Debt Strategies for Sweden and Europe

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1 Introduction

During the final decades of the previous century, most European countries accumulated large, and in peace time unprecedented, public debts. Interest payments on the debts now constitute an important fiscal burden. Today these countries also face another challenge to the public budget. In the coming 30 to 40 years, the share of people in working age is predicted to fall significantly. Considering this reduction in the relative size of the labour force, it may be wise to start adjusting public policy already now. In particular, fiscal constraints may become less tight in the future if public debts are reduced today. This paper explores what paths for the public debt and the budget surplus are optimal in the face of ageing populations.

Twelve European countries are included in the study. For all these countries, the optimal policy is to start reducing public debt immediately and continuously until sometime between year 2030 and 2045. The optimal average budget surplus varies between one and four percent of output annually for these countries. The calculations show that for most countries the welfare loss of pursuing a balanced-budget policy instead of the optimal debt policy would be modest but not negligible.

1.1 The demographic change

Figures 1 to 3 show the historical and predicted demographic development in the countries considered.[1,2] Figure 1 clearly displays that the share of workers in the population will fall during the coming 30 years. In Sweden, for example, this share is predicted to fall from 59 percent in year 2001 to 52 percent in year 2035. The figure also shows that the population ageing is predicted to be similar in all countries, but that the demographic impact will be largest in Southern Europe.

Figure 2 shows that the share of old in the population has increased and is predicted to continue to increase. The pattern is again similar for all countries, but most remarkable in Southern Europe. In Sweden, the fraction of retirees is predicted to increase from 19 percent today to 29 percent in year 2035. Figure 3 shows that the increased dependency burden from population ageing will be offset by a reduced fraction of children in the population. The fraction of children will fall from 24 to 21 percent in Sweden.

[Figures 1-3 here]

Calculations in Domeij and Floden (2001) show that, at least for Sweden, increased life expectancy and falling birth rates contribute to population ageing approximately to the same extent.

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1 People aged 20 to 64 are assumed to be in working age, while people under 20 are 'young' and people above 64 are 'old' or 'retired'. Data are from the United Nations, 1998.

2 Lindh (this volume) provides a thorough discussion of the demographic development.

1.2 Impact on public budget, saving, and production

Population ageing can influence the overall economy and, in particular, the public budget in several important ways. Before developing these issues further, let us consider a simple experiment conducted to demonstrate that the changing age structure is likely to be quantitatively important. The experiment is based on the demographic forecasts for Sweden. Assume that future government policy will be identical to the average policy in the recent past, and that everyone in working age supplies one unit of labour. Further, assume that public transfers and public consumption per capita is constant and equally divided between different age groups. Figure 4 shows the resulting development of tax revenues and public spending (not including interest payments) over time. The experiment predicts that the primary surplus will deteriorate by five percentage points in the coming 40 years. Calculations by the OECD (1998, p. 33) result in a quantitatively similar effect on the public budget.[3]

[Figure 4 here]

The real response to the demographic change will be more complicated than what the above experiment indicates. First, individuals may change their behaviour in response to changing demographic structures. For example, Bohn (1999) and Domeij and Floden (2001) show that if people live longer, incentives to save and work as young may be strengthened since people then want to accumulate more reserves for their old age. Moreover, if the population ageing implies that future pension benefits will be less generous, people will save more as young to compensate for that reduction. Since people save more, the capital stock may increase and productivity per worker will increase. The increase in savings can therefore mitigate the demographic impact on production. Domeij and Floden demonstrate that these offsetting effects are most likely to occur in countries with little distortive taxation. Consequently, countries with a large public sector are least likely to be helped by the individual response to population ageing.

Second, the interest rate and wage rate are likely to change during the demographic transition. As the number of workers falls, capital will become less productive and the interest rate will fall. Cutler et al. (1990) and Elmendorf and Scheiner (2000a, 2000b) therefore argue that the optimal response to an increased dependency burden is to reduce the national savings rate.

Third, as the experiment above indicates, maintaining an unaltered public policy will not be sustainable, and possibly not desirable. Expenses must be cut or revenue increased. The model used below is developed to examine how revenue should vary if expenses are held fixed at the current level. To some extent, the tax increases can equivalently be interpreted as expenditure cuts. However, Domeij and Floden (2001) show that savings responses to tax increases and benefit cuts can be very different, at least if individuals are not altruistic to other household members. For example, people will increase savings today if they expect future pension benefits to be low, while an increase in future social security taxes does not directly affect today's workers.

Fourth, the experiment ignores that worker productivity (wages and labour-market participation) and consumption needs may vary with age and time. In the model spelled out below, effective labour supply is adjusted for age-specific

[3] The OECD calculations also include some (not explicit) predictions of changes in policy and behaviour. The OECD calculations for Belgium, Canada, France, Germany, and the Netherlands are quantitatively similar. The demographic impact is predicted to be slightly smaller in the U.S., negligible in the U.K., and most severe in Japan.

productivity and participation rates. Throughout in the study, public spending and public transfers per capita are assumed to be held constant at the present level.[4] Inferring the present level from the data is, however, not unproblematic. As the benchmark, all public outlays are assumed to be uniformly divided between age groups. An alternative parameterisation of the model attempts to assign age-specific values to public outlays.

Health care costs account for a substantial part of public outlays. Since the elderly consume more health care than other groups, one could expect these costs to increase as the population grows older. But, as life expectancy increases people of a certain age will become healthier and thus demand less care. Several studies indeed indicate that health care costs are more closely related to the remaining life time than to age.[5] The model specification with age-specific public expenses may therefore exaggerate the future increase in public outlays.

2 The model

This section presents a formal model framework for analysing how the demographic development will affect the economy when households, firms, and governments adjust their behaviour to these changes, and when interest rates and wages adapt to restore equilibrium in factor markets. The reader not interested in the technical details of the model can jump the end of this section, where the main mechanisms of the model are summarised.

Consider an economy populated by a large number of identical and infinitely lived households. A fraction η of household members are active in the labour market and have one unit of time to dispose of. Members of the household maximise their joint utility.

A large number of competitive firms maximise profits,

$$\max F(k,\eta \nu h) - w\eta\nu h - \left[\left(1+\tau^k\right)r + \delta\right]k$$

where F is the production function, k is the capital stock, h is labour supply per worker, ν is the efficiency of the labour force, w is the wage per efficiency unit of labour, τ^k is the tax on capital returns, and δ is the depreciation rate of capital.[6,7] Competition ensures that the interest rate and wage rate equal the marginal product of capital and labour,

$$\left(1+\tau^k\right)r_t = F_{1t} - \delta \tag{1}$$

$$w_t = F_{2t} \tag{2}$$

where t denotes time and F_1 and F_2 are the marginal products of capital and (efficiency) labour.

