Employment and growth in Europe and the US – the role of fiscal policy composition *

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Abstract

We construct a simple endogenous growth model to analyse the relationship between the composition of fiscal policy, economic growth and employment. The government sets different tax rates on labour income, capital income and private consumption to finance productive expenditures, utility-enhancing consumption expenditures and transfers related to structural non-employment. Our model is able to explain the different employment and growth records of European countries and the US since the 1990s. We use the model to investigate the strength of the effects of various fiscal policy shocks on steady state employment and growth. We also develop the transitional dynamics for many variables, including welfare. Our results highlight the trade-offs that may occur between performance indicators, and between the short and the long-run.

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1. Introduction

A growing body of recent literature attempts to explain the differences in employment and growth between Europe and the US during the last decades. The general perception is that the US has outperformed Europe on both indicators. When it comes to employment, many researchers emphasize the level and the evolution of taxes on labour (see e.g. Roeger and De Fiore, 1999; Daveri and Tabellini, 2000; Prescott, 2004; Ohanian *et al.*, 2006). Taxes in the US are low, whereas countries like Germany, France and Italy show high and rising taxes during the last decades. Other authors emphasize differences in the desire for leisure (Blanchard, 2004; Alesina *et al.*, 2005). Cultural differences or differences in unionization and labour market regulations may be at the basis of a higher European taste for leisure. A recent third hypothesis explains higher employment in the US as the result of a much more extensive shift of traditional household production to the market (Freeman and Schettkat, 2005). Lower taxes on labour and higher degrees of labour market flexibility in the US may be among the factors that have contributed to this shift. When it comes to growth, differences in market flexibility are again at the centre of the discussion. Various authors see higher entry costs, less intense competition and lower firm turnover as an important part of the explanation for Europe's disappointing growth since the 1990s (e.g. Nicoletti and Scarpetta, 2003; Aghion and Howitt, 2006).

There is no doubt that these hypotheses contain relevant elements to account for contrasting employment and growth records at both sides of the Atlantic. However, they are also incomplete. First, with the exception of Roeger and De Fiore (1999) and Daveri and Tabellini (2000), all the above mentioned papers focus on only one side of the performance gap, either employment or growth, and neglect the other side. Second, each of these hypotheses will have difficulty explaining macroeconomic performance in the Nordic countries. Countries like Sweden, Norway and Denmark also have high taxes, which increased during the last decades. They also combine many of the European labour and product market 'rigidities' (see e.g. Nicoletti and Scarpetta, 2005). Yet, as we show in Table 1 for 1995–2004, the average employment rate in persons in the Nordic countries is about the same as in the US. The employment rate in hours is lower than in the US, but it is still much higher than in the core countries of the euro area or in 'convergence' countries like Spain and Ireland. The Nordic countries have also experienced faster potential *per capita* growth than most core countries of the euro area. With the exception of Sweden, growth in the Nordic countries was at least as high as in the US, or even higher.

Our main objective in this paper is to construct a simple dynamic theoretical model which explains both employment and growth in a coherent framework, and which can account for the cross-country differences reported in Table 1. The paper emphasizes the role of the composition of fiscal policy, i.e. the level and the mix of taxes and government expenditures. We allow for three kinds of taxes (taxes on labour income, capital income and consumption taxes) and three categories of government expenditures (productive expenditures, consumption and transfers related to structural non-employment). We find that the Nordic countries perform better than the core euro area mainly thanks to a higher share of productive government expenditures and lower non-employment transfers. Moreover, on average, taxes on labour are slightly lower in the Nordic countries. Growth in these countries also benefits from lower taxes on capital. To finance higher productive expenditures and lower capital and labour taxes, the Nordic countries pay lower transfers and collect higher consumption taxes. Differences in fiscal policy, in particular much lower tax rates on labour and much lower transfers related to structural non-employment, can also explain a significant part of the better employment performance of the US compared to Europe. Relatively low productive government expenditures and high taxes on capital income, however, explain why *per capita* growth in the US is much less outstanding.

Table 1 Employment and growth: Europe and the US (1995-2004)

	employment rate persons (in %)[α]	employment rate hours (in %)[β]	real *per capita* potential GDP growth (average annual, in %)[β]
Core euro area			
Austria	68.7	56.4	1.85
Belgium	58.9	48.2	1.81
France	61.0	48.1	1.77
Germany	65.6	50.3	1.38
Netherlands	71.0	50.3	2.18
Italy	54.6	45.8	1.44
Average	**63.3**	**49.9**	**1.74**
Nordic countries			
Finland	65.8	59.9	2.21
Denmark	76.3	58.6	1.92
Norway	78.0	56.0	2.71
Sweden	74.3	62.4	1.85
Average	**73.6**	**59.2**	**2.17**
Convergence EU			
Spain	55.8	52.7	2.29
Portugal	70.8	64.1	2.05
Ireland	62.6	55.6	5.22
Average	**63.1**	**57.4**	**3.17**
US	**75.1**	**71.3**	**1.93**
Switzerland	79.9	64.9	1.43
UK	72.7	64.9	2.14

Notes: Employment rate in persons is the ratio of total employment to population of age 15 to 64; Employment rate in hours is the ratio of average annual hours worked per person of age 15 to 64 to 1920. It has been calculated as the employment rate in persons times the ratio of average annual hours per employed worker to 1920. We consider 1920 to be the number of hours of a full-time worker (48 weeks times 40 working hours per week); *Per capita* GDP is GDP per person of age 15 to 64.
Sources: [α] OECD, Department of Employment and Social Affairs, historical series; [β] OECD (2005), Economic Outlook.

Two recent studies develop ideas which are close to ours. Rogerson (2007) makes the same argument that the composition of government expenditures is important for the effects of taxes. He also shows how different expenditures may explain relatively high employment in the Nordic countries, despite high taxes. However, his model does not explain growth. Doménech and García (2008) demonstrate that the effect of taxes on (un)employment may differ as a function of the efficiency with which the government transforms taxes into public goods or transfers.

In the second part of this paper we use our model to simulate the effects of changes in the composition of government expenditures and revenues on employment and growth, starting from the core euro area average as our benchmark. We consider both long-run equilibrium effects and transitional dynamics. We also pay attention to welfare effects. Our simulations reveal the relative size of the effects, and the trade-offs that exist, for instance when core euro area countries change their fiscal policies to a more Nordic or a more American composition.

The structure of this paper is as follows. In Section 2 we build our model. In Section 3 we calibrate it on actual data, we confront its predictions with the data reported in Table 1 and we present the results of a wide range of simulation exercises. Section 4 concludes the paper.

2. The model

We investigate the relationship between the composition of fiscal policy, employment and growth in a simple endogenous growth framework. Our model brings together a number of features present in the literature developed since Barro (1990). We first situate our model within this literature. Then we construct and discuss it. We analyse both steady state effects of fiscal policy shocks and related transitional dynamics.

2.1 Background

Growth in our model is determined by the accumulation of physical and (effective) human capital. Early work in this tradition, paying particular attention to the role of tax policy, has been done by King and Rebelo (1990), Rebelo (1991), Stokey and Rebelo (1995), Mendoza *et al.* (1997) and Milesi-Ferretti and Roubini (1998). More recent research has shed light also on the influence of the composition of government expenditures (see e.g. Devarajan *et al.*, 1996; Glomm and Ravikumar, 1997; Turnovsky, 2000, 2004; and Agénor, 2008).

Although there are differences, our setup in this paper is closest to Turnovsky (2000). We also model employment and growth endogenously as functions of different tax rates on labour income, capital income and consumption, and different kinds of productive and non-productive government expenditures. Our results confirm that endogeneity and elasticity of labour supply may reinforce the effects of income tax changes on growth, as emphasized before by Stokey and Rebelo (1995) and Mendoza *et al.* (1997). Endogeneity of labour supply may also imply negative growth effects of consumption taxes. Conversely, faster growth and capital formation may contribute to higher employment.

As to non-productive expenditures, we introduce utility-enhancing public consumption and transfers related to structural non-employment (inactivity). Such transfers are a fact of life in many European countries. Ample empirical evidence shows that they matter for (un)employment and growth (see e.g. Blanchard and Wolfers, 2000; Arjona *et al.*, 2002; Nickell et al, 2005; Lindert, 2004). Investigating their effects in a theoretical model of endogenous growth and employment is one of the contributions of this paper.

Unlike Turnovsky (2000) and many others (e.g. Barro, 1990; Glomm and Ravikumar, 1997; Agénor, 2008), we model the effects of productive government expenditures as a stock in the production function. Since stocks rather than their flows matter in private production, this is clearly more appropriate. Arrow and Kurz (1970), Futagami *et al.* (1993), Turnovsky (1997) and Turnovsky (2004), among others, adopted this approach before. More precisely, we introduce productive government expenditures in the private production function as a determinant of the stock of effective human capital. We think of education spending, active labour market expenditures, R&D expenditures and public investment. More such expenditures either contribute to faster accumulation of human capital, or raise the productive efficiency of accumulated human capital. Glomm and Ravikumar (1997) and Capolupo

(2000) developed models before, where the increase in human capital is uniquely linked to productive government (education) expenditures. The hypothesis that public investment and infrastructure services may also matter for aggregate human capital, next to education expenditures, has been developed recently by Agénor (2008). Still, our approach may seem narrow considering the wider class of endogenous growth models with human capital. We would consider it a promising avenue for further research to extend our model also allowing for private inputs into human capital accumulation (see e.g. Lucas, 1988; King and Rebelo, 1990; Rebelo, 1991; Milesi-Ferretti and Roubini, 1998; Blankenau and Simpson, 2004). Another relevant avenue could be to allow different kinds of productive government expenditures to affect private production and growth along different channels, as has been done by Devarajan *et al.* (1996) and Agénor (2008).

Like in most of the above mentioned contributions, fiscal policy shocks in our model have permanent effects on long-run growth. The empirical evidence in favour of permanent growth effects, however, is not strong (see e.g. Jones, 1995; Mendoza *et al.*, 1997), although Kneller *et al.* (1999) argue that the evidence may be biased because of the incomplete formulation of the budget constraint. To our advantage, the fact that long-run growth may be independent of fiscal policy variables does not imply that these are unimportant for long-run economic performance. Turnovsky (2004) shows important effects on the equilibrium level of key variables. He also finds sizeable and long-lasting effects on transitional growth after a shock. As a result, when one focuses on a relatively short period of time, as we do in this paper (see Table 1), the endogenous growth model and the neoclassical approach generate similar predictions.

2.2 Setup of the model

Consider a closed economy consisting of N identical individuals with infinite lives and perfect foresight and N identical perfectly competitive firms. Population remains constant. For the sake of simplicity we normalize N to 1. Assuming an equal number of individuals and firms implies that each firm's output equals *per capita* output.

2.2.1 Firms

Firms produce output by using physical capital and effective labour. The production function exhibits constant returns to scale, which allows us to focus on a representative firm.

$$y_t = k_t^{1-\beta}(h_t l_t)^{\beta} \qquad (1)$$

where y_t, k_t and $h_t l_t$ stand for output *per capita*, physical capital *per capita* and effective labour *per capita* at time t respectively. The evolution of physical capital is determined by the individuals' savings behaviour, to be discussed below. Effective labour depends on hours worked *per capita* (l_t) and effective human capital *per capita* (h_t). Effective human capital increases both in accumulated schooling or training and in the productive efficiency of accumulated schooling. It is our assumption that effective human capital is driven by *per capita* productive government expenditures (g_{yt}). It does not depreciate over time.

$$\dot{h}_t = q g_{yt} \qquad \text{with } q > 0 \qquad (2)$$

with q a productivity parameter. Obvious components of g_{yt} are education spending, active labour market expenditures, public fixed investment and public R&D expenditures. The former two components directly contribute to more human capital being accumulated, the latter two will mainly raise the productive efficiency of accumulated human capital. Individuals and firms take g_{yt} to be exogenous.

