where noted					
Expenditures	**100.0**	**100.0**	**100.0**	**99.9**	**100.0**	**100.0**
Social pensions *	100.0	100.0	99.9	99.9	99.9	99.9
Civil servants pension, ATP and LD	100.0	100.0	99.9	99.9	100.0	100.0
Age dependent public transfers	100.0	99.8	99.8	99.8	99.8	99.8
Age dependent public consumption	100.0	100.0	100.0	100.0	100.0	100.0
Total of age dependent exp.	**100.0**	**99.9**	**99.9**	**99.9**	**99.9**	**99.9**
Other expenditures	100.0	100.0	100.0	100.0	100.0	100.0
Tax revenues	**100.0**	**100.7**	**100.8**	**100.4**	**99.3**	**98.7**
Social pensions *	100.0	99.0	98.9	98.9	98.9	98.9
Civil servants pension, ATP and LD	100.0	99.3	99.3	99.2	99.3	99.3
Labour market pensions	100.0	74.5	75.6	73.4	58.4	49.7
Private pensions	100.0	100.0	100.0	100.0	100.0	100.0
Pension funds	100.0	100.1	89.2	74.9	63.7	61.6
Other taxes	100.0	101.4	102.1	103.2	103.7	103.7
Primary budget**	**0.0**	**5.6**	**5.4**	**2.8**	**-3.9**	**-7.7**
Interest payments**	0.0	0.0	-2.8	-9.9	-15.9	-17.6
Net debt**	**0.0**	**-28.0**	**-91.6**	**-242.1**	**-346.3**	**-365.4**

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

*** Difference (level) between counterfactual and baseline*

With private saving and pension saving considered as perfect substitutes by households, the reduction in pension saving is off-set by an increase in private saving by an equal amount. With no indexation of social transfers, it is furthermore seen that expenditures are now unaffected (the slight decline is only due to an increase in GDP since expenditures are measured relative to GDP). With the increase in household saving as a reaction to the reduction in pension saving, capital income is gradually shifted from one type with low taxation to a type with higher taxation which on net increases public tax revenues (Other taxes). This increase in tax revenues improves the primary budget and thus leads to a decreases public debt and therefore lower public interest payments over time. Over time this facilitates a reduction of the primary budget and thus enables a reduction in the sustainable tax rate of 0.3 percentage points. This reduction is the reason for the decline in tax revenues accruing from social and civil servants pensions. The reduced sustainable tax rate slightly increases labour supply which together with a gradual increase in capital used in production increases GDP.

4.3 Households' limited time horizon

As mentioned, consumers in DREAM only take into account the part of pension payments that accrue until the age of 78. This has the effect that households consider part of pension payments as a "tax" and implies that households do not consider private saving and pension saving as perfect substitutes and therefore do not fully increase private saving in response to a reduction in pension saving. The effect of this is shown in tables 7 and 8 below, where pension saving is reduced in a model in which the only non-neoclassical feature is households limited time horizon.

Table 7: Macroeconomic behaviour with reduced contribution to pension funds

1998	*1998*	*2008*	*2018*	*2038*	*2058*	*∞*
	Indexes, baseline=100 except where noted					
Private consumption	100.0	99.8	100.1	100.2	100.0	99.6
Real GDP at factor prices	100.0	100.0	100.0	100.0	99.9	99.9
Employment	100.0	99.9	99.9	99.9	99.9	99.9
in private production sector	100.0	99.9	99.9	99.9	99.9	100.0
in construction sector	100.0	100.1	100.1	99.9	99.9	99.8
in public sector	100.0	99.9	100.0	100.0	99.9	99.9
Capital in private production sector	100.0	100.0	99.9	99.9	99.9	100.0
Capital in construction sector	100.0	100.0	100.1	100.0	99.8	99.8
Capital in public sector	100.0	100.0	100.0	100.0	99.9	99.9
Total households assets*	0.0	54.0	143.8	283.2	350.2	350.7
Total households financial assets*	0.0	52.7	140.8	282.9	355.4	361.0
Total pension assets*	0.0	-96.2	-281.9	-625.2	-821.8	-854.5
Foreign assets *	0.0	1.8	-5.2	-35.8	-62.3	-72.1

** Difference (level) between counterfactual and baseline*

Table 8: Public expeditures and revenues with reduced contribution to pension funds