Let β denote the time discount factor, U the instantaneous utility, let c^a and c^i denote consumption per active and inactive household member, respectively, and let g denote public consumption. Household preferences are then described by

$$\sum_{t=0}^{\infty} \beta^t U\left(c_t^a, c_t^i, h_t, g_t, \eta_t\right).$$

The household budget constraint is

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[4] There is no explicit productivity growth in the model, so 'constant' should be interpreted as 'constant relative to productivity'.

[5] See for example the discussion in chapter 4 in Batljan and Lagergren (2000).

[6] The efficiency term, ν, depends on the age structure of the labour force.

[7] The tax on capital returns is source based so that it also applies to foreigners investing in the country.

$$a_{t+1} = R_t a_t + \left(1-\tau_t^h\right) w_t H_t + b_t - \left(1+\tau^c\right) C_t \tag{3}$$

where a_{t+1} is savings from period *t* to period *t*+1, $R = 1+r$ is the gross interest rate, τ^h is the income tax rate, $H = \eta \nu h$ is the aggregate labour supply in efficiency units, *b* is a lump sum transfer from the government, $C = \eta c^a + \left(1-\eta\right) c^i$ is aggregate private consumption, and τ^c is the consumption tax. The budget constraint can be rewritten as a life-time constraint,

$$\sum p_t \left[\left(1+\tau^c\right) C_t - \left(1-\tau_t^h\right) H_t - b_t\right] = R_0 a_0$$

where $p_t / p_{t-1} = 1/R_t$. The household's first order conditions are then

$$\frac{U_{1t}}{\eta_t} = \frac{U_{2t}}{1-\eta_t} \tag{4}$$

$$\frac{U_{3t}}{U_{1t}} = \frac{-\left(1-\tau_t^h\right)\nu_t w_t}{1+\tau^c} \tag{5}$$

$$\beta^t U_{1t} = \lambda p_t \eta_t \left(1+\tau^c\right) \tag{6}$$

where λ is the Lagrange multiplier on the budget constraint. If p_0 is normalised to unity, the household's budget constraint reduces to

$$\sum \beta^t \left[U_{1t}\left(c_t^a - \frac{b}{\eta_t\left(1+\tau^c\right)}\right) + U_{2t} c_t^i + U_{3t} h_t\right] = \frac{U_{10} R_0 a_0}{\eta_0\left(1+\tau^c\right)}. \tag{7}$$

Let *d* denote the public debt. The government's budget constraint is then

$$d_{t+1} = R_t d_t + g_t + b_t - \tau_t^h w_t H_t - \tau^k r_t k_t - \tau^c C_t \tag{8}$$

By substituting the household budget constraint (3) into (8), the government's budget constraint can be rewritten as

$$\sum p_t \left(g_t + C_t - \tau^k r_t k_t - w_t H_t\right) = R_0 \left(a_0 - d_0\right). \tag{9}$$

2.1 The world economy

A small open economy takes factor prices for given. These prices are determined on the world market, and it is assumed that policy in the world economy balances the public budget in each period.[8]

The world economy is thus characterised by a sequence of tax rates, $\left\{\hat{\tau}_t^h\right\}$, that fulfils the budget constraint

$$0 = r_t d + g_t + b_t - \hat{\tau}_t^h w_t H_t - \tau^k r_t k_t - \tau^c C_t \tag{10}$$

for all periods *t*. In this budget constraint, the levels of debt, *d*, public expenditure, *g*, and transfers, *b*, are exogenous, as is the demographic development and the tax rates on capital and consumption. Total household asset holdings must equal the sum of the capital stock and total government debt in a closed economy,

$$a_t = k_t + d .$$

The interest rate, wage rate, and capital stock are determined by this restriction in combination with (1) and (2). Household decisions for a_{t+1}, h_t, c_t^a, and c_t^i are determined by the first order conditions (4) - (6) in combination with the household

[8] This assumption is arbitrary and will not be consistent with the implications of optimal public policy. As an alternative, the implications of assuming that future factor prices will be constant at the present levels are also considered.

budget constraint (3). The initial capital stock, k_0, and initial household assets, a_0, are given.

2.2 Optimal debt policy in a small economy

The interest rate path is exogenous to the small open economy. Capital can move freely between countries but labour is immobile. Competition still ensures that interest rates and wages equal the marginal products of capital and labour. Equations (1) and (2) must therefore hold also in the small open economy.

A feasible government policy is a sequence of tax rates, $\{\tau_t^h\}$, fulfilling the budget constraint and a transversality condition. To find the optimal policy, it is convenient to reformulate the government's optimisation problem as a Ramsey allocation problem where the government chooses sequences of consumption and labour supply under the additional constraint that these sequences are consistent with household optimisation. For more on the Ramsey allocation problem, see Chari and Kehoe (1999) and Atkeson, Chari, and Kehoe (1999).[9]

The Ramsey allocation problem is thus

$$\max_{\{c_t^a, c_t^i, h_t\}} \sum \beta^t U\left(c_t^a, c_t^i, h_t, g_t, \eta_t\right)$$

subject to the household and government budget constraints, (7) and (9), and household optimisation, (4) and (6). The first order conditions to this problem are reported in Floden (2001). Note that one of the household optimisation equations, (5), is used to solve for tax rates as a function of allocations.

2.3 Model interpretation and model implications

The main mechanism implied by the model is that households want the consumption stream per household member to be smooth. Further, households prefer to supply labour in periods when the wage is high and when the labour-income tax is small, but they also have a preference for leisure being smooth over time. Savings behaviour is thus to a large extent affected by households' desire to smooth consumption and leisure.

The government's choice of tax policy affects households' ability to smooth consumption and leisure. If taxes are volatile, households face conflicting interests of smoothing leisure and supplying labour when the after-tax wage is high. As Barro (1979) has demonstrated, holding taxes constant and letting debt fluctuate will therefore be close to the optimal policy.[10]

Questions regarding intergenerational implications of the demographic change cannot be addressed in this framework since households are assumed to be infinitely lived. Furthermore, since the non-working population consists both of children and of retirees, the model does not explicitly distinguish between increased life expectancy and reduced birth rates. However, since individuals are altruistic to other household members, separating the life-expectancy and population growth rate effects is less important than in the standard overlapping-generations models used by for example Domeij and Floden (2001).

[9] Their sections on open economy models are particularly relevant.

[10] If wages were constant over time, perfect tax smoothing would indeed be optimal.

3 Data, specification and solution strategy

The previous section described the equilibrium conditions for the world economy and for small open economies taking prices as given. The strategy is now to solve for the interest rate path that is consistent with world market equilibrium. The path for pre-tax wages can then be solved as a function of these interest rates. The world market prices are then used when solving for the optimal policy in each of the twelve countries. Before solving the model and searching for optimal debt policies we must specify the utility and production functions in more detail, provide initial values for public debt and household wealth, determine exogenous characteristics of public policy in different countries, and provide data on the demographic development in these countries.

