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Distributional Effects of Fiscal Consolidation*

Svend E. Hougaard Jensen

Centre for Economic and Business Research, DK-2100 Copenhagen, Denmark
shj@cebr.dk

Thomas F. Rutherford

University of Colorado, Boulder, CO 80309-0256, USA
rutherford@colorado.edu

Abstract

If public goods and transfers are relatively more valuable to the poor, the elderly poor stand to lose from public debt reduction achieved through spending cuts. When long-term surpluses produced by debt reduction are recycled into higher provision of public goods and transfers, future generations of poor could gain. If future surpluses are recycled through lower labour taxes, working households in the future would be positively affected. The impact of debt reduction on vertical equity is ambiguous, yet inter- rather than intragenerational equity is likely to pose the greatest obstacle to fiscal consolidation. Based on majority voting by self-interested households, debt reduction is unlikely to occur.

Keywords: Public debt reduction; public goods; inter- and intragenerational redistribution

JEL classification: *D*91; *E*62; *H*23; *H*63.

I. Introduction

Since the early 1970s most European countries have experienced a considerable rise in their public debt–GDP ratios. Despite recent successful efforts to reduce deficits, debts are still high, and the sustainability of current fiscal policies has been cast into doubt. For example, Artis and Marcellino (1998) find that most EU countries fail to satisfy the solvency condition on the basis of their revealed behaviour in the past 20 years. The situation becomes even more pessimistic if sustainability indicators incorporate projected future events such as changes in the age structure of the population. For example, using the methodology of generational accounting, Raffelhüschen (1999) has reported that the average *true* public debt–GDP ratio is 130 percent, i.e.,

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more than twice as high as the debt threshold value set out in the Maastricht Treaty.

Unless modified, current fiscal policy in Europe is thus likely to pass huge tax bills onto future generations. In itself this seems to constitute a strong case for fiscal consolidation in Europe. Why is it, then, that so many countries find it so difficult to undertake fiscal consolidation? Possible explanations drawing on various political-economy models of government behaviour have been offered.[1] Similarly, it seems difficult to agree on painful measures to keep the budget balanced if fiscal restraint is widely perceived to be associated with not only a higher net tax burden on current generations, but also a more unequal distribution of their after-tax incomes. Such concerns about intragenerational equity appear to be well justified if deficit reduction is implemented through cuts in social assistance, such as sickness, unemployment and old-age benefits, or through more or less regressive indirect taxes. Since wage taxes are already high in Europe, deficit reduction is more likely to be achieved through expenditure cuts, or non-wage tax increases, than through higher revenues. Not least from a Nordic welfare state perspective, a programme of debt reduction could easily conflict with ambitious (re)distributive objectives.

With fiscal consolidation as a high-priority policy issue in Europe today, it seems important to arrive at a better understanding of how the gains and losses from deficit reduction are determined. In view of the weak empirical foundation of the so-called "expansionary fiscal contraction" hypothesis, as evidenced in Bergman and Hutchison (1999), most countries would most likely face a short-term trade-off between stabilisation and sustainability. More precisely, they would have to balance the short-term output/employment losses against some potential longer-term gains; see Hughes Hallett and McAdam (1998). While this macro trade-off is certainly important, the focus of this paper is on the perceived trade-off between inter- and intragenerational equity, i.e., the welfare problem of balancing the expected gains to be enjoyed by future generations against the potential worsening of the distribution of incomes among different groups of current generations.

Having this assessment criterion in mind, a number of fiscal design questions arise. For example: should the government strive to eliminate its outstanding debt, or should it rather pursue a less ambitious strategy of, say, consolidating the debt–GDP ratio at its current level, or adjust fiscal policy to comply with the 60 percent debt criterion? The answers here would clearly depend on the timing as well as on the magnitude of the fiscal adjustment needed to achieve a certain debt target. The choice of fiscal instrument is

[1]For example, high frequencies of turnover of government power and widespread formation of coalition governments in Europe have been found to constitute empirically relevant obstacles to debt reduction; see Alesina and Tabellini (1990) and Roubini and Sachs (1989).

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also important. In particular, should a tighter fiscal policy be implemented on the expenditure side or on the revenue side of the government budget? Recent evidence seems to suggest that the composition of fiscal adjustments also influences both their duration and their macroeconomic consequences. It has thus been found, as in Alesina and Perotti (1997), that fiscal adjustments which rely primarily on spending cuts on transfers and the government wage bill stand a good chance of becoming long lasting and expansionary. On the other hand, fiscal adjustments which rely primarily on tax increases and cuts in public investment tend not to last and may be contractionary.

Against this background, we focus solely on debt consolidation through contraction on the expenditure side of the government budget. We thus restrict our attention to alternatives of public debt reduction that avoid increases in average and marginal wage tax rates, and other tax increases. However, by focusing on reductions in the level of government provision and transfers, we consider a model in which there is a likelihood of adverse equity consequences. For this reason, the issue of timing is also considered: if debt reduction is undertaken over a 10-, 20- or 30-year horizon, which is the most likely to produce the least adverse distributional impact?

Deficit reduction implies a relaxation of future public budgets as debt repayment results in lower interest obligations. We consider two methods of *recycling* these revenues: reductions in future wage taxes and increases in the future provision of public goods and services. The key question is: to what extent can reduced interest obligations compensate different types of citizens for the austerity required to consolidate public debt?

Our model produces several surprising results. First, we find that *inter*- rather than *intra*generational equity is likely to pose the greatest obstacle to debt reduction. When we consider a programme in which debt reduction through short-term cuts in government expenditure is followed by increased provision of public goods financed by reductions in the interest obligations of future governments, the overall impact of the reform is positive from the standpoint of income equity. Furthermore, when we evaluate these outcomes formally, using an explicit social welfare function, we find that for discount rates of 2.5 percent or less, debt reduction programmes are beneficial.

The results are found using a general equilibrium model of Denmark, but we believe our findings and their policy implications are relevant for any (small) country in Europe. The specific results do, however, depend on a number of factors, including in particular the relative weighting of welfare impacts for older generations *vis-à-vis* younger or unborn generations. If a 1 percent equivalent variation in residual lifetime income for an older generation is counted on a par with a 1 percent change for the newly born, no debt reduction programme makes sense. If, on the other hand, all welfare impacts are measured on a lifetime basis (including past years for the older genera-

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tions), then debt reduction can be desirable. The model provides some hints as to the nature of the political opposition to debt reduction. If the electoral system is based on one-person, one-vote, then it places equal weight on young and old citizens, and the older citizens—who bear the burden of debt reduction without living long enough to reap the rewards—would (in the absence of intergenerational altruism) reject any such proposal.