Firms hire labour and physical capital up to the point where their marginal products equal the real wage per hour and the real interest rate respectively.

$$w_t = \beta k_t^{1-\beta} h_t^{\beta} l_t^{\beta-1} = \beta h_t \left(\frac{h_t l_t}{k_t} \right)^{\beta-1}$$
$$r_t = (1-\beta)\left(\frac{h_t l_t}{k_t} \right)^{\beta} \qquad (3)$$

2.2.2 Individuals

The representative individual's welfare is given by the intertemporal utility function:

$$U = \int_0^\infty u(c_t,(1-l_t),g_{ct})e^{-\rho t}dt \qquad (4)$$

where c_t is *per capita* private consumption at time t, l_t *per capita* hours worked in the market sector and g_{ct} government consumption. $\rho > 0$ is the pure rate of time preference. To keep things simple, we normalize the maximum number of hours to one. By consequence, $(1-l_t)$ indicates *per capita* hours devoted to useful non-market activities and leisure. In what follows we will define l_t as the employment rate.

We further define instantaneous utility in eq. (5). Our log-linear specification in private consumption and 'leisure' is not uncommon in equilibrium macroeconomics – see, for instance, Baxter and King (1993), Roeger and De Fiore (1999) and Prescott (2004).[1] Many authors also introduce utility-enhancing public spending separable from private consumption. Among them, Baxter and King (1993) do not further specify a functional form. Park and Philippopoulos (2004) and Agénor (2008) in his initial model, for instance, also adopt a logarithmic specification on public consumption.[2]

$$u(c_t,(1-l_t),g_{ct}) = \ln(c_t) + a\ \ln(1-l_t) + \kappa\ \ln(g_{ct}) \qquad \text{with } a, \kappa > 0 \qquad (5)$$

[1] It is well known that log utility is restrictive in the sense that it implies an intertemporal elasticity of substitution equal to 1, whereas the bulk of empirical estimates are lower. All of our main results, however, go through for the more general CES utility function (see our brief discussion in Section 3.3.3).
[2] Our assumption of additive separability deviates from the approach in e.g. Turnovsky (2000, 2004) who introduces public spending in a non-separable way. Most of the empirical evidence, however, would not reject our assumption (see e.g. Karras, 1994; Pozzi, 2003).

The parameter a specifies the relative value of non-market activities and leisure versus private consumption, κ indicates the relative value of public consumption.

Individuals will maximize (4), taking into account (5), subject to the following resource constraint

$$\begin{aligned}\dot{k}_t &= (1-\tau_l)w_t l_t + (1-\tau_k)r_t k_t + b_t(1-l_t) - (1+\tau_c)c_t + z_t \\ &= (1-\tau_l)\beta y_t + (1-\tau_k)(1-\beta)y_t + b_t(1-l_t) - (1+\tau_c)c_t + z_t\end{aligned} \quad (6)$$

with k_t the individual's capital holdings, τ_l the tax rate on wage income, τ_k the tax rate on capital income, τ_c the consumption tax rate, b_t a *per capita* transfer related to non-employment and z_t a lump-sum transfer paid by the government. The second line in (6) uses the result following from (3) that *per capita* wage and capital income are constant fractions of *per capita* output. Like human capital, physical capital is assumed not to depreciate.

2.2.3 Government

The government runs a balanced budget. Productive expenditures, consumption and transfers related to non-employment are financed by three kinds of taxes.

$$\begin{aligned}g_{yt} + g_{ct} + z_t + b_t(1-l_t) &= \tau_l w_t l_t + \tau_k r_t k_t + \tau_c c_t \\ &= \tau_l \beta y_t + \tau_k(1-\beta)y_t + \tau_c c_t\end{aligned} \quad (7)$$

Following Turnovsky (2000, 2004), we assume that the government claims given fractions of output for productive expenditures and consumption:

$$g_{yt} = \sigma_y y_t, \quad g_{ct} = \sigma_c y_t \qquad \text{with } \sigma_y, \sigma_c > 0 \quad (8)$$

Transfers (b_t) are an unconditional source of income support related to inactivity ('leisure') and non-market household activities. Although it may seem strange to have such transfers in a model without involuntary unemployment, one can of course analyse their employment and growth effects as a theoretical benchmark case (see also van der Ploeg, 2003; Rogerson, 2007). Moreover, there is also clear practical relevance. Unconditional or quasi unconditional benefits to structurally non-employed people are a fact of life in many European countries (see Table 3 below). In eq. (9) we assume that the transfer b_t is proportional to after-tax *per capita* wage income according to the replacement rate, v.

$$b_t = v(1-\tau_l)w_t l_t = v(1-\tau_l)\beta y_t \tag{9}$$

Substituting eqs (8) and (9) into (7), we can re-write the budget constraint as:

$$z_t / y_t = \tau_l \beta + \tau_k (1-\beta) + \tau_c \varphi - \sigma_y - \sigma_c - v(1-\tau_l)\beta(1-l_t) \tag{7'}$$

where we define that $c_t / y_t = \varphi$.

2.2.4 Optimization

The individual's objective is to maximize lifetime utility, subject to the resource constraint (6) and taking w_t, r_t, g_{yt}, g_{ct}, z_t, b_t, τ_l, τ_k and τ_c as given. The present value Hamiltonian for this problem is:

$$H_t = \left[\ln(c_t) + a\ln(1-l_t) + \kappa \ln(g_{ct})\right]e^{-\rho t} + \lambda_t \left[(1-\tau_l)w_t l_t + (1-\tau_k)r_t k_t + b_t(1-l_t) - (1+\tau_c)c_t + z_t\right]$$

Performing the optimization and dropping time subscripts yields:

$$\gamma_c = \frac{\dot{c}}{c} = (1-\tau_k)(1-\beta)\left(\frac{hl}{k}\right)^{\beta} - \rho \tag{10}$$

$$\gamma_k = \frac{\dot{k}}{k} = \left[(1-\sigma_y - \sigma_c) - \varphi\right]\left(\frac{hl}{k}\right)^{\beta} \tag{11}$$

$$\frac{a}{1-l} = \left[(1-\tau_l)\beta k^{1-\beta} h^{\beta} l^{\beta-1} - b\right]\frac{1}{(1+\tau_c)}\frac{1}{c} \tag{12}$$

Equation (10) is the usual Euler equation for the optimal growth rate of consumption over time γ_c. This equation describes intertemporal optimality. Agents decide to invest more, and to have a higher growth rate of consumption over time, the higher the after-tax marginal product of physical capital and the lower the rate of time preference. Equation (11) follows from the individual's resource constraint (6) after dividing both sides by *k*, and taking into account the government budget constraint (7') as well as the result that $\frac{y}{k}=\left(\frac{hl}{k}\right)^{\beta}$. Equation (12) describes the intratemporal optimality condition between labour (consumption) and 'leisure'. The left hand side of this equation represents the marginal utility of non-employment, the right hand side is the net marginal utility of working. The latter rises in the marginal utility of consumption $(1/c)$ and in the net marginal after-tax consumption possibilities induced by employment $\left[(1-\tau_l)\beta k^{1-\beta}h^{\beta}l^{\beta-1}-b\right]\frac{1}{1+\tau_c}$.

2.3 Steady state

In order to find equilibrium growth and employment rates in terms of the parameters of the model, we first re-write eq. (2) using that $g_y=\sigma_y y$. This yields an equation for the growth rate of effective human capital

$$\frac{\dot{h}}{h}=\gamma_h=q\sigma_y\frac{y}{h}=q\sigma_y l\left(\frac{hl}{k}\right)^{\beta-1} \tag{2'}$$

from which we can derive an expression for $\left(hl/k\right)^{\beta}$.

$$\left(\frac{hl}{k}\right)^{\beta}=\left[\frac{ql\sigma_y}{\gamma_h}\right]^{\beta/(1-\beta)} \tag{13}$$

Next, using (9) we can re-write (12) as an equation for $c/y=\varphi$.

$$\frac{c}{y}=\varphi=\beta\frac{1}{a}\frac{(1-l)}{(1+\tau_c)}\left[\frac{(1-\tau_l)}{l}-v(1-\tau_l)\right] \tag{14}$$

Our final equation for intertemporal optimality (15) follows from substituting eq. (13) into the Euler eq. (10). Substituting eqs (13) and (14) into (11) yields eq. (16) which is consistent with intratemporal optimality, private agents' resource constraint and government budget balance.

$$\gamma_c = (1-\tau_k)(1-\beta)\left[\frac{ql\sigma_y}{\gamma_h}\right]^{\beta/(1-\beta)} - \rho \tag{15}$$

$$\gamma_k = \left[\frac{ql\sigma_y}{\gamma_h}\right]^{\beta/(1-\beta)}\left[(1-\sigma_y-\sigma_c)-\beta\frac{1}{a}\frac{(1-l)}{(1+\tau_c)}\left(\frac{(1-\tau_l)}{l}-v(1-\tau_l)\right)\right] \tag{16}$$

Since along the economy's balanced growth path the growth rates of *per capita* consumption, output, physical capital and human capital are all equal ($\gamma_c = \gamma_k = \gamma_y = \gamma_h$), eqs (15) and (16) determine the equilibrium values of γ and l, consistent with both individual optimization, firm optimization and the government budget constraint.

2.4 Transitional dynamics

To analyse the transitional dynamics of the economy about its balanced growth path, we basically follow the procedure explained in Turnovsky (1997, 2004). First, we express the system in terms of three stationary variables: (i) the effective human to physical capital ratio ($\omega = h/k$), (ii) the private consumption to physical capital ratio ($\chi \equiv c/k$) and (iii) the employment rate (l). Next, given the production function and eqs (10), (11) and (12), the transitional dynamics can be expressed as follows:

$$\frac{\dot{\omega}}{\omega} = \frac{\dot{h}}{h} - \frac{\dot{k}}{k} = \left[\frac{q\sigma_y}{\omega} - (1-\sigma_y-\sigma_c)\right]\omega^{\beta} l^{\beta} + \chi \tag{17}$$

$$\frac{\dot{\chi}}{\chi} = \frac{\dot{c}}{c} - \frac{\dot{k}}{k} = \left[(1-\tau_k)(1-\beta)-(1-\sigma_y-\sigma_c)\right]\omega^{\beta} l^{\beta} - \rho + \chi \tag{18}$$

$$\dot{l} = F(l)\left\{\omega^{\beta} l^{\beta}\left[(1-\beta)(\sigma_y+\sigma_c-\tau_k) - \frac{\beta q\sigma_y}{\omega}\right] + (1-\beta)\chi - \rho\right\} \tag{19}$$

with $F(l) = \dfrac{l(1-l)(1-vl)}{(vl^2-1)+\beta(1-l)(1-vl)}$

The derivation of eq. (19) is laid out in greater detail in Appendix 1. Linearizing around the steady state, denoted by ω^*, χ^* and l^*, the dynamics can be approximated by

$$\begin{pmatrix} \dot{\omega} \\ \dot{l} \\ \dot{\chi} \end{pmatrix} = \begin{pmatrix} (1-\beta)\chi^* - (1-\sigma_y-\sigma_c)\omega^{*\beta} l^{*\beta} & \dfrac{-\beta\chi^*\omega^*}{l^*} & \omega^* \\ F(l^*)\beta(1-\beta)\omega^{*\beta-1} l^{*\beta}(\sigma_y+\sigma_c-\tau_k+\dfrac{q\sigma_y}{\omega^*}) & F(l^*)\beta\omega^{*\beta} l^{*\beta-1} G + F'(l^*)\left[\omega^{*\beta} l^{*\beta} G + (1-\beta)\chi^* - \rho\right] & F(l^*)(1-\beta) \\ \left[(1-\tau_k)(1-\beta)-(1-\sigma_y-\sigma_c)\right]\beta l^{*\beta}\chi^*\omega^{*\beta-1} & \left[(1-\tau_k)(1-\beta)-(1-\sigma_y-\sigma_c)\right]\beta l^{*\beta-1}\chi^*\omega^{*\beta} & \chi^* \end{pmatrix} \begin{pmatrix} \omega_t - \omega^* \\ l_t - l^* \\ \chi_t - \chi^* \end{pmatrix} \quad (20)$$

with $G \equiv \left[(1-\beta)(\sigma_y+\sigma_c-\tau_k) - \dfrac{\beta q \sigma_y}{\omega^*} \right]$.