The utility function is assumed to be

$$U\left(c^a, c^i, h, g, \eta\right) = \eta \frac{\left(c^a\right)^{1-\mu} \exp\left[-\zeta\left(1-\mu\right)h^{1+1/\gamma}\right]}{1-\mu} + \left(1-\eta\right)\frac{\left(c^i\right)^{1-\mu}}{1-\mu} + v\left(g\right)$$

where v is some increasing function. Risk aversion, μ, is set to 2 for the baseline calibration. Estimates of the intertemporal labour supply elasticity, γ, typically range between 0 and 0.5 – see for example Altonji (1986), Flood and MaCurdy (1992), and Aronsson and Palme (1998).[11] As the benchmark the elasticity is set to 0.3 but a lower ($\gamma = 0.1$) and a higher ($\gamma = 0.5$) elasticity are also considered.

The effective potential labour supply depends on the size of the labour force (captured by η) and by its efficiency (captured by ν). The fraction of individuals that is active in the labour market, η, is shown in Figure 1. People aged 20 to 64 are assumed to be workers.[12]

Worker efficiency is affected by the age structure of the labour force. Middle-aged workers appear to be both more productive (reflected by a higher wage rate) and to participate in the labour market to a higher extent than young and old workers. The variable ν captures these effects.[13]

The consumption tax rate, τ^c, and the initial tax rate on labour income, τ_0^h, were taken from table 4 in Carey and Tchilinguirian (2000). They calculate effective average tax rates for OECD countries using an improved version of the method suggested by Mendoza et al. (1995). The first two columns in Table I summarise these country-specific tax rates.

Production is given by the Cobb-Douglas function

$$y = F\left(k, H\right) = k^{\theta} H^{1-\theta}. \tag{11}$$

[Table I here]

[11] The intertemporal labour supply elasticity is equal to γ when $\mu = 1$, and approximately equal to γ otherwise. In practice, estimates of the elasticity are often estimates of γ rather than the elasticity.

[12] The demographic forecasts are based on the United Nation's estimates from 1998. Thomas Lindh kindly provided this data.

[13] Age-specific productivity is based on estimates for the United States reported in Hansen (1993). Participation rates are estimated by Fullerton (1999) and are also based on U.S. data. See Floden (2001) for a more detailed description of how ν is calculated. Note that the same adjustment factor ν was used for all countries. In reality, age-specific participation rates may be quite different in different countries because of different education or retirement patterns. However, the quantitative importance of ν is small, so such differences are likely to be negligible.

3.1 Initial steady state

All economies are assumed to be in a steady state in year 2000. These steady states are calibrated to be similar to the actual economies in the recent past. The initial net position of households against the rest of the world is assumed to be zero in each economy (see Nordin et al., 1992, pp 30-32, for Swedish evidence), hence $a/y = d/y + k/y$. The tax rate on capital returns, τ^k, is assumed to be 40 percent in all countries.[14]

The time discount rate, β, is calibrated so that the capital-output ratio equals 2.5. The capital share in production, θ, is set to 0.36, and the depreciation rate of capital, δ, is set to 10 percent per year. Consequently $(1+\tau^k)r = 0.044$.

Public transfers, *b*, are based on OECD's Social Expenditure Data Base. Transfers per capita for the initial steady state are calculated as the sum of public spending on old-age cash benefits, disability cash benefits, occupational injury and disease, sickness benefits, survivors pensions, family cash benefits, unemployment benefits, and housing benefits. The values are from 1995 or 1996 depending on availability, and all values are relative to GDP per capita.[15] Public debt is gross government debt in year 2000 from OECD's Economic Outlook, relative to GDP from the same data set. Table I reports the country-specific parameter values used in the initial steady-state.[16]

Initial public debt and public policy in the world economy are assumed to be the population weighted average of debt and policy in the U.S., Canada, and the twelve examined European countries. The population weights and resulting world averages are also reported in Table I.

It is assumed that labour supply is 33 percent of available time in the initial steady state for the world economy, and that $\beta R = 1$ (otherwise no steady state would exist under optimal policy). Seven variables then remain to solve for in the steady state, c^a, c^i, ζ, *w*, *y*, *g*, and *r*. The seven equations used to solve for these variables are the household budget constraint; the government budget constraint; the production function; the first order conditions for factor prices (two equations); and the first order conditions for c^i and *h*.[17] Table II summarises the parameter values that are common to all economies.

[Table II here]

The seven equations used to solve the world economy are also used to find the initial steady states for each small economy. In these economies, however, the preference parameter ζ is set to the same value as in the world economy, and initial labour supply is not calibrated.

[14] Estimates of tax rates on capital income varies between studies and appear unreliable. Estimates around 40 percent are common, see e.g. Carey and Tchilinguirian (2000).

[15] The transfers reported by OECD are gross and may be subject to taxation in some countries. The adjustment factors reported in Adema's (1999) table 3, row 1, have therefore been used to adjust the OECD figures. Adema does not report adjustment factors for France, Spain and Portugal. The German adjustment factor was used for France, while the Italian factor was used for Spain and Portugal.

[16] The levels of public consumption reported in the table are solved from the equilibrium conditions as described below.

[17] These equations are reported in detail in Floden (2001).

3.2 Future development of public expenditure

Two alternative approaches are used for choosing the future paths of transfers and public consumption. Both approaches attempt to predict what happens if there are no changes in policies. The first approach assumes that these variables remain constant at the level from the initial steady state. The implicit assumptions are then that costs grow proportionally with technological development (recall that there is no such development in the model), and that costs are independent of the age structure in the population.

The alternative approach tries to predict how the demographic development will affect public expenditure. Per capita levels of public expenditure in the initial steady state are then calculated separately for the young, for workers, and for the old. These per capita levels are then assumed to remain constant, but total expenditure will be affected by the demographic composition of the population. When calculating the group-specific transfer levels, it is assumed that disability cash benefits, survivors pensions, and housing benefits are evenly divided in the full population, that family cash benefits are evenly divided among the young and the workers, that old-age cash benefits only accrues to the old, and that occupational injury and disease benefits, sickness benefits, and unemployment benefits only accrues to the workers. Many items in public consumption are (implicitly) assumed to be independent of the age structure (for example police and defence). Health care costs, education costs, and spending on day care and long term care are allocated to the different age groups.[18,19]

4 Findings

Figure 5 shows the interest rate path that solves the system of equations (10). As expected, interest rates fall during the transition to a new steady state with an older population. The capital stock must shrink in this transition since there are fewer workers in the new steady state. Because population ageing *per se* calls for more savings, the return to savings must be low in the transition to reduce incentives to save and thus allow for a shrinking capital stock. In the long run, however, interest rates return to the equilibrium level.