From here the paper proceeds as follows. We first outline our analytical framework (Section II). After defining the scenarios and alternative performance criteria (Section III), we then discuss how fiscal consolidation could impact on welfare, from an inter- as well as from an intragenerational perspective (Section IV). Finally, conclusions and suggestions for further research are offered (Section V).

II. The Model

Basics

We have in mind a world in which public debt policy has distributional effects, both across and within generations. Changes in public debt thus act as an intergenerational transfer device, implying that reductions in the level of public debt provide benefits for future generations at the expense of current generations who would have to pay higher net taxes and/or face lower provision of public goods and services.[2] We also assume that households within the same generation are heterogeneous, in the sense that they earn different incomes over their lifetimes. Moreover, as a result of progressive income taxation and public provision of welfare services, the government redistributes purchasing power across different socio-economic groups within generations.[3] As expenditure cuts and revenue increases would impact differently on different classes of households, the redistributive capacity of public finances is clearly not invariant to the choice of fiscal

[2]This is unlike the result arising from infinitely-lived agent (ILA) models, where income transfers across generations are by definition absent, generally known as "Ricardian" equivalence between debt and non-distortionary taxes; see Barro (1974). As a special case, though, we can handle the presence of altruistically motivated bequests so that it becomes irrelevant, at least from a generational perspective, whether public expenditures in the model are financed by debt or by taxes.

[3]In order to focus attention on the expenditure side of the model, we have chosen to use a highly simplified representation of the system of direct taxation in Denmark. Our primary tax instrument is a wage tax, and all other direct taxes are represented through a lump-sum instrument. Due to these simplifications, we do not consider exogenous changes in the progressivity of income taxes as a means of addressing problems of intragenerational equity. Likewise, we maintain a fixed ratio of income transfers to public provision throughout the analysis.

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instrument. Finally, the government budget is assumed to be financed through distortionary taxes including a tax on labour supply.

To capture these features we constructed a dynamic general equilibrium model of a small open economy, *ad modum* the Auerbach and Kotlikoff (1987) OLG model. Figure 1 provides a sketch of the model which describes the behaviour of profit-maximising firms, overlapping generations of inter-temporally optimising households, divided into different income classes, and a government equipped with a menu of fiscal instruments. The model has no uncertainty, and there are rational point expectations of future prices (perfect foresight). Producers and consumers are perfectly competitive in that they take market prices as given.[4] The model is defined over 24 time periods for a 120-year time horizon and seven generational cohorts. Different life stages (education, work and retirement) are explicitly represented in the final

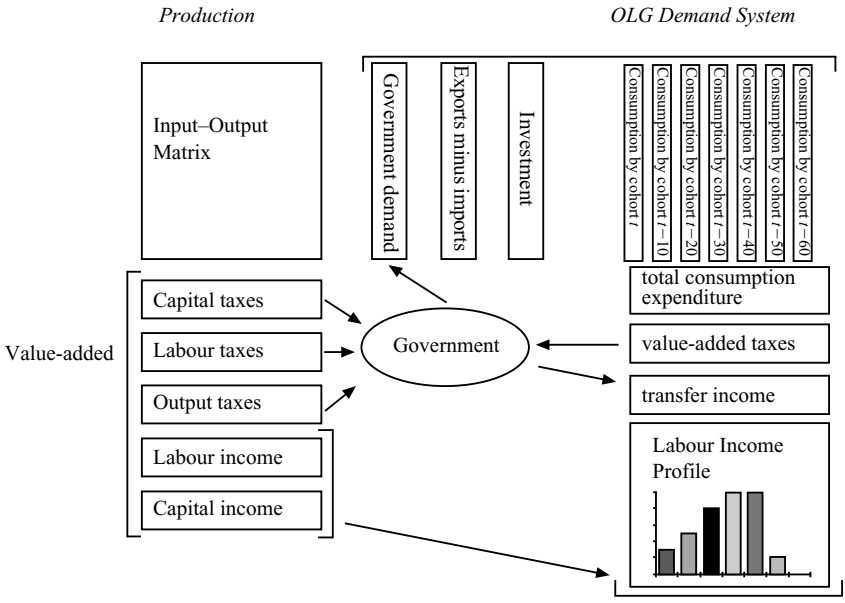

Fig. 1. The single-period equilibrium structure

[4]Although the neoclassical setting is adopted, we are well aware that a unionised labour market seems to be particularly relevant in a Nordic context. In Calmfors (1990), union models of wage formation have in fact been applied empirically with a reasonable degree of success to explain wage formation in the Nordic countries. Jensen (1997) offers an analysis of debt policy using a model with a unionised labour market and an OLG setting based on Blanchard (1985). The extension of our model to account for these labour-market features is left for future research.

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demand module. In the following we concentrate on the demand side of the economy.[5]

Households

The household side of the model is disaggregated both within and across generations. Seven new households corresponding to seven income classes enter the model in each period. Each household is characterised by overlapping generations which face an identical life cycle but different proportional levels of labour income throughout their lifetime. Generations differ with respect to the relative importance of public goods in aggregate consumption and the level of direct government transfer. Each generation has a known and finite lifespan in which they engage in market activities for 70 years. Each period in the model represents 5 years; hence in any given period there are $14 \times 7 = 98$ different households engaged in market transactions. Households are endowed with a fixed allocation of time in each period of their lifetime which they allocate to work or leisure.

Within a generation, households differ with respect to their labour endowments, transfer income and valuation of public output. In our central case, the valuation of public output is assumed to be uniform across the population; hence it represents a larger fraction of implicit expenditure for the poor than for the rich. Old generations enter the model endowed with labour and initial stocks of capital and debt. There is a perfect market for borrowing, and there is no risk of default. Net creditors in the initial year are assumed to hold debt and equity in common proportions.

Over time there is exogenous growth in labour supply which may be attributed either to population growth or to increases in labour productivity due to an external accumulation of human capital by society. For the purpose of computing market equilibria, it is really irrelevant whether growth of potential GDP is due to productivity growth or population growth. As we will see below, however, the distinction between these two components of the growth process can have important implications when we try to assess the social welfare consequences of debt consolidation. If growth occurs primarily through productivity, then future generations will be rich and there is not a strong argument for reducing their interest obligations. On the other hand, if growth is immiserising, then the case for debt consolidation is strengthened.

[5]The production side of the model is based on a conventional nested constant-elasticity-of-substitution (CES) technology with *ad valorem* taxes on labour, capital and output. Capital accumulation arises from intertemporal profit maximization by competitive firms. A more detailed description of the other parts of the model is available on request. The model is based on the MobiDK 1992 dataset aggregated to eight sectors; see Rutherford (2000).