One can show that the linearized system has three eigenvalues with the following properties $\mu_1 < 0,\ \mu_2 > 0,\ \mu_3 = 0$. Since our system features two 'jump' variables, $\chi = c/k$ and l, and one state variable $\omega = h/k$, we need one stable and two unstable eigenvalues in order to have a unique stable dynamic adjustment path. Unfortunately, due to the complexity of the system, we cannot find a simple general condition to prove this uniqueness, but in all simulations carried out over a wide range of plausible parameter sets, we always obtain one negative root.

Given the one negative eigenvalue μ_1, we obtain one-dimensional time paths. Starting from the initial steady states $\omega(0)$, $l(0)$ and $\chi(0)$, we can write these time paths as follows:

$$\begin{cases} \omega(t) - \omega^* = Be^{\mu_1 t} \\ l(t) - l^* = v_{21} Be^{\mu_1 t} \\ \chi(t) - \chi^* = v_{31} Be^{\mu_1 t} \end{cases}$$

where B is a constant and $(1 \;\; v_{21} \;\; v_{31})'$ is the normalized eigenvector associated with the stable eigenvalue μ_1. The constant B depends upon the specific shock. Thus suppose that the economy starts out from the initial steady state $\omega(0)$, $l(0)$ and $\chi(0)$ and through some policy shock converges to ω^*, l^* and χ^*. Setting t=0, we obtain $B = \omega(0) - \omega^*$.

The above equations determine the evolution of the ratio of effective human to physical capital, the ratio of private consumption to physical capital and the employment rate, consistent with the ultimate attainment of steady state.

3. Fiscal policy effects on employment and growth

Due to its complexity we cannot solve our model analytically. Important insights into the effects of fiscal policy can be obtained, however, by carrying out numerical analysis of the model. In Section 3.1 we discuss our choice of parameters. Starting from actual cross-country fiscal policy data, we compare in Section 3.2 our model's predictions with the employment and growth differences that we have reported in Table 1. This comparison provides a first and simple test of our model. It is also useful as a guide to the particular policy shocks that we will numerically simulate in Section 3.3 We consider both long-run equilibrium effects and the transitional adjustment paths. We also simulate the welfare effects of changes in policy.

3.1 Parameters

Following among others Barro (1990), we set the rate of time preference ρ equal to 0.02. With respect to effective labour, we assume a share coefficient β equal to 0.6. This value is well in line with the literature. For example, King and Rebelo (1990) and Mendoza *et al.* (1997) also model goods production as a function of effective labour (human capital) and physical capital. They assume a value for β equal to 2/3. The productivity parameter q and the relative weight of 'leisure' a in the felicity function are determined by calibration. We have calibrated values for these parameters such that with observed average levels of the transfer replacement rate, tax rates and government expenditures in the core countries of the euro area (see Table 2 below), the model correctly predicts the average of these countries' employment and growth rates in 1995-2004 (employment in hours). The weight of 'leisure' a has been set at 0.26, the productivity parameter q at 0.11. Our calibrated value for a is very low compared to the value of 1.54 assigned to this parameter by Prescott (2004). Turnovsky (2000), however, assigns a relative weight of 0.3 to 'leisure'. Moreover, Prescott's choice of a high relative weight of 'leisure' is one of the elements underlying the criticism that the elasticity of hours worked with respect to the wage and with respect to taxes is excessively high in his study (Alesina *et al.*, 2005). Finally, we follow Turnovsky (2000) in assigning the same relative weight to government consumption in the utility function as to 'leisure'. This implies that κ is also equal to 0.26. Turnovsky (2000) imposes a value of 0.30, Park and Philippopoulos (2004) choose 0.25.

Table 2 Benchmark

Benchmark Parameter Values (average for the core euro area countries)					
Production parameters			$\beta = 0.6$, $q = 0.11$		
Preference parameters			$\rho = 0.02$, $a = 0.26$, $\kappa = 0.26$		
Government expenditures variables (in %)			$\sigma_y = 9.4$, $\sigma_c = 16.3$, $v = 51.6$		
Tax rates (in %)			$\tau_k = 41.1$, $\tau_l = 57.8$, $\tau_c = 13.6$		
Benchmark Equilibrium					
l	***γ***	***c/y***	***ω***	***χ***	***μ***
49.9 %	1.74 %	63.4 %	9.33 %	10.1 %	-0.04897

Together with the observed average levels of all fiscal policy parameters in the core countries of the euro area, these parameter values imply the benchmark equilibrium described in Table 2. The stable adjustment path for the benchmark economy is characterized by one stable eigenvalue of approximately -0.049.[3] *Per capita* output and capital therefore converge at the asymptotic rate of approximately 4.9%. This speed of convergence may seem relatively fast compared with much of the empirical evidence. A recent survey by Islam (2003),

[3] This root is relatively stable over all simulations that we have conducted and that are described in later sections.

however, shows that better estimation techniques which are better able to control for differences in countries' steady states, typically yield higher convergence rates.

3.2 Predicted versus actual employment and growth in Europe and the US

A major objective of this paper is to explain the contrasting employment and growth records in Europe and the US that we have reported in Table 1. In this section we confront our model's predictions with the true data for 1995-2004. Clearly, one should be aware of the serious limitations of such an exercise. Our model is highly stylized and may (obviously) miss potential determinants of growth or employment. Also, lack of data – especially with respect to marginal labour tax rates and non-employment transfers in the early 1990s – makes it impossible for us to execute a maybe more convincing test, which is to relate changes in growth and employment to changes in policy within countries over time. In spite of that, if one considers the extreme variation in the predictions of existing calibrated models in the literature (see Stokey and Rebelo, 1995), even a minimal test of the 'goodness of fit' of our model is informative. This information is important to assess the value of the simulation results that we present in the next section. Our findings here will also guide us to determine which simulations would be most interesting.

3.2.1 Description of the fiscal policy data

Table 3 describes key characteristics of fiscal policy in 1995-2001. All reported data are averages of the available annual data in that period[4]. In our brief discussion here we focus on the core euro area, the Nordic countries, the US and the UK.

[4] More details are shown in Appendix 2 to this paper.

Table 3 Fiscal policy in Europe and the US (1995-2001)

	tax rate on labour income (%)[α]	tax rate on capital income (%)[β]	consumption tax rate (%)[α]	productive government expenditures (% of GDP)[δ]	government consumption (% of GDP)[η]	net transfer replacement rate (%)[λ]
Proxy for :	τ_l	τ_k	τ_c	σ_y	σ_c	v
Core euro area						
Austria	56.2	34.0	13.2	9.1	14.0	62.3
Belgium	67.4	40.2	13.4	8.3	17.9	60.2
France	50.6	38.7	17.1	11.1	18.3	52.2
Germany	61.8	52.5	11.1	8.7	15.3	61.5
Netherlands	54.5	35.0	12.2	10.3	18.1	44.8
Italy	56.1	46.1	14.7	8.9	14.1	28.5
Average	**57.8**	**41.1**	**13.6**	**9.4**	**16.3**	**51.6**
Nordic countries						
Finland	59.4	27.9	15.2	11.8	16.1	62.3
Denmark	50.8	32.9	18.9	12.4	18.4	39.8
Norway	46.4	28.0	16.4	12.2	14.7	23.2
Sweden	51.5	28.0	17.9	13.5	20.6	37.8
Average	**52.0**	**29.2**	**17.1**	**12.5**	**17.5**	**40.8**
EU convergence						
Spain	45.0	35.0	10.9	9.1	13.5	21.7
Portugal	39.6	37.7	13.4	11.0	13.8	35.3
Ireland	42.5	10.0	16.4	10.0	12.5	63.3
Average	**42.4**	**27.6**	**13.5**	**10.0**	**13.3**	**40.1**
US	**34.7**	**39.3**	**7.2**	**9.6**	**9.8**	**15.3**
Switzerland	36.4	34.1	2.9	8.8	6.3	45.3
UK	39.4	31.1	14.5	7.3	14.6	40.8

Notes: A description of all variables is given in the main text. For more details on calculation and underlying assumptions, see Appendix 2.

Sources: [α] OECD (2005), Financial and Fiscal Affairs, Taxing Wages; [β] Devereux *et al.* (2002) and Institute for Fiscal Studies (www.ifs.org.uk/publications.php). Data for Denmark have been taken from Danish Ministry of Taxation, http://www.skm.dk/ and KPMG Corporate Tax Rate Survey; [δ] See Appendix 2; [η] OECD (2005), Economic Outlook; [λ] OECD, Tax-Benefit models. Data kindly provided by D. Paturot (OECD).

The core euro area countries have the highest marginal tax rates on labour, the highest tax rates on capital income and moderate tax rates on consumption. The Nordic countries also have high tax rates on labour. Moreover, they have the highest consumption taxes. Taxes on capital income, however, are among the lowest in the Nordic countries. The tax system in the US is remarkable in its combination of very low tax rates on labour and – especially – consumption, but relatively high tax rates on capital income. Tax rates in the UK are moderate in each category.