[Figure 5 here]

Figure 6 shows the optimal paths for debt and taxes in Sweden, and resulting effects on the Swedish economy.[20,21] The top right panel in the figure shows that the optimal policy is to reduce debt during the initial years, before the demographic situation deteriorates. The dashed lines in Figure 6 show the implications of optimal policy when world market prices are assumed to be constant. Note first that the implied optimal policy is almost identical to the optimal policy in the benchmark

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[18] Health care costs are assumed to be four times higher per capita for old persons (aged 65+) than for others (see Batljan and Lagergren, 2000, section 3.2) . Further, it is assumed that only the old consume long term care, only the young consume day care and primary and secondary education, and only workers consume tertiary education. The data sources are OECD (1998, table VI.3.) for health care and long term care, and OECD (2001, table B2) for education costs. Public spending on long term care was estimated to be 50 percent of total spending in Italy, Spain, and Portugal, and 80 percent in Denmark.

[19] The resulting age structure of transfers and public consumption is reported in Floden (2001). The age structure of public consumption in Sweden is similar to that reported in Olsson and Nordén (1999). The calculations for transfers, however, appear to assign considerably smaller values to children than what Olsson and Nordén did.

[20] The figure also reports the results of a balanced-budget experiment that is described below.

[21] Corresponding figures for the other countries display the same general pattern for taxes, debt, hours worked, and output.

scenario when the interest rate responds to the demographic change. The model was also solved with different values of the risk aversion and labour-supply elasticity, but the optimal policy is consistently similar to the one shown in Figure 6. With the alternative assumption for the development of public expenditures, the implied policy is an even sharper reduction in debt, accompanied by a higher initial tax raise.

[Figure 6 here]

Note also that although the middle-left panel in the figure shows that private savings would be higher if the interest rate did not respond to the population ageing, this effect on savings is not reflected in production levels. Except for the very first years, output is higher in the benchmark economy. Two factors cause this result. First, interest rates are low during the population ageing episode because the number of workers is falling, implying a higher capital-output ratio and thus making workers more productive. Second, lower interest rates reduce interest payments on public debt so that less taxation is required in the benchmark economy.

The optimal policy in terms of tax rates is to increase taxes in the first year and then letting them remain approximately unchanged. This result is not surprising and is in line with the tax smoothing argument put forward in Barro (1979).

Tables III to V report the implications of optimal policy for the respective countries. Results are reported for the benchmark specification of the economy, for the alternative assumption about the path of public expenditure, and for the assumption of constant world market prices. We see that the implied optimal policies are similar for most countries. Table III shows that the optimal, immediate, tax increase varies from 2.1 percent for the U.K. to 8.3 percent for Finland. Table IV shows that average annual budget surpluses should be between 1.3 percent for the U.K. and 4.1 percent for the Netherlands during the first ten years and similar during the following decades. Finally, Table V shows the implied reductions in debt levels.

The differences between the extreme countries – the U.K. which appears least affected by the demographic change and Finland, Italy, and the Netherlands, which appear most affected – are explained by several factors. First, the size of the public sector matters for the effectiveness and distortions of taxation. The excess burden of taxation increases with the size of the government sector, thus taxes are more distortive in countries with a large government sector, such as Finland, and the effect on tax revenue of a one percent increase in tax rates is smaller. Second, population ageing has a larger impact on the public budget in countries with high public expenditure. Third, in countries with a large initial public debt, such as Italy, the optimal policy is to reduce this debt significantly (see Table V) in order to lessen the future fiscal burden. Fourth, Figure 1 showed that the demographic change will be somewhat less severe in the U.K. than in many other countries. Finally, some countries (most notably the Netherlands and Belgium) are predicted to have a particularly unfavourable development of the age-structure within the group of workers.[22]

[Tables III-V here]

4.1 Alternative policies and welfare effects

How important is it that the government tries to follow the optimal debt strategy? Would welfare be significantly reduced if mistakes were made or if the government

[22] Portugal, Spain, and Denmark are predicted to have the most favourable development. The negative impact on long-run productivity is 1.9 percent in Portugal and 5.3 percent in the Netherlands according to the authors calculations of ν .

pursued other objectives? To answer these questions, the optimal policy was compared to a policy balancing the public budget in each period.[23] The alternative policy is thus a sequence of tax rates, $\{\hat{\tau}_t^h\}$, that fulfils equation (10) for each t when the sequences for interest rates and wages are exogenous.

The dotted line in the top-left panel of Figure 6 shows the sequence of tax rates that balances the Swedish budget. While tax rates can be held down initially, substantial increases are required between years 2020 and 2050 when the number of retirees increases. Consequently, hours worked and output is lower in the long run with the balanced-budget policy. Again, the corresponding figures for all other countries are similar.

Although the balanced-budget policy is quiet different from the optimal policy, the difference in households' welfare turns out to be modest. Table VI shows welfare losses for different specifications of the model. As expected, tax smoothing is more important when labour supply is elastic. Still, a welfare loss of 0.5 percent of annual consumption amounts to less than USD 100 per person and year. With labour-supply elasticities like those typically used by macroeconomists, the welfare losses of deviations from the optimal policy would be sizeable.

[Table VI here]

The results reported in Table VI also indicate that under the alternative assumption of age-dependent public expenditure, pursuing a balanced-budget policy will be infeasible in most countries. This is due to a Laffer-curve effect. To balance the budget, year-to-year fluctuations in public expenditure and in the tax base, may require sharp fluctuations in the tax rate. But if taxes are already high, further tax increase may induce households to substitute labour supply into periods with lower taxes. Thus only the countries with low public expenditure (the U.K. and Portugal) or a small initial debt (Norway) appear able to balance the budget in that scenario.

Cutler et al. (1990) argue that although the optimal policy for the U.S. government probably is to reduce the public debt in the years before the dependency ratio deteriorates, the welfare gains of such a policy are likely to be small since taxes are not particularly distortionary. The present study supports their story (the welfare gains for the U.S. would be smaller than those found for the U.K.), but also indicates that their arguments are not valid for the typical European countries, where the public sector is larger and where the demographic development is somewhat more problematic.

5 Concluding remarks

The above analysis ignores several factors that can have important effects on public finances in the future. Most of these factors are discussed in other chapters in this volume. The contributions by Andersen, Huber and Norrman, and Pedersen et al. show that the process of increased internationalisation, tax competition between EU countries, and a more mobile labour force can make the collection of taxes more difficult. Such changes would be similar to an increased labour-supply elasticity, making taxes more distortive over time. Taking such factors into account would therefore make the case for reducing the debt today even stronger.