	1998	1998	2008	2018	2038	2058	∞
		Pct. of GDP at factor costs as Index (baseline=100) except where noted					
Expenditures		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.1**
Social pensions *		100.0	100.1	100.1	100.0	100.1	100.1
Civil servants pension, ATP and LD		100.0	100.1	100.0	100.0	100.1	100.1
Age dependent public transfers		100.0	100.2	100.2	100.2	100.2	100.3
Age dependent public consumption		100.0	100.0	100.0	100.0	100.0	100.0
Total of age dependent exp.		**100.0**	**100.1**	**100.1**	**100.0**	**100.1**	**100.1**
Other expenditures		100.0	100.0	100.0	100.0	100.0	100.0
Tax revenues		**100.0**	**101.5**	**101.2**	**100.3**	**99.2**	**98.7**
Social pensions *		100.0	101.5	101.5	101.5	101.5	101.6
Civil servants pension, ATP and LD		100.0	100.9	100.9	100.9	101.0	101.0
Labour market pensions		100.0	71.5	73.1	72.4	60.5	54.9
Private pensions		100.0	100.0	101.0	103.7	106.1	107.5
Pension funds		100.0	100.0	87.5	74.4	66.3	65.3
Other taxes		100.0	102.1	102.5	103.1	103.3	103.2
Primary budget**		**0.0**	**9.0**	**7.2**	**1.7**	**-5.6**	**-8.9**
Interest payments**		0.0	0.0	-4.3	-12.9	-18.8	-20.2
Net debt**		**0.0**	**-44.8**	**-135.5**	**-305.8**	**-403.2**	**-420.3**

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

*** Difference (level) between counterfactual and baseline*

In this analysis, there is no indexation of social transfers, and tax rates on capital income from private and pension savings are equal. The decrease in the overall saving ratio that is a consequence of the reduced occupational pension saving implies that the future tax base is reduced. This decreases future tax revenue which worsens the future primary budget. The long run level of public debt therefore has to decrease in order to be sustainable. This requires the primary budget to increase in the short run, which is enabled through an increase of the sustainable tax rate of 0.4 percentage points. This increase has a minor contradictory effect on production through decreased labour supply.

5 Concluding remarks

In this analysis we found that the significant increase in contributions to occupational pensions schemes that Denmark has witnessed during the 1990s has a positive effect on total welfare as measured by the social welfare function. This positive impact is due to the increased aggregate savings that follows from the increased contributions. Increased savings tend to increase welfare since the Danish income tax system distorts the savings decision by high rates of taxation on (personal) capital income and by the progressive nature of the income tax system.

We have argued that three factors account for the positive effect on aggregate savings from increased occupational pension contributions: First, indexation of social pensions to the wage rate net of contributions to occupational pensions schemes implies that social pension are reduced as contributions are

increased. This generates an incentive to higher savings due to consumption smoothing. Second, tax rules implies that there is a subsidy to savings in occupational pension systems compared to individual non-pension savings. Third, there may be a direct effect on savings from increased compulsory contributions to occupational pensions. One element of this is that mainly young and low-income households may be subject to credit rationing and therefore unable to reduce their non-occupational pensions savings. Another is that occupational pension saving is not a perfect substitute to individual savings. This is due to the collective life insurance property of the occupational pension savings, where the savings is property of the pension fund and pension payments are contingent on the person being alive.

If the government runs a sustainable fiscal policy with perfect tax smoothing, the increased occupational savings implies that public expenditures are reduced due to the indexation rule. This, ceteris paribus, generates a potential reduction in the sustainable tax rate. Second, increased private savings imply that level of the future tax bases are increased. This also tends to reduce the sustainable tax rate. Finally, savings are shifted towards tax-subsidized saving, which tend to reduce future tax bases. This tends ceteris paribus to increase the sustainable tax rate. The decomposition of the effects shows that the latter two effects tend to off set one another and therefore the net effects no the sustainable tax rate is quantitatively comparable to the effect from the reduced public spending.

From a more theoretical perspective the analysis showed that it may be seriously misleading to interpret changes in Generational Accounts as equivalent to changes in welfare if the policy in question involves changes in the valuation of stocks.

References

[1] Jensen, S.H., U. Nødgaard, and L.H. Pedersen, 2002, Fiscal Sustainability and Generational Burden Sharing in Denmark, *Nordic Journal of Political Economy 2002:1.*

[2] Knudsen, M. B., L. H. Pedersen, T. W. Petersen, P. Stephensen and P. Trier, 1998, Danish Rational Economic Agents Model - DREAM Version 1.2, working paper, Statistics Denmark, available at http://www.dreammodel.dk

[3] Knudsen, M. B., L. H. Pedersen, T. W. Petersen, P. Stephensen and P. Trier, 1999, Dynamic calibration of a CGE model with a demo-

graphic application, working paper, Statistics Denmark, available at http://www.dreammodel.dk

[4] Madsen, A. D., 2000, Velfærdseffekter ved skattesænkninger i DREAM, Economic Modelling Working Paper Series 2000:5, Statistics Denmark, available at http://www.dreammodel.dk

[5] Pedersen, L. H., P. Stephensen and P. Trier, 1999, A CGE analysis of the Danish ageing problem, working paper, Statistics Denmark, available at http://www.dreammodel.dk