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The endowment of labour services, measured in efficiency units, is assumed to vary both *across* and *within* generations. Younger generations of each household type have less work experience and consequently have lower labour productivity, as reflected in a lower endowment of labour services measured in efficiency units. Likewise, labour supply in efficiency units declines as generations age, reflecting assumptions about demand for leisure and retirement behaviour. No labour is supplied in the final decade of life, and in that period all consumption is financed out of accumulated savings. Within generations, richer households have a higher level of labour income over the life cycle and a corresponding higher share of assets. The labour supply schedules across households have an identical shape but a different magnitude.[6]

Figure 2 illustrates the baseline labour supply over a typical rich household's life cycle. The horizontal axis represents a generation of a given age. The curve labelled "labour" indicates each age group's share of aggregate labour services, "income" represents the fraction of present value lifetime

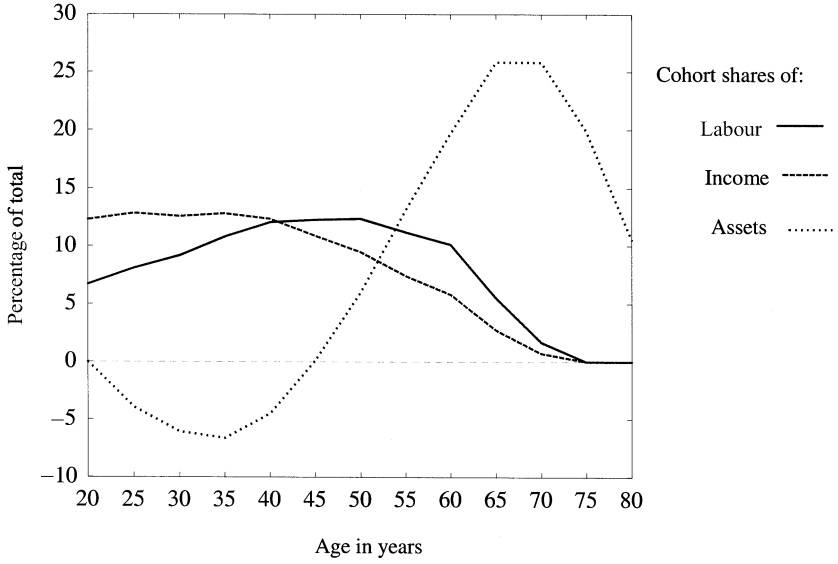

Fig. 2. Steady-state labour, income and equity shares by cohort

[6]In future development of our model we hope to improve the empirical basis for the model of labour supply for different households over the life cycle.

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income provided at different ages in the steady-state equilibrium with an interest rate of 5 percent. The curve labelled "assets" represents each cohort's share of the economy-wide stock of assets. These shares are negative for younger cohorts, reflecting borrowing in early years when the value of consumption exceeds the value of labour income. Each of these curves describes the decisions of generations on the baseline growth path in which relative prices of goods and labour determine (implicitly) labour supply over the life cycle and preferences for leisure and goods. We assume that along the baseline growth path, leisure demand in every period of life except the final decade equals 50 percent of the time allocated to work.[7]

Independent of our assumptions about labour supply and preferences for public output, individual households are assumed to allocate lifetime disposable income to consumption over their lifetime in order to maximise the present value of welfare. The intertemporal utility function is convex, consistent with the idea that a household smooths income by saving decisions. Hence, the household will save income in earlier periods to finance consumption during retirement. There are no bequests, and household h in generation g chooses a time path of leisure demand and private consumption which maximises the present value of utility over the life cycle, subject to an intertemporal budget constraint:

$$\max U_{gh}(\ell_{ght},\, C_{ght})$$

$$= \left[\sum_{t=g}^{g+T}\left(\frac{1}{1+\delta}\right)^{t-g} u_{h,t}(\ell_{ght},\, C_{ght},\, \overline{g}_t)^{\psi}\right]^{1/\psi}$$

$$= \left\{\sum_{t=g}^{g+T}\left(\frac{1}{1+\delta}\right)^{t-g}\left[\epsilon_h \ell_{ght}^{\rho} + (1-\epsilon_h)\left((1-\alpha_h)C_{gt}^{\gamma} + \alpha_h \overline{g}_t^{\gamma}\right)^{\rho/\gamma}\right]^{\psi/\rho}\right\}^{1/\psi}, \tag{1}$$

subject to

$$M_{gh} = \sum_{t=g}^{g+T} w_t \ell_{ght} + p_t C_{ght}(1+t^C), \tag{2}$$

[7]The assumption regarding the value of leisure demand is arbitrary in the present version of the model. Subsequent analysis could focus on differences in the time path of leisure demand over the life cycle and associated variations in the wage elasticity of labour supply.

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where

g identifies a generation by the period in which it enters the economy;
T stands for the number of periods that any generation lives;
δ represents the private single period (5-year) discount rate;
ℓ_{ght} represents leisure demand, a choice variable which indirectly determines labour supply, $L_{ght} = \overline{L}_{ght} - \ell_{ght}$;
C_{ght} defines aggregate consumption demand by household h, generation g in time period t;
$\overline{g}_t$ is the level of public provision, per capita;[8]
p_t is the present-value price of period t consumption;
w_t is the present-value wage rate for period t;
t^C is the VAT rate applying to consumption demand, as defined by base year statistics and held constant in all simulations;
M_{gh} is lifetime income for household type h in generation g, defined by initial endowments of initial assets or debt (if $g < 2000$), wage income over the life cycle, public-sector transfers and lump-sum taxes:

$$M_{gh} = \overline{A}_{gh} + \sum_{t=g}^{g+T} w_t \overline{L}_{ght} + H_{ght} - T^{LS}_{ght}. \tag{3}$$

The individual household derives utility from a composite of leisure and consumption. The share parameter in the utility function, ϵ_h, defines the relative valuation of leisure. The elasticity parameter ψ has been set to -1, which maintains an elasticity of intertemporal substitution equal to 0.5. The elasticity parameter ρ has been set to 0, which maintains a unitary elasticity of substitution between current consumption and leisure.

It is a common practice in general equilibrium analysis to calibrate supply and demand functions to base-year prices and quantities. The base-year financial statistics thereby define all the share parameters appearing in the production functions. There are "free elasticity parameters" which are not typically obtained from base-year statistics. These values control the second-order properties of the model and can be of considerable importance.

The present model gives rise to some additional difficulties in parameter specification which do not arise in a conventional model. For one thing, the explicit representation of public goods in the consumer preferences requires that we specify share parameters for these goods, even though such data are not provided in the dataset. The parameter α_h is the share parameter

[8]The public good is "congestible" only in the sense that as the economy grows, public goods and services must grow at an identical rate in order to maintain a steady state.