Implicitly, the study has also assumed that the generosity and structure of welfare and pension systems and public services are unaffected by the demographic

[23] Note that the study ignores business cycle fluctuations. A balanced-budget policy in the model economy is therefore less drastic than a real-world ditto.

change. The internationalisation and population ageing may imply that the generosity of welfare systems must be reduced or that welfare systems must be reformed. Households may then respond by increasing savings and labour supply, and thus reduce the importance of debt reduction today.

Furthermore, maintaining an unaltered level of public services may be difficult when the demographic structure changes. For example, even if consumption needs for children and old are identical and do not change over time, population ageing requires investments in the infrastructure (schools cannot easily be transformed into hospitals). Evidence reported in Bucht et al. (2000) shows that, at least in the short run, school expenditure does not seem to vary directly with the number of students.

There is little doubt that most developed countries will see an ageing of their populations in the coming 30 to 40 years. Still, forecasting the long-term future is difficult and associated with many sources of uncertainty. Lindh (this volume) reports that previous forecasts of survival probabilities have been biased downwards, and that nativity is volatile but difficult to predict. Nativity may also be influenced by policy, something which has been neglected here. Migration is another factor that is difficult to forecast (for example, migration flows may be influenced by war episodes or changes in immigration policies) but that can influence demographic structures.

Considering the above caveats, the implications of the model and experiments conducted should be interpreted cautiously. The following conclusions, however, do not appear daring. First, population ageing will put pressure on future public finances. In the long run taxes must be raised or public spending cut. Second, at least if intergenerational issues are ignored, welfare is enhanced if public debts are reduced during the next two or three decades. Finally, the welfare benefits of such policies compared to policies that hold debts constant are likely to be small or modest, except in countries with a large public sector and/or a large public debt.

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Table I
Country-specific parameters

	τ_0^h	τ^c	$\bar{d}$	$\bar{b}$	$\bar{g}$	w (%)
Belgium	0.397	0.187	1.110	0.163	0.192	1.53
Denmark	0.428	0.257	0.516	0.144	0.269	0.79
Finland	0.445	0.227	0.406	0.167	0.250	0.78
France	0.402	0.180	0.646	0.179	0.190	8.87
Germany	0.359	0.158	0.617	0.154	0.178	12.34
Italy	0.363	0.160	1.152	0.150	0.171	8.60
Netherlands	0.410	0.187	0.606	0.137	0.234	2.37
Norway	0.355	0.269	0.332	0.115	0.264	0.67
Portugal	0.227	0.205	0.554	0.108	0.170	1.48
Spain	0.304	0.137	0.706	0.129	0.156	5.95
Sweden	0.485	0.187	0.644	0.147	0.265	1.34
U.K.	0.210	0.169	0.492	0.147	0.112	8.83
Canada	0.287	0.131	0.825	0.070	0.192	4.68
USA	0.226	0.061	0.571	0.071	0.126	41.78
World	0.291	0.122	0.653	0.114	0.156	100.00

Note: w is the country's population weight.

Table II
Parameter values and initial steady state

Risk aversion	μ	2.000
Labour-supply elasticity	γ	0.300
Time discount rate	β	0.969
Capital-output ratio	$\bar{k}$	2.500
Capital share	θ	0.360
Interest rate	r	0.031
Hours worked, percent of available time	h	0.330
Tax on capital returns	τ^k	0.400

Table III
Implications of optimal policy: initial tax effect

	$\Delta\tau_{2001}$		
	$\{g,b\}$	$\{g_t,b_t\}$	constant *r*
Belgium	5.4	11.7	6.9
Denmark	6.9	14.0	8.4
Finland	8.3	17.2	9.7
France	4.6	13.0	5.9
Germany	4.4	16.2	5.4
Italy	6.8	20.6	8.0
Netherlands	8.1	20.5	9.2
Norway	5.2	11.0	6.3
Portugal	2.3	7.2	3.0
Spain	4.1	13.6	4.8
Sweden	5.4	12.4	7.0
U.K.	2.1	6.3	2.9

The table shows the tax increase (in percentage points) the first year with optimal policy.
Note: $\{g,b\}$ denotes the benchmark specification, $\{g_t,b_t\}$ denotes the specification where public expenditure depends on the population's age structure, 'constant *r*' denotes the specification with constant world market prices.

Table IV
Implications of optimal policy: necessary budget surplus

	first 10 years		first 30 years	
	$\{g,b\}$	$\{g_t,b_t\}$	$\{g,b\}$	$\{g_t,b_t\}$
Belgium	3.1	6.6	3.0	6.1
Denmark	2.8	6.0	2.1	4.5
Finland	3.4	7.2	2.3	4.7
France	2.5	7.0	2.3	6.0
Germany	2.7	7.8	2.7	7.2
Italy	4.0	10.7	4.2	10.6
Netherlands	4.1	10.1	3.7	8.4
Norway	2.5	5.9	2.1	4.8
Portugal	2.0	5.2	2.6	6.1
Spain	3.4	9.2	4.2	10.2
Sweden	2.5	5.7	2.7	5.0
U.K.	1.3	4.1	1.4	3.7

The table shows the average annual budget surplus (in percentage points) implied by optimal policy.
Note: $\{g,b\}$ denotes the benchmark specification, $\{g_t,b_t\}$ denotes the specification where public expenditure depends on the population's age structure.

Table V
Implications of optimal policy: change in public debt

	until 2010		until 2030	
	$\{g,b\}$	$\{g_t,b_t\}$	$\{g,b\}$	$\{g_t,b_t\}$
Belgium	-30.0	-60.9	-86.8	-182.7
Denmark	-26.5	-56.6	-65.2	-135.7
Finland	-32.8	-69.2	-71.3	-144.8
France	-24.1	-65.1	-68.0	-179.1
Germany	-26.2	-73.4	-81.4	-222.9
Italy	-38.7	-97.2	-124.6	-324.8
Netherlands	-40.0	-94.7	-116.1	-264.6
Norway	-24.0	-56.8	-64.1	-147.6
Portugal	-20.5	-50.6	-81.0	-184.6
Spain	-35.5	-88.2	-131.1	-319.3
Sweden	-23.7	-52.6	-80.1	-150.9
U.K.	-13.1	-39.6	-40.2	-120.9

The table shows the increase in debt (in percentage points) implied by optimal policy.
Note: $\{g,b\}$ denotes the benchmark specification. $\{g_t,b_t\}$ denotes the specification where public expenditure depends on the population's age structure.