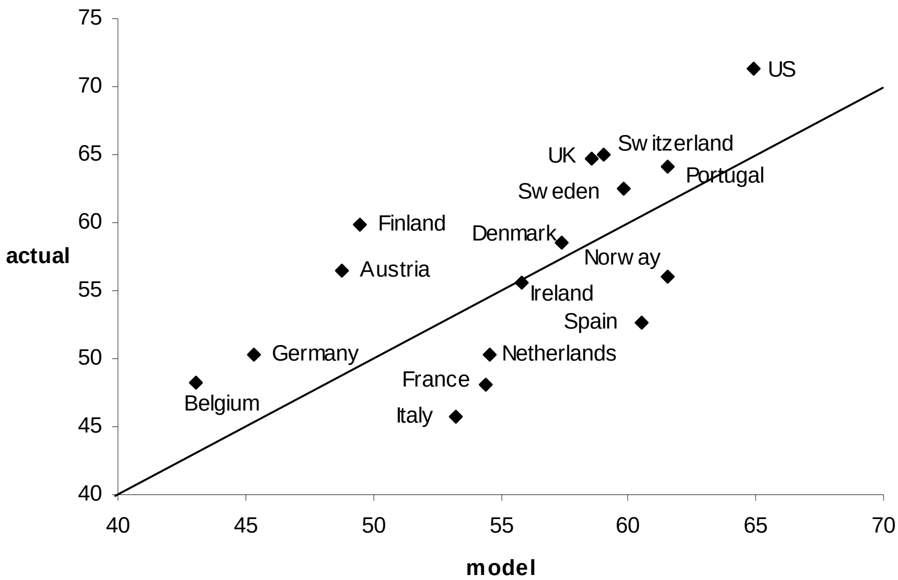
Our data for productive government expenditures include education, active labour market expenditures, government financed R&D and public investment. Governments in the Nordic countries allocate by far the highest fractions of output to productive expenditures. Productive expenditures in percent of GDP are the lowest in the UK. The US and the core countries of the euro area take intermediate positions. Government consumption in percent of GDP is the highest also in the Nordic countries, followed at close distance by the core euro area on average. In the US, government consumption is (much) lower. A final variable in Table 3 is our proxy for the net transfer replacement rate related to structural non-employment. Structural non-employment is here defined as unemployment for at least 5 years. The core countries of the euro area pay the highest net transfers on average. In each country v is (much) higher than 40%. The only exception is Italy. In the Nordic countries the transfer replacement rate is below 40%, with now Finland being the only exception. Transfers to structurally non-employed people are by far the lowest in the US.

3.2.2 Cross-country employment and growth differences

Using the fiscal policy data of Table 3, Figs 1 and 2 now assess the explanatory power of our model for all countries in our sample. Figure 1 depicts predicted and actual employment rates in hours. Actual employment rates are averages for 1995-2004. Predictions are based on the parameter values for β, ρ, a and q as mentioned above and on true values for the fiscal policy variables τ_k, τ_l, τ_c, σ_y, σ_c and v in 1995-2001.

Correlation in Fig. 1 is quite strong (R=0.63). Our model correctly predicts the highest employment rate in the US and relatively strong employment in the Nordic countries and the UK. The rather poor employment performance in the core countries of the euro area is also correctly predicted by our model. Moreover, all countries are reasonably close to the 45°-line. Only for Finland the gap is bigger than 8 percentage points.

Fig. 1. Employment rates in hours in individual countries, in %, 1995-2004



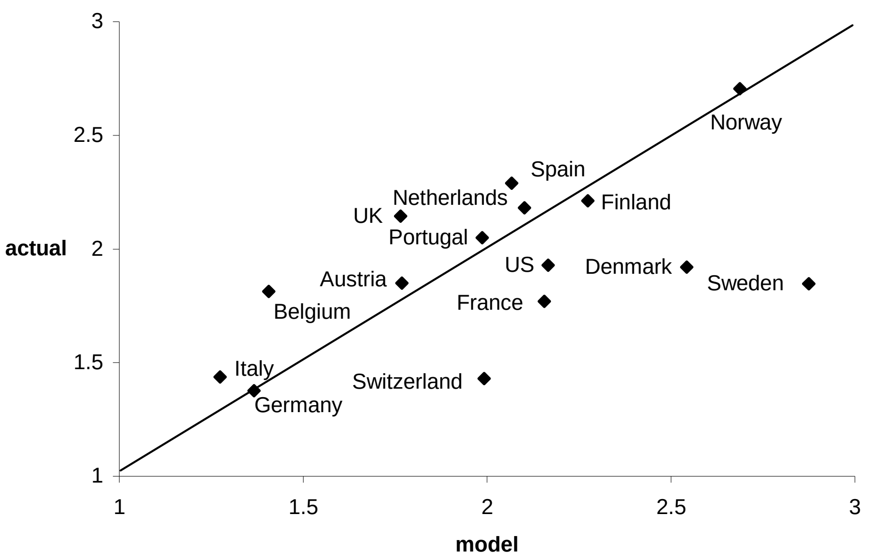
Note: The added solid line is the 45°-line

With the clear exception of Ireland, our model does a rather good job also in explaining cross-country *per capita* potential growth differences.[5] Disregarding Ireland, correlation in Fig. 2 between actual growth in 1995-2004 and predicted growth is 56%. Our model correctly predicts a relatively strong growth performance in the Nordic countries and, to a lesser extent,

[5] Considering Honohan and Walsh (2002), however, we should not take the difficulty with Ireland too seriously. Honohan and Walsh point to the exceptional - and unlikely to be repeated - nature of the very high Irish growth in the second half of the 1990s. In line with this, OECD data for the more recent period 2002-05 reveal an average annual per capita potential growth rate of 'only' 3.5 %.

the US in comparison with the core countries of the euro area. With the exception of Switzerland, Sweden and Denmark, all countries are within a band of 0.4 percentage points from the 45°-line. If we include Ireland, correlation in Fig. 2 falls to 42%.

Fig. 2. *Per capita* potential growth rates in individual countries, in %, 1995-2004



Note: The added solid line is the 45°-line

Our predictions in Figs 1 and 2 are based on parameter values for *a* and *q* calibrated such that our model correctly predicts the average of the core euro area countries' employment and growth rates in 1995-2004. As a robustness test we have alternatively calibrated the values for *a* and *q* on the average of the Nordic countries' employment and growth rates, and on the employment and growth rate of the US. Obviously, the (minor) changes in the values for *a* and *q* implied by these alternative calibrations affect the position of individual countries around the 45°- line.[6] However, the correlation between predicted and actual employment or growth rates hardly changes, which again confirms the fairly good explanatory power of our model. As a second robustness test, we have allowed variation in the imposed value for β

[6] Calibrating on the average for the Nordic countries implies a=0.23 and q=0.08. Calibrating on the US yields a=0.19 and q=0.08.

between 0.3 and 0.6. Changing this parameter again affects the position of countries vis-à-vis the 45°-line, but it does not affect correlation for employment in Fig. 1. Correlation for growth in Fig. 2 rises with a decreasing β. A final test considered the effects of variation in ρ between 0.01 and 0.03. Again only the position of countries vis-à-vis the 45°-line changed, especially for growth, but not the correlation between actual and predicted data. All these results are available from the authors upon request.

3.3 Numerical effects of fiscal policy changes

We now simulate a series of policy shocks. Our aim is to illustrate the functioning of our model, and to discover the relative effectiveness for employment and growth of changes in individual policy variables. We also pay particular attention to the trade-offs that exist when different aspects of fiscal policy come into play. Once we know the policy variables that are most effective, it should be straightforward to explain why the Nordic countries perform best within Europe, and where the differences between Europe and the US mainly come from.

Starting from budget balance, we impose permanent shocks equal to 3% of initial output, i.e. output before any changes in employment or growth have taken place. We consider reductions in the tax rates and in the transfer replacement rate, and increases in government expenditures. All shocks are therefore expected to increase output and growth. The choice of 3% is arbitrary. Smaller or larger shocks would generate similar results as far as the direction and the relative size of effects is concerned. Our benchmark against which all policy shocks are evaluated, is the average situation in the core euro area (see Table 2).

Table 4 considers the effects of policy changes on steady state growth and employment. In the upper part of the table we assume that policy changes are financed by lump-sum transfers to maintain budget balance. The lower part assumes shocks that are compensated by a change in another fiscal policy variable. Figures 3 to 6 describe the transitional dynamics of the economy after some of these shocks. Figures 3 and 4 consider the dynamics after policy shocks compensated by a change in lump-sum transfers, Figures 5 and 6 the effects of shocks compensated by a change in another fiscal policy variable. Figures 3 and 5 describe the transition paths of the *per capita* growth rates of physical capital, effective human capital and output. Figures 4 and 6 consist each out of four panels. Panel (A) describes the transition path of the employment rate. Panel (B) depicts the evolution of private consumption relative to its hypothetical level in the benchmark economy. Panel (C) shows the consumption-output ratio. Panel (D) describes welfare gains or losses along the transition path. Individual welfare gains Z_t in a particular period t after the shock have been calculated as the change in the present value of instantaneous utility due to the policy change, i.e. $Z_t = \left(ln\left(\frac{c_t}{c_t^*} \right) + a\, ln\left(\frac{1-l_t}{1-l_t^*} \right) + \kappa\, ln\left(\frac{\sigma_c y_t}{\sigma_c^* y_t^*} \right) \right) e^{-\rho t}$, where c_t, l_t and y_t are evaluated along the transition path after the policy shock and where c_t^*, y_t^*, l_t^* and σ_c^* are hypothetical levels of these variables in the benchmark equilibrium. Table 5 reports a measure for the intertemporal present discounted value of welfare gains after the shock. More precisely, we start by computing the intertemporal utility gain $\Delta W = \int_0^\infty Z_t dt$. Next, we calculate the (constant) percentage increase in benchmark consumption c_t^* that the representative individual should receive per period for ΔW to become zero (see also King and Rebelo, 1990, for a similar approach). We indicate this percentage change in Table 5 as θ.

Table 4 Fiscal shocks in the model (equal to 3% of output) [a]

Compensated by a change in lump sum transfers

	$\Delta\tau_l$=-5.4	$\Delta\tau_k$ = -7.5	$\Delta\tau_c$ = -5.1	$\Delta\sigma_y$ = +3.0	$\Delta\sigma_c$ = +3.0	Δv = -16.2
Effect on employment	Δl = +2.7	Δl = +0.6	Δl = +1.0	Δl = +1.5	Δl = +1.1	Δl = +2.4
Effect on growth	$\Delta\gamma$ = +0.07	$\Delta\gamma$ = +0.13	$\Delta\gamma$ = +0.03	$\Delta\gamma$ = +0.45	$\Delta\gamma$ = +0.03	$\Delta\gamma$ = +0.06
Ex-post effect on lump sum transfers	$\Delta(z/y)$ = -3.8	$\Delta(z/y)$ = -3.2	$\Delta(z/y)$ = -3.1	$\Delta(z/y)$ = -3.4	$\Delta(z/y)$ = - 3.3	$\Delta(z/y)$ = +2.3