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representing the base-year valuation of public goods. In order to obtain this parameter, we have assumed in the reference case that the valuation of public goods in aggregate equals the marginal cost of production, and furthermore, that the valuation of public provision is constant across all individuals.

While the individual determines the private rate of consumption, utility is derived from an aggregate of private and government consumption goods; see e.g. Aschauer (1988). Per capita public output is represented in the model as a pure public good (non-congestible and non-rivalrous). If the government cuts down on its consumption expenditures in order to reduce public debt, there would be a positive "wealth" effect in the sense that resources previously expropriated by the government would now be available to the private sector. There would also be an effect of a cut in government consumption through its impact on the subjective evaluation of private consumption (i.e., a decrease in $\overline{g}_t$). We assume that the marginal valuation of public provision is uniform across households, and therefore the public good receives a higher-value share in the utility functions of poor households. Specifically, we have set the elasticity parameter $\gamma = -1$ which maintains an elasticity of substitution between private and public goods in current consumption equal to 0.5.

Public transfers and public provision are held in fixed proportions during all simulations, and household shares of public transfers are also fixed, hence

$$\sum_{gh} H_{ght} = \phi_{ght} p_t^G G_t, \quad \forall g,\ h,\ t. \tag{4}$$

Data and Calibration

The database underlying the model consists of the most recent (1992) Input–Output (IO) table from Statistics Denmark. As is customary in applied general equilibrium analysis, the model is based on economic transactions in a benchmark year, in this case 1992. Benchmark data determine parameters of the functional forms from a given set of benchmark quantities, prices (expressed in present value) and elasticities. The IO database covers outputs and intermediate inputs, factor earnings, imports and the final demand categories (consumption, investment, government expenditures and exports). Prices in the benchmark year are normalised to unity for calibration purposes, so monetary values can be interpreted as physical quantities in the benchmark year. The database also contains tax revenues by type and social contributions. Base-year financial statistics indicate the value of payments to capital and the gross value of capital formation. Using these data, the baseline growth rate, the depreciation rate, the interest rate and the consumption path over the life cycle are selected in order to ensure consistency with a

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Table 1. *Principal characteristics of the seven socio-economic groups*

Household	Labour share	Population share	Transfers per capita	Expend per capita
H1 (poorest)	1	4	9,161	51,947
H2	8	17	3,212	73,313
H3	12	24	2,028	112,063
H4	19	20	1,764	189,830
H5	30	19	1,395	288,282
H6	20	10	2,023	380,017
H7 (richest)	11	7	1,853	503,516

Source: Statistics Denmark, 1989 expenditure survey.

balanced steady-state growth path. Finally, relevant data on each socio-economic group in the model are based on the most recent expenditure survey (1989) from Statistics Denmark; see Table 1.[9]

III. Evaluating Fiscal Consolidation

Fiscal Scenarios

Our analysis of fiscal consolidation begins with the annual budget identity, stating that the deficit run by the government through year t is equal to the change in the stock of debt between (beginning-of-years) $t+1$ and t:

$$p_t^G G_t + H_t - T_t + rD_t = B_t - R_t = D_{t+1} - D_t, \tag{5}$$

where all variables are expressed in present values. $p_t^G G_t$ is the value of public spending on goods and services, H_t is transfer payments, T_t is the tax revenue, r is the real interest rate, D_t is the outstanding stock of debt, B_t is additional borrowing and R_t is repayment of the principal. The government revenue is obtained from a range of indirect taxes. In the present analysis we consider revisions in wage taxes. All other indirect taxes are held constant in percentage terms and lump-sum direct taxes are held fixed in real value.

In the reference growth path, there are no repayments on the principal, nor

[9]The dataset indicates a relatively low level of income transfers to households. Future revision of these data is warranted. We performed sensitivity analysis wherein we increased the level of transfers above those indicated in the table. In the simulations we first set up a balanced growth path as a check on logical consistency of the dataset. Subsequently we introduced interest payments on an initial stock of public debt, causing lower levels of public provision and transfers along the reference growth path.

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is there additional borrowing. Debt repayment affects the net public expenditures in current and future periods according to the equation:

$$N_t = R_t + rD_t - B_t = R_t + r\left(D_0 - \sum_{\tau=0}^{t}(R_\tau - B_\tau)\right). \tag{6}$$

The public budget can then be written:

$$p_t^G G_t + H_t + N_t = T_t. \tag{7}$$

In our fiscal consolidation scenarios we only consider financing debt repayments through variations in the level of public goods/services and transfers during the repayment period. Tax rates are held constant and the level of public provision is determined by the public-sector budget constraint.[10]

The magnitude of debt reduction is assumed to be equivalent to 75 percent of base-year public expenditure.[11] Three alternative timetables for debt reduction are compared, including time horizons of 10, 20 and 30 years. In all cases, the present value of payments are identical. In each of these scenarios, the extra net revenue is used to reduce the government's financial net debt, and there will be no discretionary fiscal adjustment, such as a cut in tax rates. By the end of the period of fiscal consolidation, a new fiscal policy scenario would need to be launched; otherwise debt reduction would just continue. Two alternative strategies are considered, one in which lower interest obligations are recycled as an increase in public output and transfers. In a second simulation we assume that revenues are recycled through lower wage taxes.

Performance Criteria

Most countries that undertake a programme of debt reduction would have to balance some short-term costs against some potential longer-term gains,

[10]Another approach, as in Hansen, Jensen and Junge (1999), would be to model fiscal policy in terms of a target debt–GDP ratio, with the government budget adjusted ("controlled") period-by-period so as to ensure that the debt ratio converges smoothly on its targeted rate according to a certain timetable.

[11]The empirical relevance of such an adjustment may be quite substantial. For example, in a typical Scandinavian welfare state, where both the public debt–GDP ratio and the ratios of public expenditures and revenues to GDP are around 60 percent, fiscal contractions of that order might cause some social and economic distress unless the transition period is drawn out. This intuition shows up in our formal analysis where we find that longer transition periods typically produce greater social benefit than rapid, short-term programmes.