Table VI
Welfare loss with balanced-budget policy

	benchmark	$\gamma = 0.1$	$\gamma = 0.5$	$\{g_t, b_t\}$
Belgium	0.24	0.06	0.75	n.s.
Denmark	0.21	0.05	0.67	n.s.
Finland	0.36	0.07	n.s.	n.s.
France	0.13	0.03	0.31	n.s.
Germany	0.12	0.03	0.28	n.s.
Italy	0.61	0.11	n.s.	n.s.
Netherlands	0.44	0.10	n.s.	n.s.
Norway	0.09	0.03	0.19	0.78
Portugal	0.06	0.02	0.10	0.43
Spain	0.25	0.07	0.56	n.s.
Sweden	0.51	0.08	n.s.	n.s.
U.K.	0.01	0.00	0.02	0.10

Note: Welfare loss in percent of annual consumption. N.s. = "no solution". $\{g, b\}$ denotes the benchmark specification. $\{g_t, b_t\}$ denotes the specification where public expenditure depends on the population's age structure.

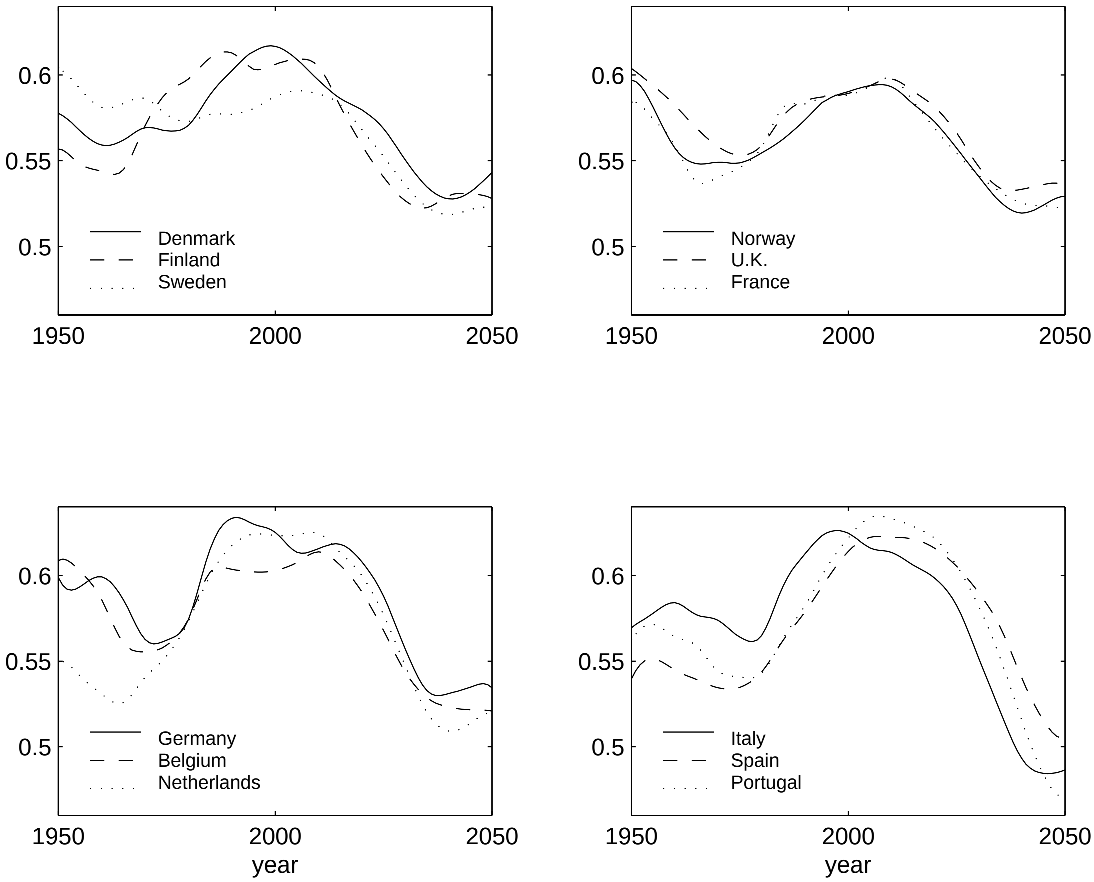

Figure 1: Share of people in working age (20-64)