Compensated by a change in another fiscal policy variable, indicated vertically

Changing : / Compensating [b, c] :	$\Delta\tau_l$ = -5.4	$\Delta\tau_k$ = -7.5	$\Delta\tau_c$ = -5.1	$\Delta\sigma_y$ = +3.0	$\Delta\sigma_c$ = +3.0	Δv = -16.2
$\Delta\tau_l$	-	$\Delta\tau_l$ = +4.6 Δl = -1.9 $\Delta\gamma$ = +0.05	$\Delta\tau_l$ = +4.5 Δl = -1.5 $\Delta\gamma$ = -0.04	$\Delta\tau_l$ = +4.9 Δl = -1.2 $\Delta\gamma$ = +0.37	$\Delta\tau_l$ = +4.7 Δl = -1.5 $\Delta\gamma$ = -0.04	**$\Delta\tau_l$ = -3.4 Δl = +4.2 $\Delta\gamma$ = +0.11**
$\Delta\tau_k$	$\Delta\tau_k$ = +8.9 Δl = +1.8 $\Delta\gamma$ = -0.09	-	$\Delta\tau_k$ = +7.6 Δl = +0.4 $\Delta\gamma$ = -0.11	$\Delta\tau_k$ = +8.0 Δl = +0.8 $\Delta\gamma$ = +0.28	$\Delta\tau_k$ = +7.8 Δl = +0.4 $\Delta\gamma$ = -0.11	$\Delta\tau_k$ = -5.3 Δl = +2.9 $\Delta\gamma$ = +0.16
$\Delta\tau_c$	$\Delta\tau_c$ = +6.2 Δl = +1.5 $\Delta\gamma$ = + 0.04	**$\Delta\tau_c$ = +5.3 Δl = -0.4 $\Delta\gamma$ = +0.10**	-	$\Delta\tau_c$ = +6.0 Δl = +0.4 $\Delta\gamma$ = +0.42	$\Delta\tau_c$ = +5.7 Δl = 0.0 $\Delta\gamma$ = 0.0	$\Delta\tau_c$ = -3.7 Δl = +3.2 $\Delta\gamma$ = +0.08
$\Delta\sigma_y$	$\Delta\sigma_y$ = -3.3 Δl = +0.9 $\Delta\gamma$ = -0.48	$\Delta\sigma_y$ = -2.7 Δl = -0.9 $\Delta\gamma$ = -0.34	$\Delta\sigma_y$ = -2.9 Δl = -0.5 $\Delta\gamma$ = -0.45	-	$\Delta\sigma_y$ = -2.9 Δl = -0.5 $\Delta\gamma$ = -0.44	**$\Delta\sigma_y$ = +2.0 Δl = +3.5 $\Delta\gamma$ = +0.37**
$\Delta\sigma_c$	$\Delta\sigma_c$ = -3.4 Δl = +1.5 $\Delta\gamma$ = + 0.04	$\Delta\sigma_c$ = -2.9 Δl = -0.4 $\Delta\gamma$ = +0.10	$\Delta\sigma_c$ = -3.0 Δl = 0.0 $\Delta\gamma$ = 0.0	**$\Delta\sigma_c$ = -3.1 Δl = +0.4 $\Delta\gamma$ = +0.42**	-	$\Delta\sigma_c$ = +2.0 Δl = +3.2 $\Delta\gamma$ = +0.08
Δv	Δv = -25.7 Δl = +6.7 $\Delta\gamma$ = + 0.17	Δv = -23.6 Δl = +4.2 $\Delta\gamma$ = +0.23	Δv = -23.4 Δl = +4.6 $\Delta\gamma$ = +0.12	Δv = -25.7 Δl =+5.5 $\Delta\gamma$ = +0.58	Δv = -24.6 Δl =+4.8 $\Delta\gamma$ = +0.13	-

Notes: [a] All changes in fiscal policy variables and changes in the employment rate (in hours) and the growth rate are changes in percentage points compared to the core euro area benchmark described in Table 2.
[b] The upper line in each cell indicates the precise size of the compensation.
[c] In Figs 5 and 6 below we further analyse the transition paths of key variables after the fiscal policy shocks indicated in bold cells.

3.3.1 Fiscal shocks compensated by lump-sum transfer changes

Key variables in the upper part of Table 4 are the marginal tax rate on labour (τ_l), the transfer replacement rate (v), the share of productive government expenditures (σ_y) and the tax rate on capital (τ_k). Permanent 'positive' shocks to each of these variables raise both equilibrium employment and growth. Table 5 also reveals intertemporal welfare gains. There are significant differences though in the size of long-run effects, as well as in short-run dynamics. The effect of changes in government consumption (σ_c) and consumption taxes (τ_c) are typically much smaller, especially for growth and welfare. In our discussion we therefore mainly focus on the other shocks.

Shocks to σ_y and τ_k are dominant in their effect on capital formation and growth. As one can observe in Fig. 3(A), a 3 percentage points increase in the share of productive government spending raises the growth rate of effective human capital immediately to about 2.4%. The increase in effective human capital raises the marginal productivity of labour and physical capital. Rising returns to working and investing explain higher labour supply and employment, a lower consumption-output ratio and higher physical capital growth in the long-run (Figs 4(A), 4(C) and 3(A)). Due to the mutual effect on each others' productivity, higher employment further promotes physical capital investment and vice versa. Steady state growth increases by 0.45 percentage points (Table 4 and Fig. 3(A)). The equilibrium employment rate rises to 51.3% (Fig. 4(A)). In the short-run, the growth rate of physical capital falls, however, as individuals incur the direct negative effect of the fall in lump-sum transfers on their resources. The direct fall in disposable income is not fully compensated by falling consumption, since individuals also respond to the strong rise in their permanent income. The very positive permanent income effect also explains why the initial increase in employment is moderate after the fall in lump-sum transfers.[7]

A cut in lump-sum transfers by 3% of initial output allows the government to reduce the capital tax rate by 7.5 percentage points. Mainly thanks to a rise in the after-tax return to savings and investment, the steady state growth rate of the economy rises by a relatively strong 0.13 percentage points (Table 4 and Fig. 3(D)). Faster growth in physical capital pushes up labour productivity and wages which explains why labour supply and employment are higher in the new long-run. In comparative perspective, this employment increasing

[7] Note the difference when the share of government consumption (σ_c) rises. The positive effect on permanent income then being much smaller, private consumption is adjusted downwards much more strongly and employment rises more on impact (see Figs 4(B) and 4(A)). The growth rate of physical capital then increases marginally on impact (Fig. 3(B)).

mechanism is not so powerful however (Table 4). As already mentioned, higher employment further strengthens the incentive to invest. Short-run dynamics reveal a drastic revision of individual consumption and investment plans after the cut in capital taxes. The consumption-output ratio is cut by about 5 percentage points on impact (Fig. 4(C)), whereas the growth rate of physical capital rises strongly to about 2.6% (Fig. 3(D)). Lower consumption raises the utility gain from working, which explains why employment effects are relatively strong in the short-run. Employment jumps by almost 2 percentage points (Fig. 4(A)). As can be seen, most of the short-run adjustment of consumption and employment is only temporary.

Shocks to τ_l and v have the strongest effects on employment. Reducing either of them permanently raises the net return to working, which encourages individuals to supply more labour. The employment rate jumps up to about 52.5% in both cases (Fig. 4(A)). Long-run employment effects are only a little smaller. Permanent positive growth effects follow from the increase in the marginal productivity of physical capital due to higher employment. In line with earlier arguments, individuals will save and invest more. The growth rate of physical capital rises moderately to about 1.9% on impact. It then declines to its new equilibrium (Figs 3(C) and 3(E)). The consumption-output ratio shows an initial 0.5 percentage point decline and then recovers partially (Fig. 4(C)). Still, slightly higher consumption is possible in the period of the shock (Fig. 4(B)) thanks to the strong rise in output, which is itself induced by the jump in employment. A reduction in the consumption tax rate (τ_c) has basically the same effects, induced by an initial rise in the utility gain from working, but they are always smaller.

Table 5 reveals very strong intertemporal welfare gains after a lump-sum financed increase in productive government spending (θ=22.1). The intertemporal gains from a cut in capital taxes (θ=9.5) and labour taxes (θ=7.1) follow at a distance.[8] Figure 4(D) clearly brings out the possibility of trade-offs in welfare over time, however. Individuals may have to give

[8] These may seem high numbers. Note, however, that King and Rebelo (1990) report even much higher numbers. The implication of endogenous growth models that positive fiscal policy shocks permanently raise growth, and the low rate of time preference that we assume, underlie the high intertemporal welfare effects.

up private consumption and 'leisure' in the short-run for larger output and consumption later. The short-run welfare loss is especially strong after a capital tax cut. Short-run welfare effects are also negative after a lump-sum financed increase in productive spending.

Table 5 Effects of fiscal policy shocks on intertemporal welfare

Compensated by a change in lump sum transfers

	$\Delta\tau_l = -5.4$	$\Delta\tau_k = -7.5$	$\Delta\tau_c = -5.1$	$\Delta\sigma_y = +3.0$	$\Delta\sigma_c = +3.0$	$\Delta v = -16.2$
Effect on employment	$\Delta l = +2.7$	$\Delta l = +0.6$	$\Delta l = +1.0$	$\Delta l = +1.5$	$\Delta l = +1.1$	$\Delta l = +2.4$
Effect on growth	$\Delta\gamma = +0.07$	$\Delta\gamma = +0.13$	$\Delta\gamma = +0.03$	$\Delta\gamma = +0.45$	$\Delta\gamma = +0.03$	$\Delta\gamma = +0.06$
Effect on welfare (θ, in %)	$\theta = +7.1$	$\theta = +9.5$	$\theta = +2.7$	$\theta = +22.1$	$\theta = +2.4$	$\theta = +6.4$

Compensated by a change in another fiscal policy variable, indicated vertically

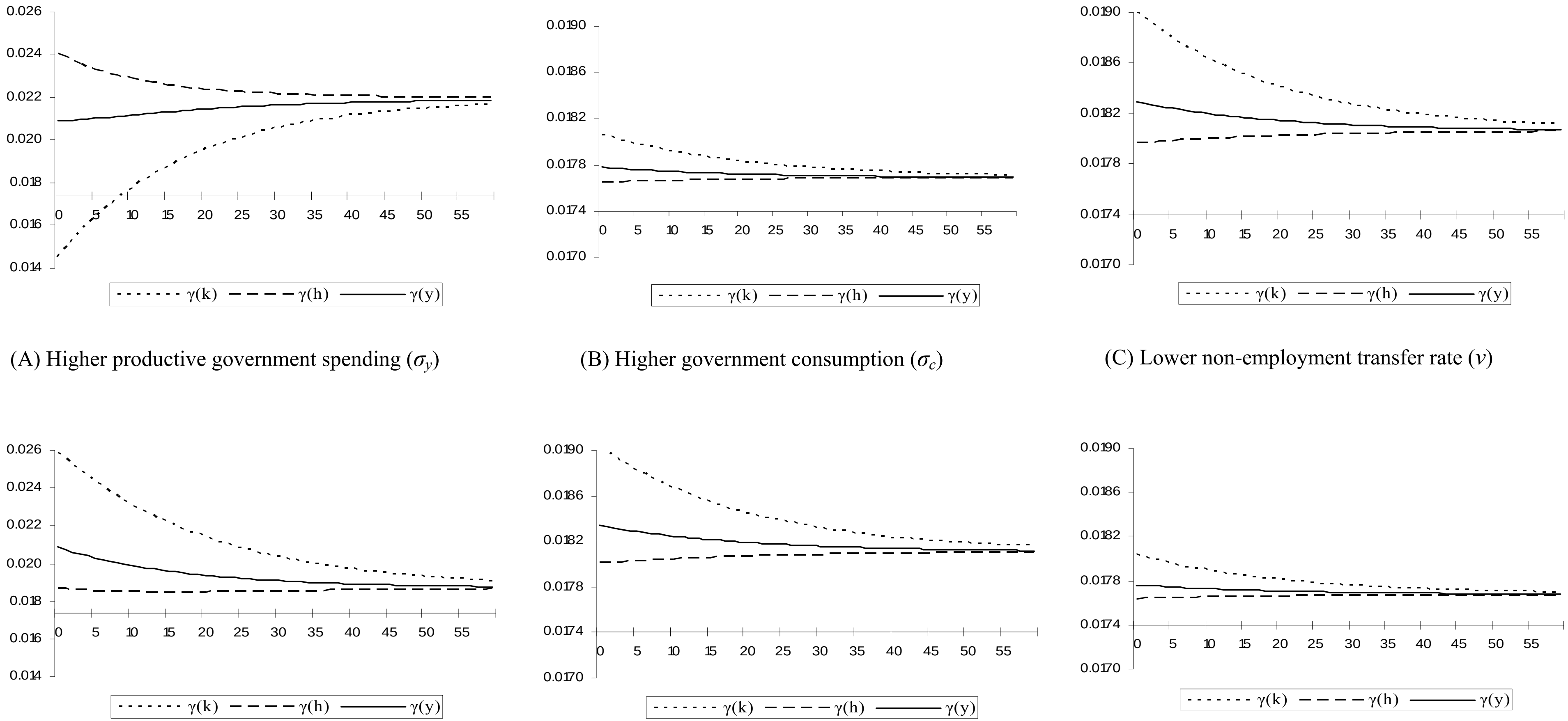
Changing :	$\Delta v = -16.2$	$\Delta v = -16.2$	$\Delta\tau_k = -7.5$	$\Delta\sigma_y = +3.0$
Compensating :	$\Delta\tau_l = -3.4$	$\Delta\sigma_y = +2.0$	$\Delta\tau_c = +5.3$	$\Delta\sigma_c = -3.1$
Effect on employment	$\Delta l = +4.2$	$\Delta l = +3.5$	$\Delta l = -0.4$	$\Delta l = +0.4$
Effect on growth	$\Delta\gamma = +0.11$	$\Delta\gamma = +0.37$	$\Delta\gamma = +0.10$	$\Delta\gamma = +0.42$
Effect on welfare (θ, in %)	$\theta = +11.2$	$\theta = +21.5$	$\theta = +6.5$	$\theta = +17.6$

Notes: Δl and $\Delta\gamma$ indicate the effect of a policy shock on the steady state employment rate and the steady state growth rate, in percentage points. θ indicates the (constant) percentage increase in benchmark consumption per period that the individual should receive to attain the same intertemporal lifetime utility as after the policy shock.