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including more solid public finances, a higher capital stock, a higher level of consumption per capita and a larger stock of net foreign assets. However, rather than conducting an explicit evaluation of some macroeconomic responses to contractionary fiscal adjustments, we address the more fundamental task of measuring the change in economic welfare for specific generations, with alternative assumptions about timing and composition of the fiscal adjustment, private valuation of public goods and "social preferences". For this purpose, we use an intertemporal index of equivalent variation (EV).[12]

To shed specific light on inequality within generations, we use the Gini coefficient (Γ_t) as a summary indicator of the distribution of lifetime incomes across the seven socio-economic groups under different contingencies. The value of the coefficient ranges from 0 to 1. When $\Gamma = 0$, the income distribution is perfectly egalitarian. When $\Gamma = 1$, all income is concentrated in the hands of a few. The Gini coefficient measures the area under the Lorenz curve, here approximated by:

$$\Gamma_t = 1 - 2\sum_{gh} \alpha_t^{gh}\left[\frac{\beta_t^{gh}}{2} + \sum_{\{g',h'\}} \delta_{g'h'}^{gh}\beta_t^{g'h'}\right], \tag{8}$$

in which α_t^{gh} represents the period t population share for household h in generation g, β_t^{gh} represents the income share for the same generation/household and $\delta_{g'h'}^{gh}$ is an indicator function which is equal to unity only if generations g and g' are both living in period t, and the lifetime income of household h' in generation g' is less than the lifetime income of household h and generation g which are also living in period t. This expression is simply an approximation of the integral of the Lorenz curve defined by lifetime income.

Next, in assessing the aggregate impacts of the scenarios, we apply a very direct social welfare function approach. Specifically, we assume that aggregate welfare can be measured as:

$$EV_{SWF} = \left(\sum_{g,h} \theta_{gh} U_{gh}^{1-1/\sigma}\right)^{1/1-1/\sigma} - 1, \tag{9}$$

[12]This is found by first calculating the level of discounted lifetime utility (consumption expenditure net of the disutility of work) obtained by every household in the reference equilibrium of the model and then, for the same households, calculating the level of discounted lifetime utility after the relevant debt reduction programme has been initiated and given the initial set of prices. The net lifetime welfare gain or loss is given by the difference between the two.

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where σ is an index of the elasticity of substitution across welfare gains for different agents, and θ_{gh} is a weighting factor which accounts for discounting and population:

$$\theta_{gh} = N_{gh}(1 - \tilde{\delta})^{g}. \tag{10}$$

In this expression N_{gh} is the number of households represented by the generation and household type, and $\tilde{\delta}$ is a parameter which discounts the contribution of future generations to aggregate social welfare. When $\tilde{\delta}$ is larger, then the welfare of future generations plays a smaller role in defining social welfare; contrariwise, when δ is small, then it is mainly impacts on current generations that matter for social welfare. Social welfare is also influenced by the interhousehold substitution elasticity, σ, which captures trade-offs in welfare for households born at different times and in different income classes. Finally, the utility index associated with generation g and household h, U_{gh}, is important. Consumers can define utility either over the horizon of the model, looking forward, or they can define utility over lifetime consumption, including (for older generations) consumption in periods prior to the first period of the model.

IV. Results

We now report simulation results from public debt reduction obtained under alternative assumptions about the distribution of the valuation of public goods, the use of the surplus (public goods provision versus tax reductions), and the timing of the debt reduction programme (slow versus fast). Sensitivity analysis with respect to selected elasticity parameters is also performed.

As a starting point we illustrate the time profiles of the public provision of goods/transfers (Figure 3) and the wage tax (Figure 4) for each of the four scenarios which constitute the basic set of results. The required cutbacks in public provision of goods and transfers are identical in present-value terms across the four scenarios, but the profiles differ depending on how fast the adjustment is implemented and how the resulting surplus is recycled. Scenarios 2010, 2020 and 2030 involve debt reduction over two, three and four decades, respectively. In all of these cases, public-sector cutbacks in the early period result in reductions in debt service payments which produce public-sector surpluses in later periods. The final scenario shows the case where induced public surpluses are "spent" on reduced wage taxes, henceforth referred to as "wage tax recycling". In this scenario public-sector output is curtailed up to 2020, but thereafter the public-sector output remains fixed. This scenario could be seen as expressing what some European (welfare) states have formulated as an important objective: a gradual

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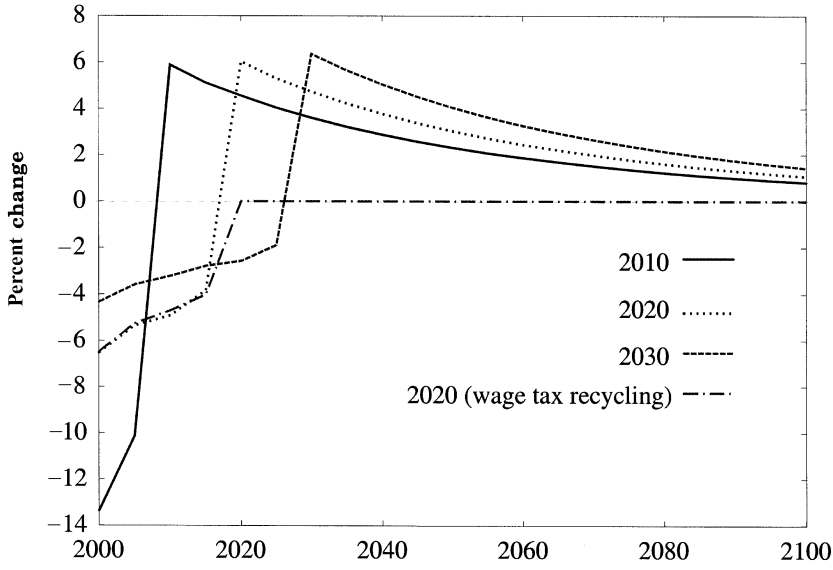

Fig. 3. Level of public provision under alternative scenarios

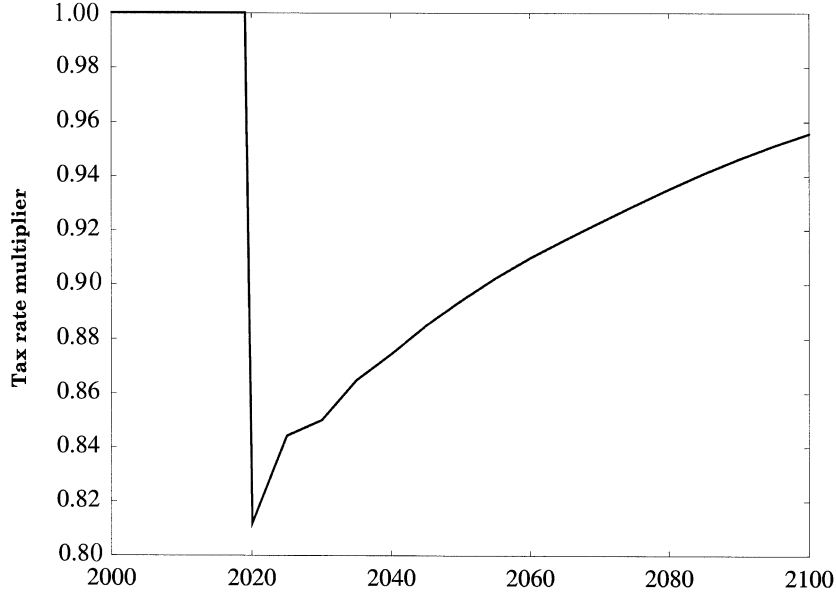

Fig. 4. Wage tax multiplier: 2020 repayment target

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reduction in the size of government so as to pave the way for a lower tax burden.