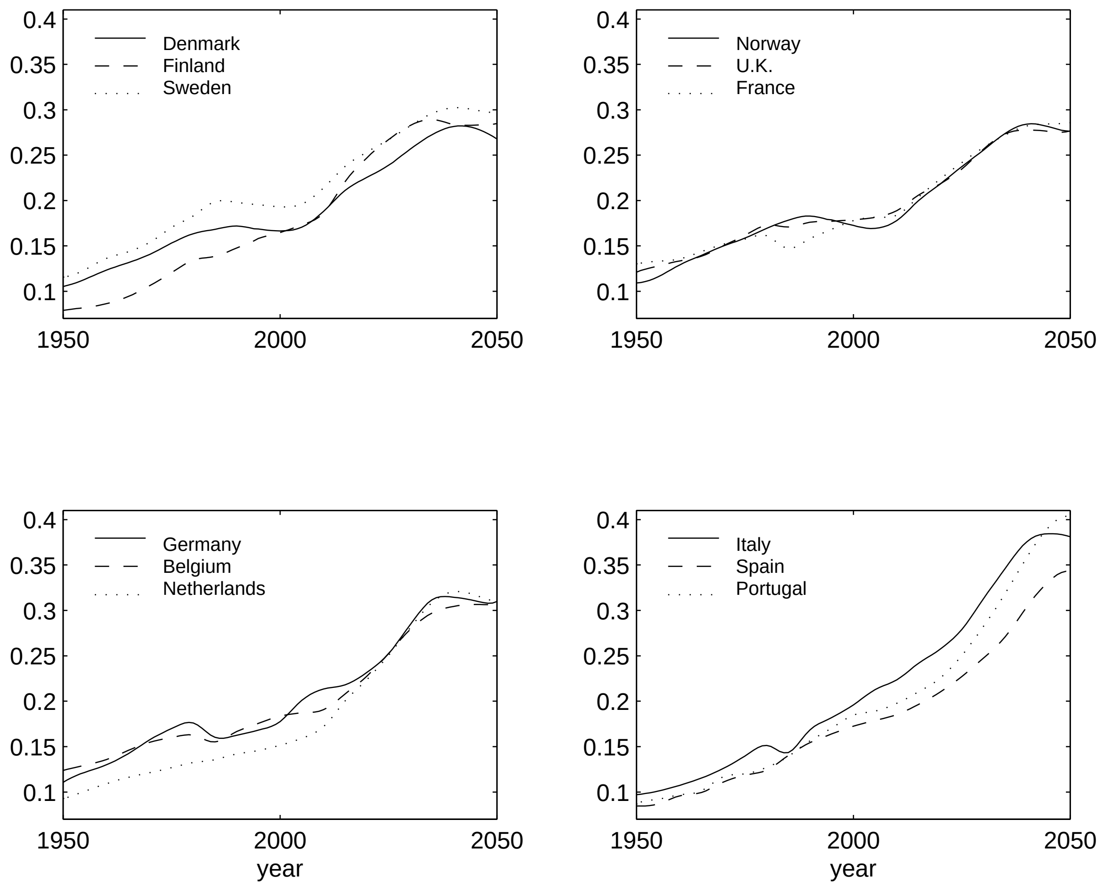

Figure 2: Share of old (65+) in population

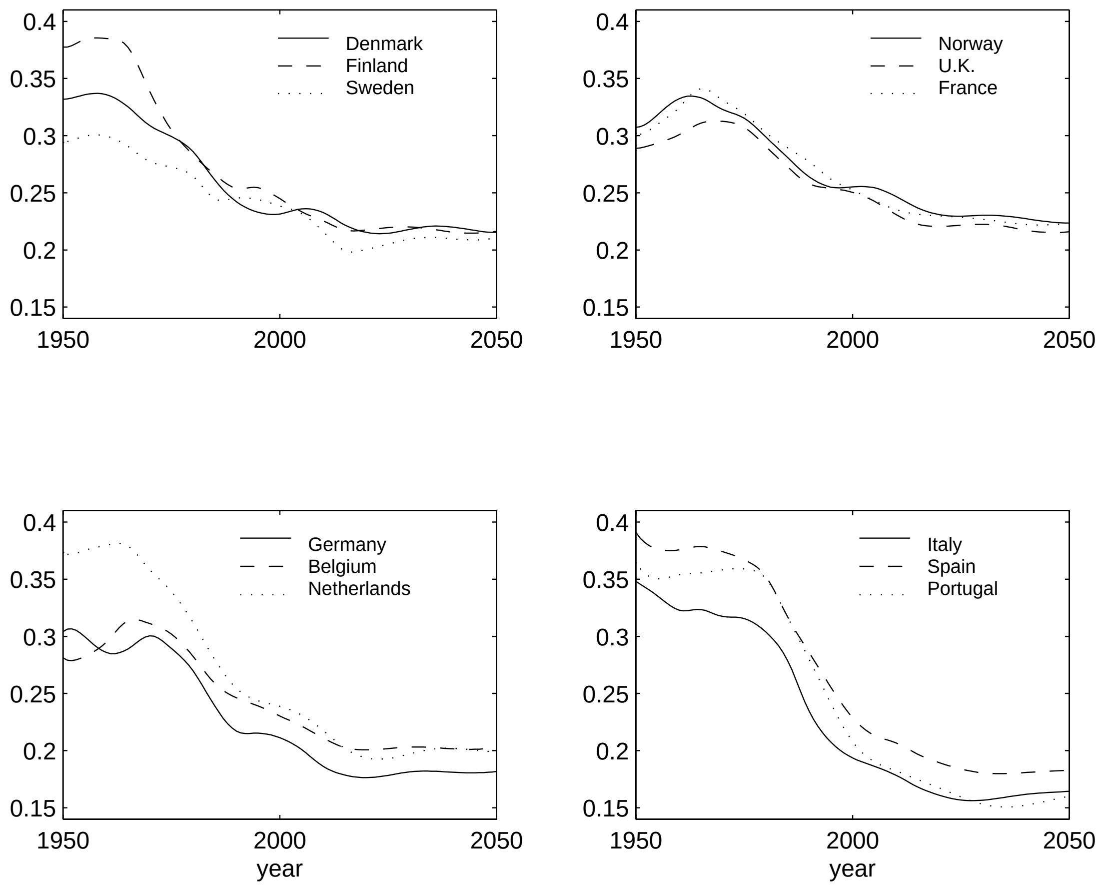

Figure 3: Share of young (aged 0-19) in population

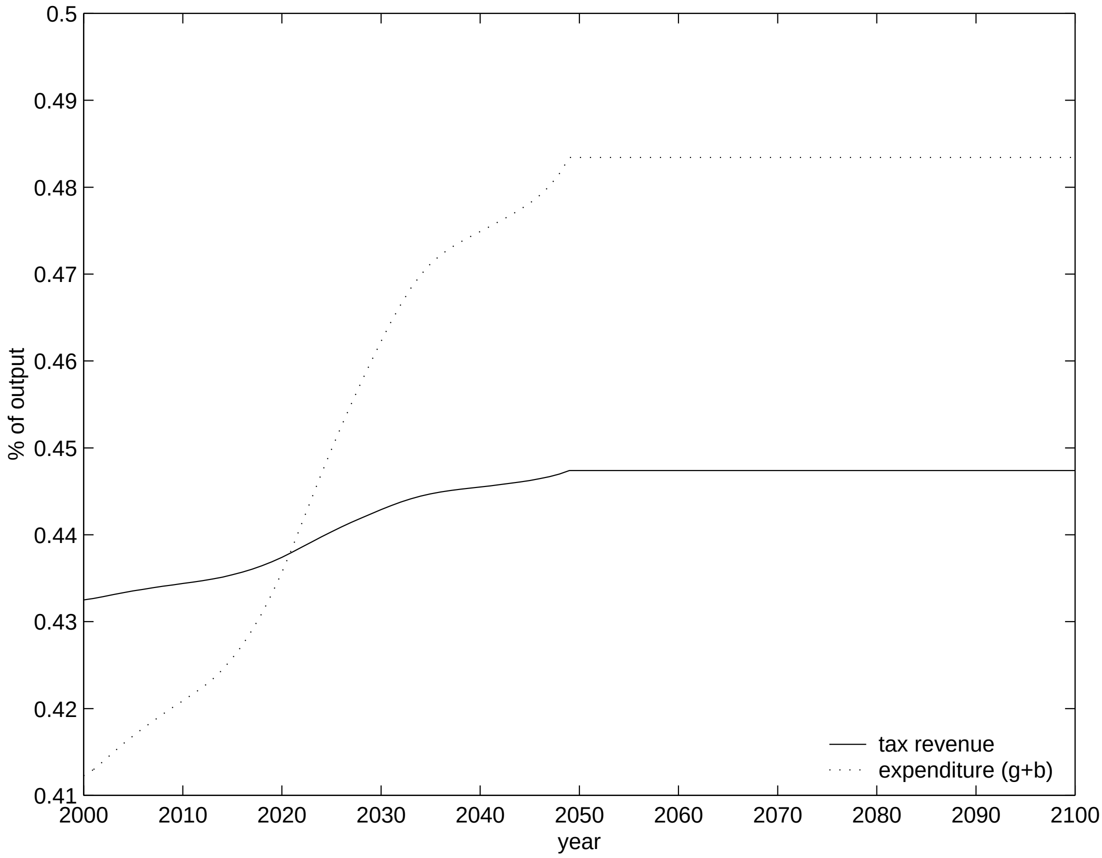

Figure 4: Direct impact of demographic change on public budget (Sweden)