3.3.2 Fiscal shocks compensated by other policy variables

The lower part of Table 4 shows the long-run effects of 'budget neutral' combined fiscal policy shocks, which are likely to be more realistic experiments. Again, we focus on the most striking results. The most effective policy adjustments always seem to involve cuts in the transfer replacement rate (see utter right column). The employment rate always rises by at least 2.9 percentage points. The increase in steady state employment is the strongest when the cut in v is combined with lower taxes on labour. Very effective also in raising steady state employment is the combination of lower v with an increase in productive government expenditures. Moreover, this fiscal policy readjustment is among the most effective in promoting growth. In line with our lump-sum financed results, reducing taxes on labour shows up as another relatively effective way to stimulate employment. Reducing the transfer replacement rate is clearly the more efficient way to finance the reduction in labour taxes.

Fig.3. Transition paths of *per capita* growth rates (lump-sum financed shocks)



(A) Higher productive government spending (σ_y)

(B) Higher government consumption (σ_c)

(C) Lower non-employment transfer rate (ν)

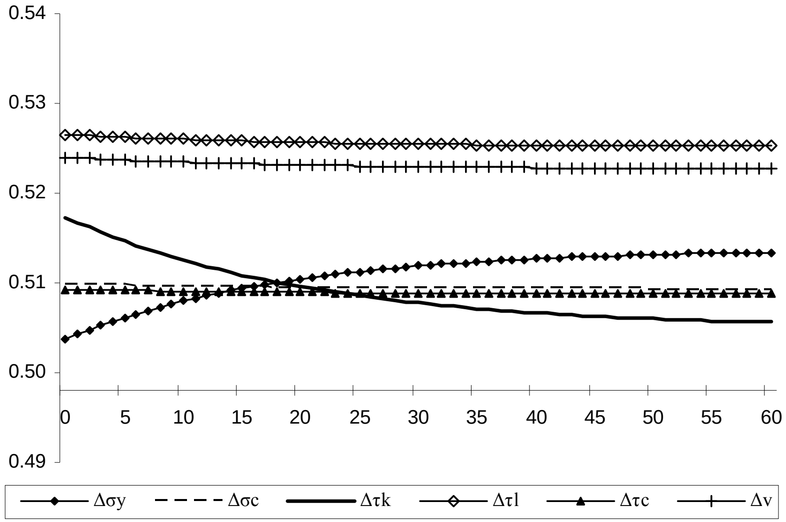
(D) Lower capital tax rate (τ_k)

(E) Lower tax rate on labour income (τ_l)

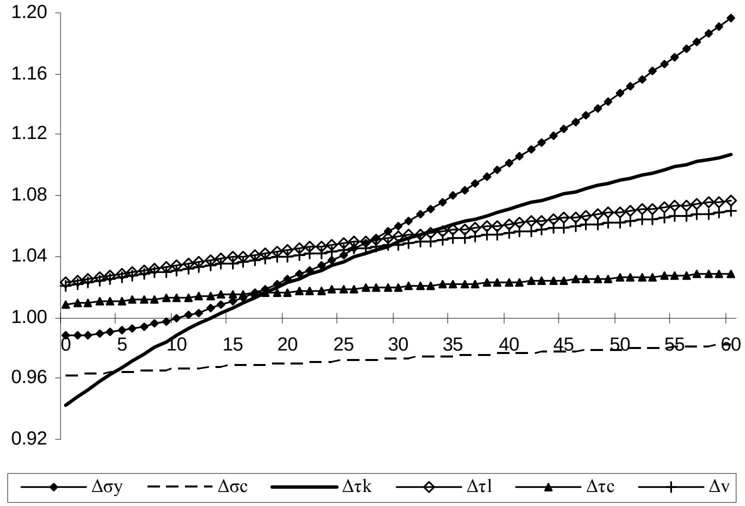
(F) Lower consumption tax rate (τ_c)

Note: Time is on the horizontal axis. The horizontal axis cuts the vertical axis at the benchmark growth rate (1.74%). Note also the different scales on some vertical axes.

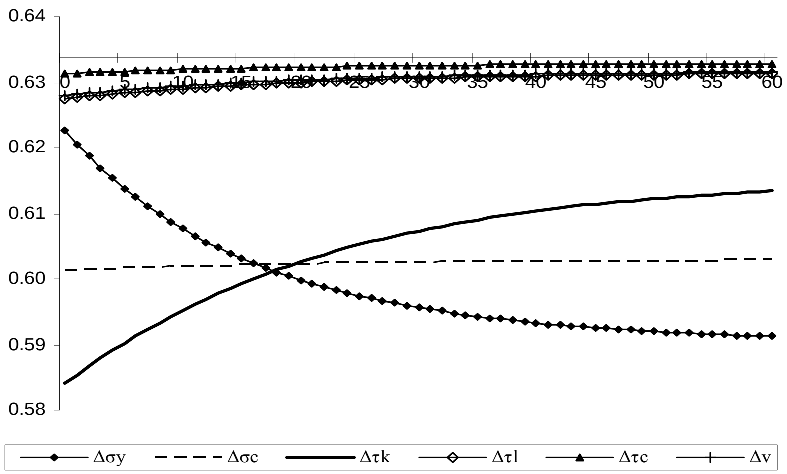
Fig.4. Transition paths of employment, consumption and welfare (lump-sum financed shocks)



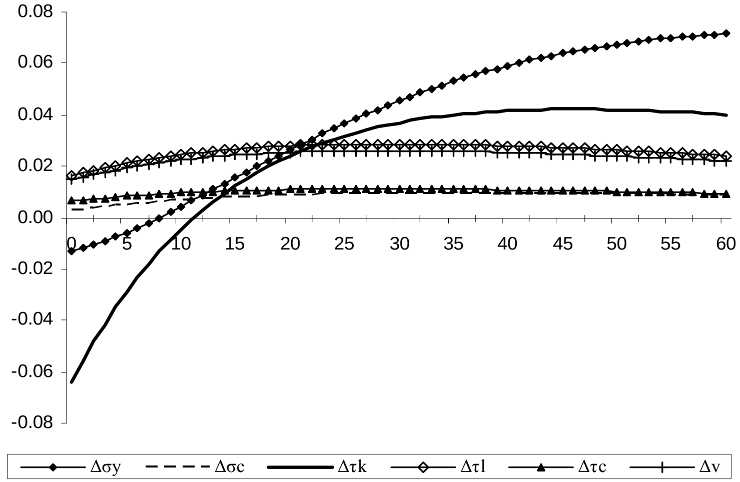
(A) Employment rate (l)



(B) Private consumption (relative to benchmark) (c/c^*)



(C) Consumption-output ratio (c/y)



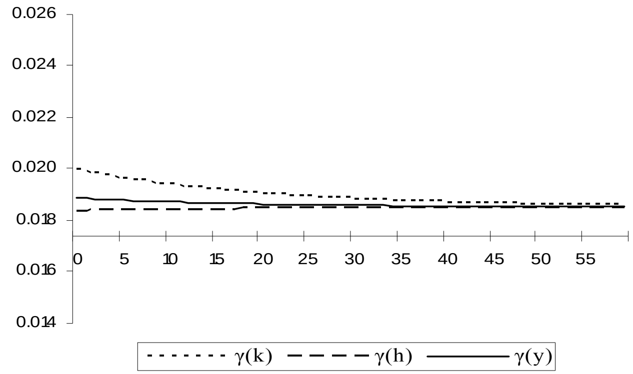
(D) Welfare (Z)

Note: Time is on the horizontal axis. The horizontal axis cuts the vertical axis at the (no shock) benchmark.

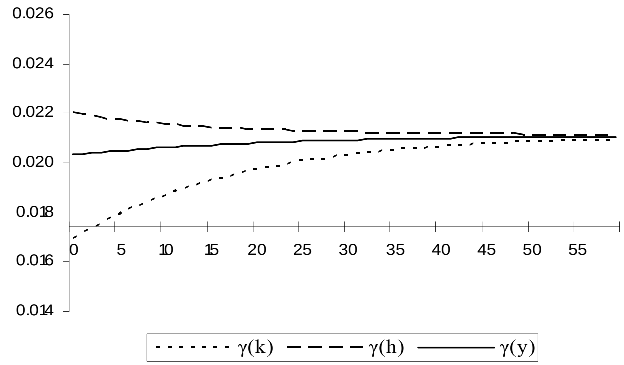
Putting long-run growth first, it is clear from our results that the fraction of productive government expenditures has to rise. The more efficient way to finance this is again a reduction in non-employment transfers *v*, followed by an increase in consumption taxes or a reduction in government consumption. Reducing capital taxes also contributes to higher long-run growth. Except in the case of lowering the transfer replacement rate, however, the need to finance this reduction in capital taxes always seems to be harmful to employment.

Considering all our previous results, a clear picture emerges. Growth benefits most from a high share of productive government expenditures and low tax rates on capital. Fiscal policy in the Nordic countries combines these two characteristics (Table 3), which explains relatively high growth in these countries. Employment benefits most from low taxes on labour and low non-employment transfers. This is exactly as in the US, which explains very high employment in this country. The significant positive employment effects of productive government expenditures, combined with moderate non-employment transfers and slightly lower taxes on labour, may explain why employment in the Nordic countries is higher than in many other European countries. High taxes on labour and capital, an ‘average’ share of productive spending and high non-employment transfers, put the core countries of the euro area in the worst position. Further calculation reveals that not only employment and growth are relatively weak, but also the representative individual’s intertemporal utility. The need for policy change being obvious, the question could be in what direction. Tables 4 and 5 and Figs 5 and 6 may bring some answers.