Figure 4 shows that public output follows a declining path during the recycling period. The reason is that the baseline growth path involves a constant level of public debt, the interest payments for which were deducted from all future government budgets. The economy-wide GDP is growing along the baseline, so the interest payments on outstanding debt represent a decreasing share of the public budget into the future. When the debt is eliminated there is thus a larger percentage surplus generated for governments in the near future than for governments in the distant future. Figure 4 shows what happens to the wage tax in the case of wage tax recycling. Note that the wage tax rate remains at its reference level through 2020, and it only begins to fall when a surplus develops.[13]

While demonstrating that the spending cuts may be quite substantial, particularly in the initial stages of the consolidation programme, these trajectories offer no additional insights into explaining the gains and pains from debt reduction. For that purpose an explicit welfare analysis is called for. Figure 5 shows alternative welfare metrics for the central scenario, where the debt target is achieved by year 2020, through temporary cuts in public goods and transfers and with the resulting surplus recycled into higher levels of public provision and transfers. The percentage welfare changes (EV) are measured along the vertical axis, while the different generations are ordered along the horizontal axis, with generations becoming successively younger as we move from left to right. For each current and future generation we also show the welfare impacts on a "poor" (H1) and a "rich" (H7) household, respectively.

This experiment is seen to cause a significant amount of welfare redistribution. Intergenerationally, the welfare impacts depend on each generation's remaining lifetime, i.e., the benefits obtained during the "recycling period" would have to be balanced against the burdens incurred during the "repayment period". Intra-generationally, what matters is the distribution of the valuation of the public goods across socio-economic groups. We find that all future generations and some younger members of current generations gain, especially the poor who have the highest relative valuation of public goods. The losers are the elderly poor, because the compensation to poor households in the future does nothing to help the elderly poor who live through the period of debt reduction. The welfare impact critically depends on whether the EV is defined over the residual life ("future") or on a lifetime basis ("lifetime"). Figure 5 thus illustrates that for households of elderly

[13] An attractive feature of this analysis is the use of complementarity programming to represent the regime switch from cutbacks in government outlays to decreases in the taxation of labour income in precisely the time period where the public sector moves from deficit into surplus.

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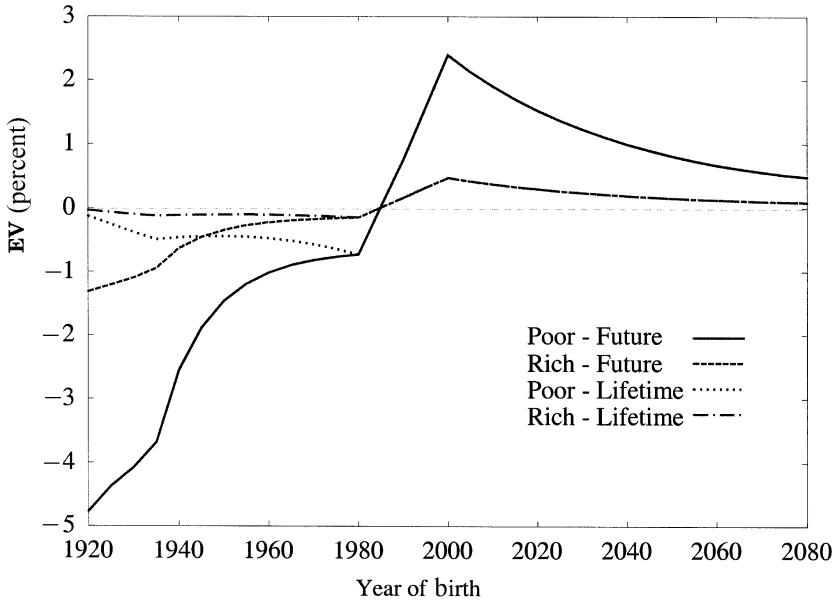

Fig. 5. Alternative welfare metrics (2020 debt reduction target)

poor, a "future" evaluation has quite dramatic effects, whereas the effects based on a "lifetime" calculation are almost negligible. From a political economy perspective, this distinction may be quite important. If a programme of debt reduction were subject to a referendum, voters would most likely vote on the basis of the "future" assessment criterion. For example, why should a generation of elderly poor vote in favour of fiscal consolidation with only minor lifetime welfare effects if the spending cuts would lead to a substantial welfare reduction over their remaining lifetime?

In the introduction it was hypothesised that the likelihood of adverse intragenerational equity consequences to be associated with public expenditure cuts would constitute an obstacle to debt reduction. Figures 6 and 7 seek to illustrate this "rich versus poor" dimension of fiscal consolidation. Figure 6 considers the welfare impact of our four scenarios in the poorest household. The results range from enormous adverse effects with a short-term debt reduction programme, −10 percent for 2010, to at most −3 percent with a 2030 target. Future generations of poor fare much better with public goods recycling where surpluses are allocated to increasing both public goods and transfers. Figure 7 goes through the same scenarios with the rich household. Here we have substantially smaller adverse effects for the older generations, with less than a 3 percent loss under a 2010 debt reduction target. Future rich households are most positively affected by wage tax recycling.

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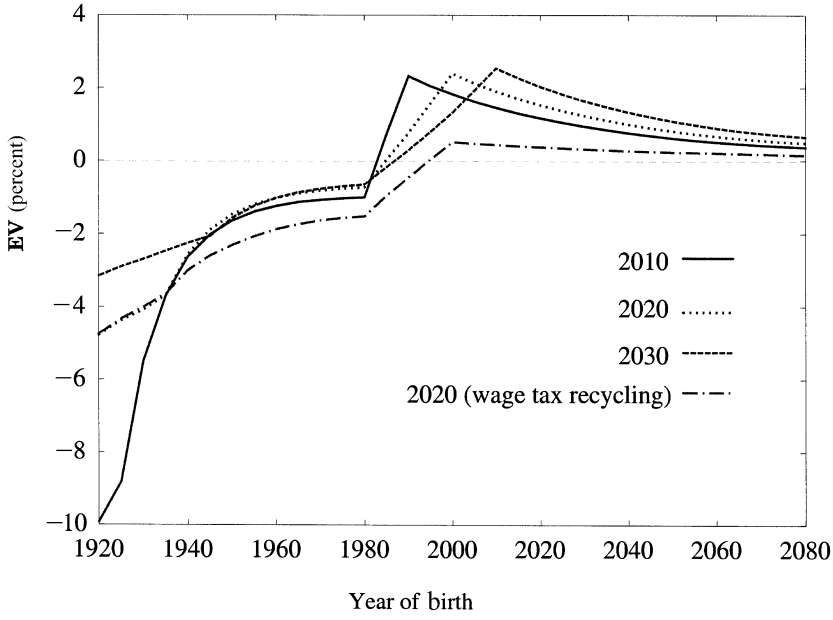