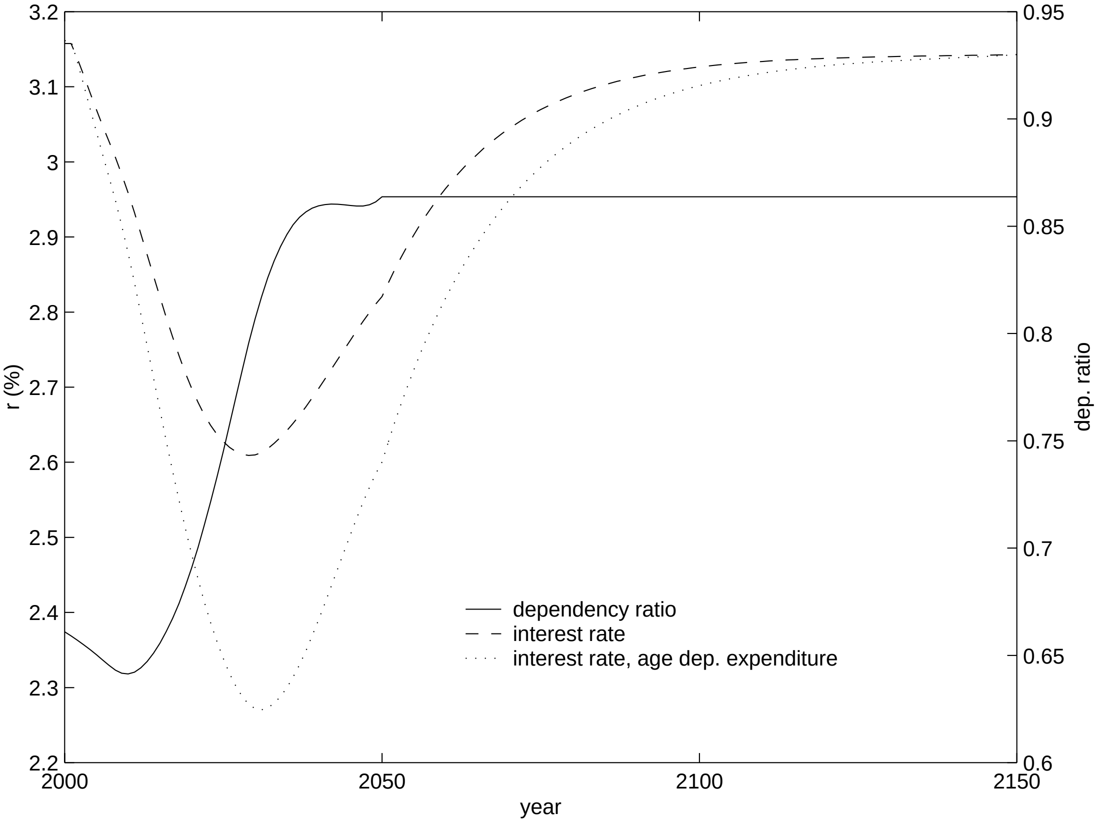

Figure 5: The world economy

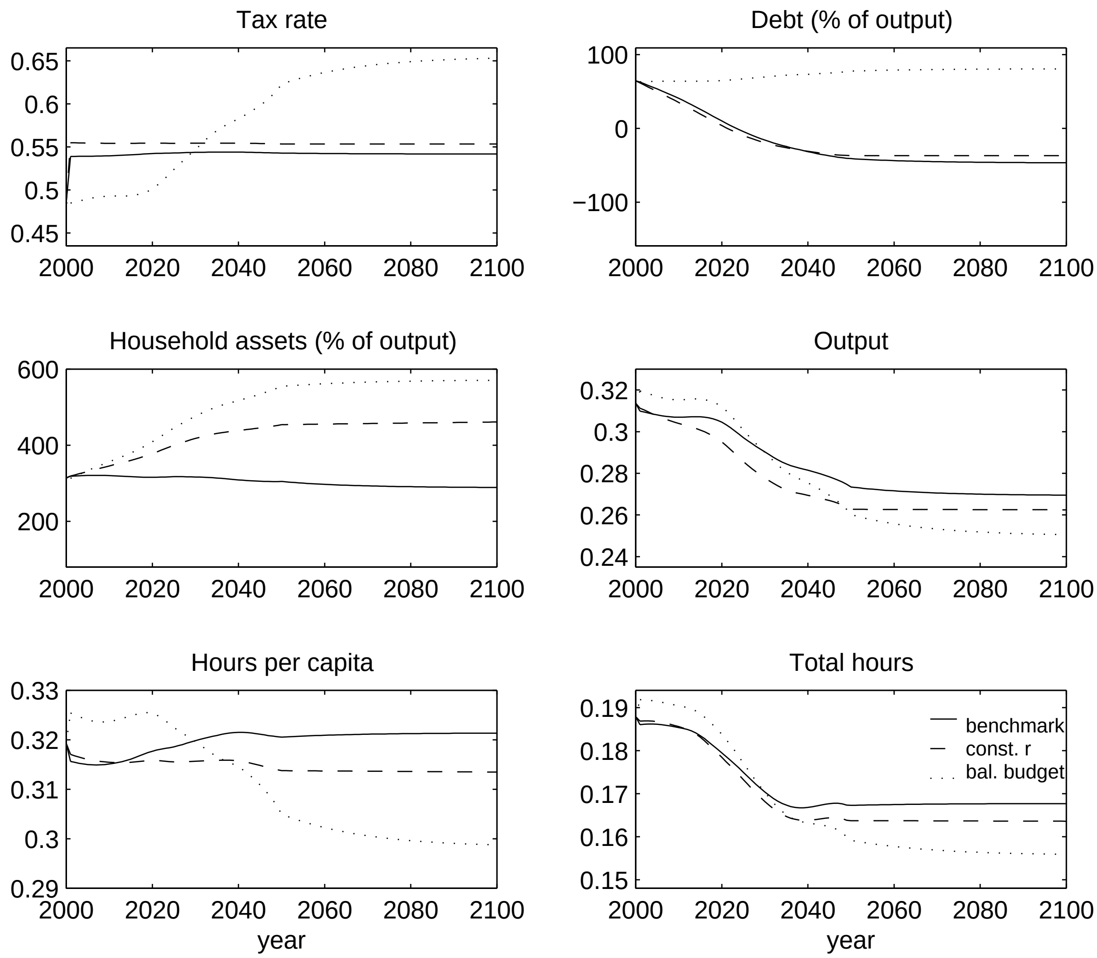

Figure 6: Implications of policy choices (Sweden)