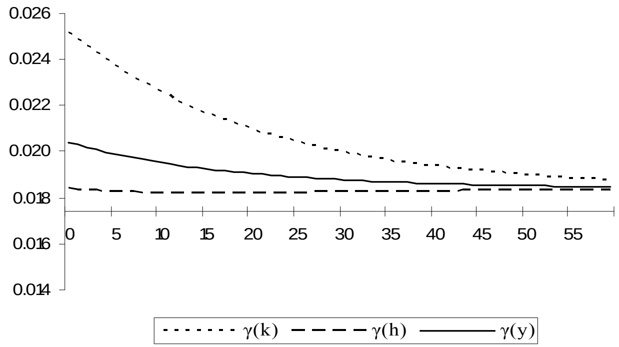
Fig.5. Transition paths of *per capita* growth rates (shocks compensated by another fiscal variable)



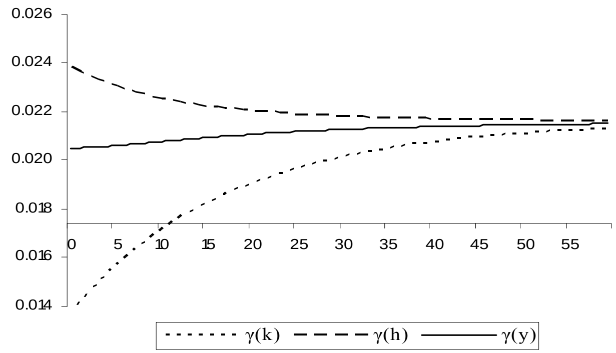
(A) Lower non-employment transfer rate (v)
compensated by
lower tax rate on labour income (τ_l)



(B) Lower non-employment transfer rate (v)
compensated by
higher productive government expenditures (σ_y)



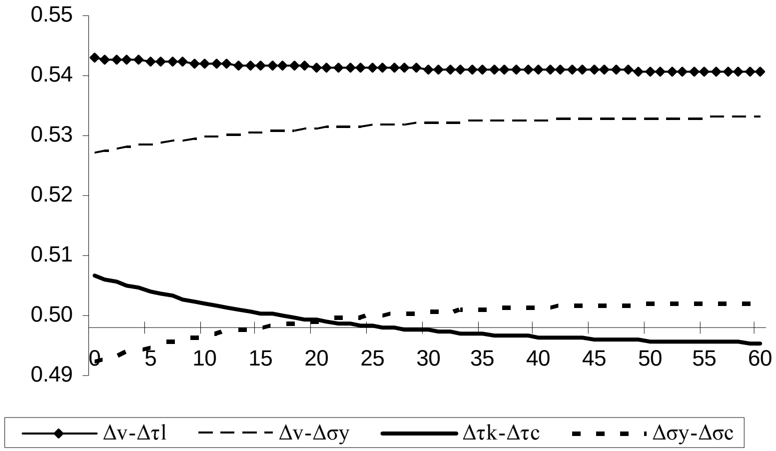
(C) Lower capital tax rate (τ_k)
compensated by
higher consumption tax rate (τ_c)



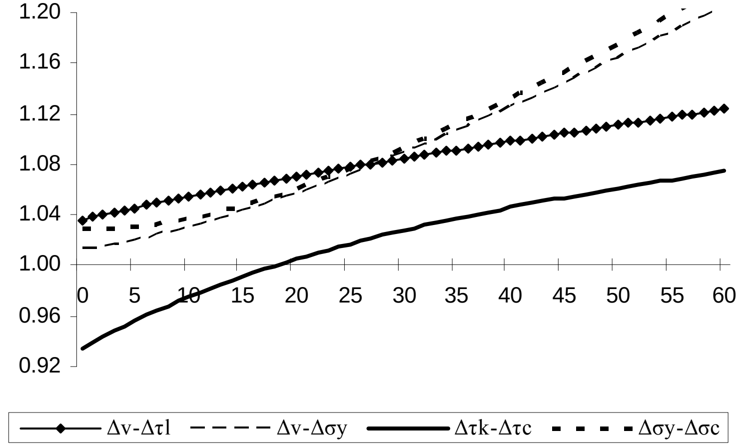
(D) Higher productive government expenditures
(σ_y)
compensated by
lower government consumption (σ_c)

Note: Time is on the horizontal axis. The horizontal axis cuts the vertical axis at the benchmark growth rate (1.74%).

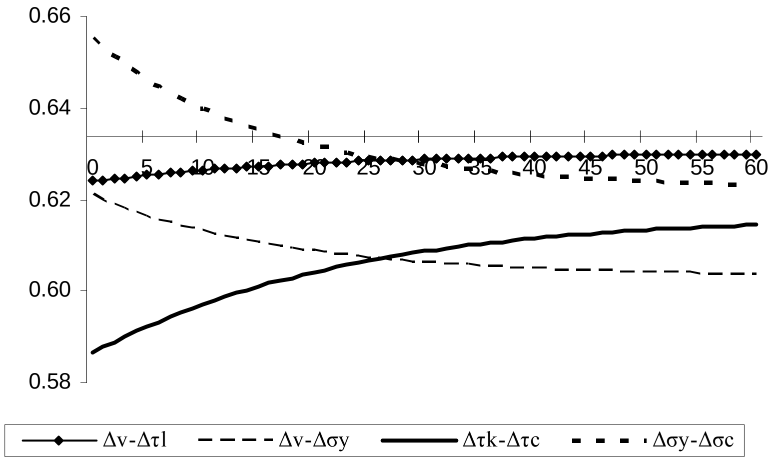
Fig.6. Transition paths of employment, consumption and welfare (shocks compensated by another fiscal variable)



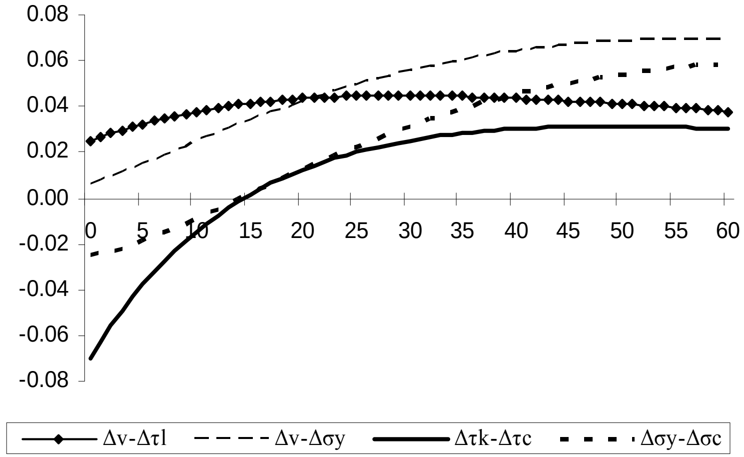
(A) Employment rate (l)



(B) Private consumption (relative to benchmark) (c/c^*)



(C) Consumption-output ratio (c/y)



(D) Welfare (Z)

Note: Time is on the horizontal axis. The horizontal axis cuts the vertical axis at the (no shock) benchmark.

We consider four combined shocks in greater detail (see also the bold cells in Table 4): (i) a reduction in non-employment transfers compensated by a cut in labour taxes (Δv = -16.2, $\Delta \tau_l$ = -3.4), (ii) a reduction in non-employment transfers compensated by higher productive expenditures (Δv = -16.2, $\Delta \sigma_y$ = +2.0), (iii) a reduction in the capital tax rate financed by higher consumption taxes ($\Delta \tau_k$ = -7.5, $\Delta \tau_c$ = +5.3) and (iv) a reallocation of government spending from consumption to productive purposes ($\Delta \sigma_y$ = +3.0, $\Delta \sigma_c$ = -3.1). The first of these combined shocks would be the 'American' policy option, the second and third belong to the Nordic approach. The fourth combined shock may reflect actual policy discussions to improve the composition of government expenditures in favour of efficiency and growth.

It is clear from Table 4 that employment will rise most when policy option (i) is taken. Growth rises most when (iv) is taken. Option (ii) comes second, both for employment and growth. From an intertemporal welfare perspective, the core euro area countries seem to benefit most from policy changes that include a higher share of productive government expenditures (policy options (ii) and (iv)). Considering the bottom part of Table 5, a re-allocation from non-employment transfers to productive purposes has the strongest positive effects (θ=21.5), followed by a re-allocation of government consumption to productive expenditures (θ=17.6). Simultaneously reducing non-employment transfers and labour taxes comes third (θ=11.2), shifting taxes from capital to consumption fourth (θ=6.5).

Figures 5 and 6 show the transition paths of key variables after each of these four combined shocks. Interesting observations would seem to be the following. (i) In line with our earlier findings, the strong positive long-run employment effects from reducing both v and τ_l manifest themselves largely on impact. The same holds for the (smaller) effects of this shock on the consumption-output ratio, *per capita* growth and welfare. Transitional welfare effects are always positive. (ii) The transitional effects of reducing v to finance higher σ_y are quite in line with our earlier (lump-sum financed) results for higher productive spending. Interesting differences are that the employment rate rises more on impact (to almost 53%, Fig. 6(A)). It also stays high afterwards. Furthermore, the short-run negative welfare effect in the case of a lump-sum financed productive spending increase has disappeared. Private consumption (relative to benchmark) does not fall anymore on impact. Our results for the other two combined shocks in Figs 5 and 6 reveal interesting trade-offs between the short and the long-run. (iii) A substitution of consumption taxes for capital taxes leads to slightly lower employment in the long-run, but it raises employment in the short-run (Fig. 6(A)). The drastic short-run cut in private consumption which this tax substitution brings about, raises the marginal utility gain from working. Short-run labour supply rises. In the long-run, however, the negative effect of higher consumption taxes on labour supply dominates. Furthermore, in the short-run the representative individual incurs serious welfare losses. Welfare gains in the long-run are comparatively limited. (iv) Re-allocating government expenditures from consumption to productive purposes implies higher employment and significant welfare gains in the long-run, but lower employment and welfare losses in the short-run (Fig. 6(A), 6(D)). In the short-run individuals reduce their labour supply and take more leisure in response to a strong rise in their permanent income. In the longer run, however, this negative labour supply effect is beaten by the positive effects from higher wages, caused by continuously increasing human and physical capital. The consumption-output ratio shows the opposite time profile (Fig. 6(C)). The permanent income effect induces higher consumption in the short-run, whereas in the longer run the rise in the marginal productivity of physical capital, caused by growing effective human capital and labour, encourages individuals to increase their savings and investment rate. Despite higher private consumption and more ‘leisure’, welfare changes are negative in the short-run. The fall in government consumption explains this result. In the longer run higher output and private consumption imply strong welfare improvements.

3.3.3 Robustness: CES utility

All our results have been derived from a model where we assume logarithmic utility (see eq. 5). This assumption may be restrictive in the sense that it implies an intertemporal elasticity of substitution (IES) equal to 1, whereas most empirical estimates are lower. To test robustness we have also solved and simulated our model assuming CES utility, with IES equal to 0.5. This value is well within the range of studies reviewed by Stokey and Rebelo (1995). Re-calibrating the relative weight of 'leisure' a and the productivity parameter q for the core countries of the euro area with IES=0.5 yields $a = 0.25$ and $q = 0.14$. Appendix 3 contains our main simulation results, which should be read like the ones in Table 4. The results are highly similar. All our main conclusions remain unchanged.