Fig. 6. Welfare impacts for poorest quintile

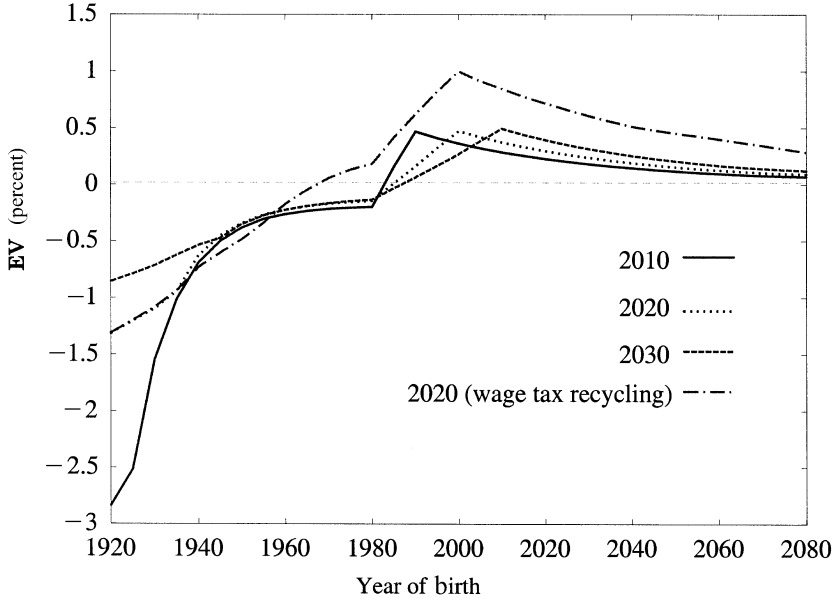

Fig. 7. Welfare impacts for richest quintile

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It is interesting to observe that with drawn-out fiscal consolidations, the overall impact of a reform may even be positive from the standpoint of income equity. Although it is the elderly poor who are hit most severely by cuts in the provision of public goods, that fall in welfare may be smaller than the welfare gains enjoyed by poor members of yet unborn generations.

Two interpretations can be derived from this. First, inter- rather than intragenerational equity is likely to pose the greatest obstacle to debt reduction. Under the wage tax recycling programme, the poor are adversely affected during the transition, and they are not really helped by the future surplus. Second, if fiscal consolidations achieved through transient spending cuts followed by expenditure recycling are more equitable than spending cuts followed by (wage) tax recycling, prototype welfare states (such as the Nordic countries) would be unlikely to opt for the latter strategy.

The results for different households depend in a rather important fashion on how the utility parameter describing preference for public goods is calibrated (not shown). When we assume that the marginal valuation is uniform across all households, then α_h tends to be relatively larger for the poor households, and there is then much greater dispersion of welfare impacts. On the other hand, if we assume that private valuation of the public good is proportional to private consumption, then there is virtually no difference in welfare impacts for households apart from differences in the level of income transfers.

Figure 8 takes a first stab at considering whether debt reduction is desirable from a social standpoint. It should be emphasised that while Figures 6 and 7 are based on forward-looking utility indices (defined over consumption in 2000 and later), we instead employ lifetime utility indices in constructing the EV_{SWF}. In this way, we treat all generations on a consistent basis.[14]

Note in Figure 8 that the planner has to regard a slow programme of debt reduction as optimal. Of the two revenue recycling options we consider, it seems that increasing transfers and public output generates the most significant improvement in the SWF (apparently due to the improvements in welfare for future poor generations). Also note in Figure 8 that social welfare gains are only apparent if the social discount rate is sufficiently small, less than 2 percent.

Figure 9 provides an alternative perspective on the distributional effects of debt elimination. Here we portray the time profile of the Gini coefficient, Γ_t, under each of the four scenarios. Changes in Γ_t are actually very small, which is not so surprising because most of the household income levels

[14]If "future" welfare were used in the SWF, it would indicate a substantial decline in the SWF as a result of debt elimination.

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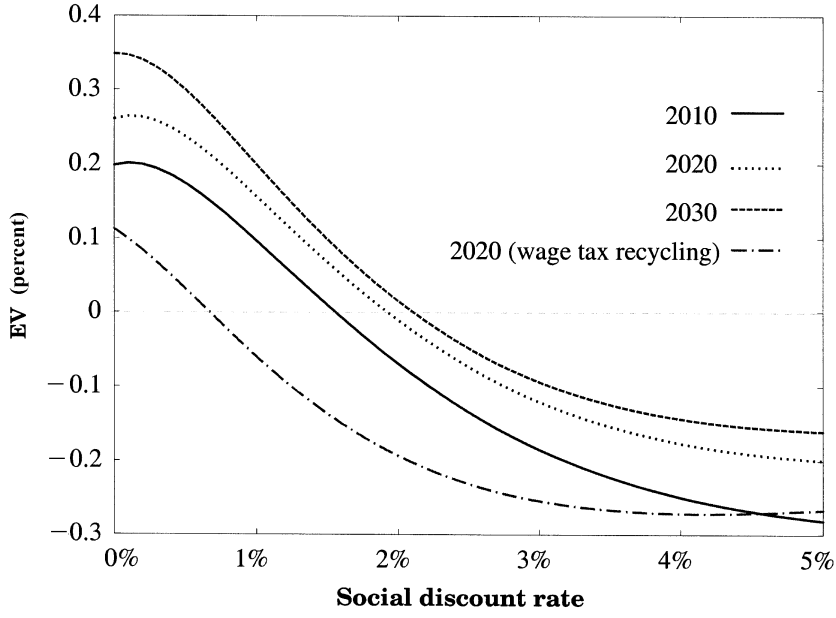

Fig. 8. Social welfare assessment of alternative scenarios

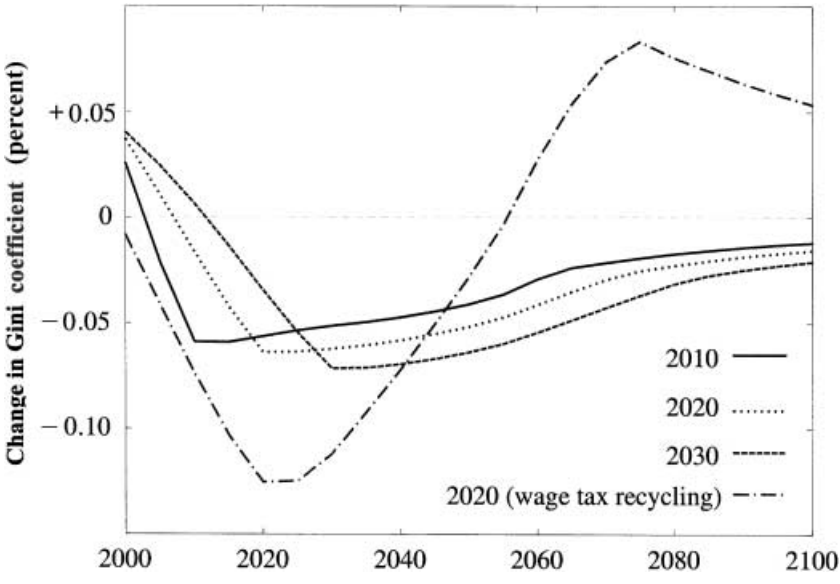

Fig. 9. Income distribution and the timing of debt consolidation

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move in parallel. A decrease in the Gini coefficient corresponds to an increase in equality. Note that for the most part, the Gini coefficient is decreasing through the time frame, except with wage tax recycling, in which case equality is declining following the wage tax cut in 2020. This finding also points to the belief that welfare states with ambitious redistributive objectives would be reluctant to combine debt reduction with future tax cuts.

A final perspective on the social desirability of different debt reduction programmes can be provided by conducting a "democratic referendum" on debt reduction in each period of the model. For this purpose, we assume that votes for or against debt reduction are based on the lifetime welfare effects of those cohorts who are alive in every period. In periods prior to 2020, the reform is easily rejected, whereas after 2030 the reform would be passed. In years between 2020 and 2030, the outcome depends on the timing of the debt reduction programme and the revenue recycling option. Of course, there is a time consistency problem here. Future generations want current generations to cut back on public output and reduce the public debt, yet if the debt were to remain unpaid they themselves would not choose to undertake the cutbacks in the future. The political assessment is quite stark: debt reduction is a policy alternative which may be beneficial from a welfare perspective, yet it would almost surely be voted down in a referendum.

Figure 10 concludes with a simple comparison of SWF results for alternative cardinalisations of welfare. This figure reminds us that the SWF by itself does not automatically judge the desirability of debt elimination. As the debt reduction programme involves both winners and losers, we first have to decide how gains by some households and generations should be traded off with losses by others. Figure 10 shows that if a more utilitarian approach ($\rho = 1$) is adopted, then debt reduction is desirable over a wide range of discount rates, yet if the social welfare metric places greater weight on equity ($\rho = 0.25$), then debt reduction is undesirable for virtually any positive discount rate.

A final comment on the utility function choice relates to assumptions regarding the baseline growth path. In these calculations, we have assumed that all the baseline growth is associated with population growth. If we were to alternatively assume that baseline growth is entirely the result of improving labour productivity, then the welfare calculus would need to change reflecting higher levels of consumption by future generations.

V. Conclusions

The formation of monetary union in Europe has led to pressure for public debt reduction. Indeed, the Stability and Growth Pact invokes a commitment to conduct fiscal policy so as to produce a "medium-term budgetary position of close to balance or in surplus". In view of the current stance of public

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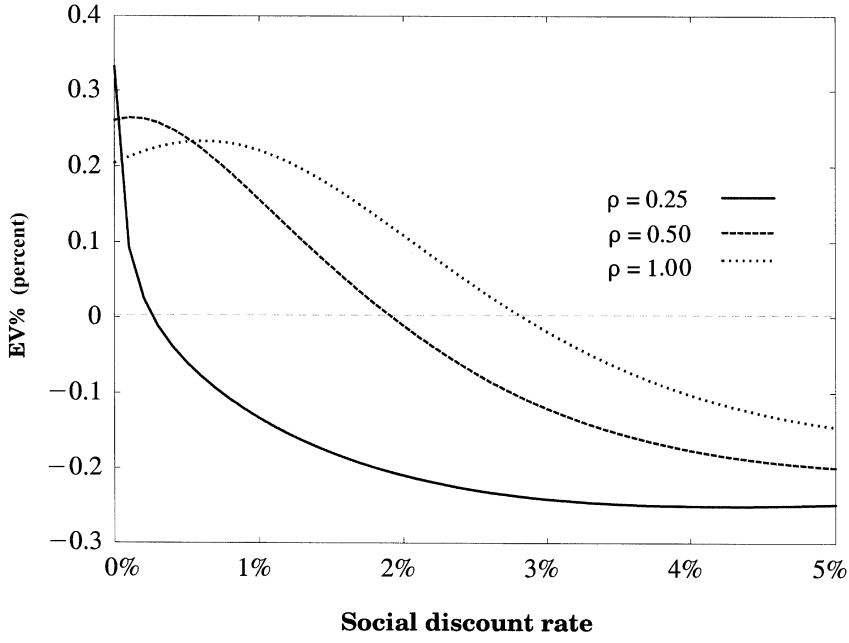

Fig. 10. Sensitivity of social welfare to inequality parameter

finances in most EU countries, this would typically require a substantial fiscal contraction. This paper has considered a variety of issues related to contractionary fiscal adjustments, focusing on inter- as well as intragenerational welfare effects.

The basic messages of the analysis can be summarised as follows:

(i) Intragenerational equity need not be sacrificed for fiscal consolidation, provided that short-term cuts in public provision are restored (with an interest dividend) for future generations.
(ii) The most likely obstacle to fiscal consolidation emerges from an intergenerational conflict in objectives. Older generations who bear the burden without reaping the gains are the likely obstacle to reform, particularly in a one-person, one-vote Western democracy.
(iii) The definition of a formal welfare metric is fraught with difficulty, but in any case it seems that slow (30-year) programmes of debt reduction are preferred to fast (10-year) programmes.

This analysis represents a modest first step towards a more complete empirical assessment of public debt reduction alternatives in a small open economy with large-scale government involvement in pursuit of redistribu-

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tive objectives. There are a number of shortcomings in our current model: we do not incorporate pensions and retirement decisions, demographic projections, nor do we introduce features of the system of direct taxation. Despite all of these deficiencies, we find the results to be quite thought provoking, as it is clear that the design of fiscal consolidation programmes requires a careful balance between inter- and intragenerational fairness. Further work is clearly needed to provide an assessment of the conclusions based on the simple model analysed in this paper.

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