4. Conclusions

We construct a simple endogenous growth model to analyse the relationship between the composition of fiscal policy, economic growth and employment. The government sets different tax rates on labour income, capital income and private consumption to finance productive expenditures, utility-enhancing consumption expenditures and transfers related to structural non-employment. Our model is able to explain the differences in employment and growth of European countries and the US since the 1990s. We use the model to investigate the strength of the effects of various fiscal policy shocks on steady state employment and growth. We also develop the transitional dynamics for many variables, including welfare. Our main results are as follows. The model identifies the share of productive government expenditures and the tax rate on capital income as the most effective fiscal policy variables with respect to growth. The most effective policy variables with respect to employment are the tax rate on labour income and transfers related to structural non-employment. Productive government spending comes third. As to welfare, raising productive expenditures generally implies the strongest intertemporal gains, followed at a distance by cutting capital taxes and labour taxes. Depending on the way it is financed, however, short-run welfare effects may be negative after an increase in productive spending. A significant welfare loss in the short-run seems to occur always when capital taxes are reduced. The policy changes that we identified as the most effective to promote employment do not cause short-run welfare losses on the representative individual in our model.

Our results may be particularly relevant for policy makers in the core countries of the euro area, given the challenges they continue to face. Considering growth, employment, and welfare in the short and the long-run, our model would predict that the representative individual may benefit most from policies that increase productive government expenditures, financed by a cut in structural non-employment transfers.

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Appendix 1. Derivation of eq. (19)

Individuals adjust their labour supply to maintain intratemporal optimality given (changes in) consumption and output growth. Differentiating eq. (14) and the production function with respect to time, we obtain:

$$\frac{\dot{c}}{c} = \dot{l}\frac{(vl^2 - 1)}{l(1-l)(1-vl)} + \frac{\dot{y}}{y} \tag{A.1}$$

$$\frac{\dot{y}}{y} = (1-\beta)\frac{\dot{k}}{k} + \beta\frac{\dot{h}}{h} + \beta\frac{\dot{l}}{l} \tag{A.2}$$

Using eq. (10) in (A1) implies a second expression for the growth rate of output:

$$\frac{\dot{y}}{y} = (1-\tau_k)(1-\beta)\frac{y}{k} - \rho - \dot{l}\frac{(vl^2 - 1)}{l(1-l)(1-vl)} \tag{A.3}$$

Combining eqs (A.2) and (A.3) after substituting eqs (2') and (11) for $\dot{h}/h$ and $\dot{k}/k$, we end up with a single equation for $\dot{l}$:

$$\dot{l} = F(l)\left\{\left[(1-\beta)(1-\tau_k) - (1-\beta)\left(1-\sigma_y-\sigma_c-\frac{c}{y}\right) - \beta q\sigma_y\frac{k}{h}\right]\frac{y}{k} - \rho\right\} \tag{A.4}$$

with $F(l) = \dfrac{l(1-l)(1-vl)}{(vl^2-1)+\beta(1-l)(1-vl)}$

Rewriting (A.4) and substituting the expressions $\omega = h/k$ and $\chi \equiv c/k$, we obtain eq. (19).

Appendix 2. Fiscal policy data and data sources

Tax rate on labour income

Our proxy for the tax rate on labour income concerns the total tax wedge, for which we report the marginal rate in %. The data cover personal income taxes, employee and employer social security contributions payable on wage earnings and payroll taxes. We have calculated the average of these marginal rates for three family situations. These family types are a single individual without children who earns 100% of the average production worker's gross wage (APW), a married couple with two children where the main earner receives 100% of the APW and the secondary earner 33% of the APW, and a married couple with two children where the main earner recieves 100% of the APW and the secondary earner 67% of the APW. Data are available since 1997 only.

Tax rate on capital income

As a proxy for the tax rate on capital income we use corporate statutory tax rates (inclusive of local taxes) collected by the Institute for Fiscal Studies (see also Devereux *et al.*, 2002).

Tax rate on consumption

We have calculated our proxy for the tax rate on consumption according to the formula below, starting from OECD data. An important underlying assumption is that consumption tax rates correspond to aggregate indirect tax rates:

$$t_c = \frac{TIND - SUBS}{TDD - (TIND - SUBS)} 100$$

with *TIND* nominal indirect taxes received by the government, *SUBS* nominal subsidies paid by the government and *TDD* total nominal domestic demand.

Productive government expenditures

The data in Table 3 are a sum of four categories: public expenditures on education, public expenditures on active labour market policy, government-financed R&D expenditures and government fixed investment. Table 3A shows underlying details.

Table 3A Productive government expenditures (1995-2001, % of GDP)

	Public education expenditure $^{\alpha}$	Public expenditures active labour market policy $^{\beta}$	Government-financed R&D $^{\gamma}$	Government fixed investment $^{\gamma}$
Austria	5.92	0.45	0.72	1.98
Belgium	4.73	1.34	0.44	1.76
France	5.83	1.29	0.86	3.10
Germany	4.67	1.33	0.80	1.95
Netherlands	4.97	1.53	0.75	3.05
Italy	4.78	0.81	0.52	2.73
Average	**5.15**	**1.12**	**0.68**	**2.43**
Finland	6.65	1.33	0.86	2.85
Denmark	8.27	1.67	0.69	1.80
Norway	7.35	0.96	0.70	3.15
Sweden	7.77	1.83	0.92	2.98
Average	**7.51**	**1.45**	**0.79**	**2.70**
Spain	4.67	0.70	0.35	3.41
Portugal	5.75	0.75	0.39	4.03
Ireland	5.33	1.38	0.46	3.01
Average	**5.25**	**0.94**	**0.37**	**3.48**
US	**5.57**	**0.17**	**0.79**	**3.10**
Switzerland	**5.15**	**0.31**	**0.66**	**2.66**
UK	**4.88**	**0.37**	**0.57**	**1.53**

Notes: Since not all data are available for each country in the whole period 1995-2001, we report averages of all available annual data.

Sources: $^{\alpha}$ OECD (2003 & 2004a), Education at a glance, UNESCO (www.uis.unesco.org); $^{\beta}$ OECD (2005), Economic Outlook, OECD (2001 & 2002), Employment Outlook; $^{\gamma}$ OECD (2005), Economic Outlook

(Non-productive) government consumption

This category is calculated as total government consumption in % of GDP, diminished with the fraction of public education outlays going to wages and working-expenses. In our model all public spending on education is productive. In national accounts data, however, most of the education expenditures (wages, working-expenses) are included in government consumption. Rough calculation for a few countries suggests that wages and working-expenses constitute about 85% of total education spending. We therefore deduct this amount from reported data on government consumption to obtain the data for σ_c in Table 3.

Net transfer replacement rate related to structural non-employment

The data concern net transfers received by long-term unemployed people and include social assistance, family benefits and housing benefits in the 60th month of benefit receipt. They also include unemployment insurance or unemployment assistance benefits if these benefits are still paid, i.e. if workers can be structurally unemployed for more than five years without losing benefit eligibility. This is the case in Austria, Belgium, France, Germany, Finland, Ireland, and the UK. Workers cannot be structurally non-employed and still receive unemployment benefits in the Netherlands, Italy, Denmark, Norway, Sweden, Spain, Portugal, Switzerland and the US (OECD, 2004b, www.oecd.org/els/social/workincentives, Benefits and Wages, country specific files). The data are expressed in % of after-tax wages. They are an average for four family types and two earnings levels. The data are available only since 2001.

Original data provided by the OECD show a net replacement rate in Italy equal to 17%. However, as shown by Reyneri (1994), the gap between Italy and the other European countries is much smaller than it seems. Although unemployment benefits barely exist in Italy, this does not imply a zero fall-back position. Reyneri (1994) points to the importance of family support as an alternative to unemployment benefits. Furthermore, he emphasizes the existence of invalidity benefits as an additional mechanism of public transfers that the unemployed could receive. To correct for this, we have set the net replacement rate in Italy equal to the average net replacement rate in two other Southern European countries, Spain and Portugal.

Appendix 3. Fiscal shocks in the model assuming CES utility, IES=0.5 (shocks equal to 3% of output) [a, b]

Compensated by a change in lump sum transfers

	$\Delta\tau_l$ = -5.6	$\Delta\tau_k$ = -7.5	$\Delta\tau_c$ = -4.8	$\Delta\sigma_y$ = +3.0	$\Delta\sigma_c$ = +3.0	Δv = -15.9
Effect on employment	Δl = +2.7	Δl = +0.5	Δl = +1.0	Δl = +1.2	Δl = +1.1	Δl = +2.3
Effect on growth	$\Delta\gamma$ = +0.06	$\Delta\gamma$ = +0.11	$\Delta\gamma$ = +0.02	$\Delta\gamma$ = +0.40	$\Delta\gamma$ = +0.02	$\Delta\gamma$ = +0.06
Ex-post effect on lump sum transfers	$\Delta(z/y)$ = -3.8	$\Delta(z/y)$ = -3.2	$\Delta(z/y)$ = -3.1	$\Delta(z/y)$ = -3.3	$\Delta(z/y)$ = -3.3	$\Delta(z/y)$ = +2.2

Compensated by a change in another fiscal policy variable, indicated vertically

Changing : **Compensating [c]:**	$\Delta\tau_l$ = -5.6	$\Delta\tau_k$ = -7.5	$\Delta\tau_c$ = -4.8	$\Delta\sigma_y$ = +3.0	$\Delta\sigma_c$ = +3.0	Δv = -15.9
$\Delta\tau_l$	-	$\Delta\tau_l$ = +3.8 Δl = -1.6 $\Delta\gamma$ = +0.06	$\Delta\tau_l$ = +3.1 Δl = -1.1 $\Delta\gamma$ = -0.03	$\Delta\tau_l$ = +4.2 Δl = -1.1 $\Delta\gamma$ = +0.34	$\Delta\tau_l$ = +4.1 Δl = -1.2 $\Delta\gamma$ = -0.03	$\Delta\tau_l$ = -3.2 Δl = +4.0 $\Delta\gamma$ = +0.10
$\Delta\tau_k$	$\Delta\tau_k$ = +9.2 Δl = +2.2 $\Delta\gamma$ = -0.08	-	$\Delta\tau_k$ = +7.7 Δl = +0.6 $\Delta\gamma$ = -0.09	$\Delta\tau_k$ = +7.4 Δl = +0.8 $\Delta\gamma$ = +0.27	$\Delta\tau_k$ = +7.3 Δl = +0.6 $\Delta\gamma$ = -0.09	$\Delta\tau_k$ = -5.4 Δl = +2.6 $\Delta\gamma$ = +0.14
$\Delta\tau_c$	$\Delta\tau_c$ = +5.7 Δl = +1.6 $\Delta\gamma$ = + 0.04	$\Delta\tau_c$ = +4.3 Δl = -0.4 $\Delta\gamma$ = +0.09	-	$\Delta\tau_c$ = +5.5 Δl = +0.15 $\Delta\gamma$ = +0.37	$\Delta\tau_c$ = +5.3 Δl = 0.0 $\Delta\gamma$ = 0.0	$\Delta\tau_c$ = -3.4 Δl = +3.0 $\Delta\gamma$ = +0.07
$\Delta\sigma_y$	$\Delta\sigma_y$ = -3.3 Δl = +1.4 $\Delta\gamma$ = -0.43	$\Delta\sigma_y$ = -2.8 Δl = -0.8 $\Delta\gamma$ = -0.32	$\Delta\sigma_y$ = -3.0 Δl = -0.2 $\Delta\gamma$ = -0.42	-	$\Delta\sigma_y$ = -2.9 Δl = -0.2 $\Delta\gamma$ = -0.41	$\Delta\sigma_y$ = +2.0 Δl = +3.1 $\Delta\gamma$ = +0.33
$\Delta\sigma_c$	$\Delta\sigma_c$ = -3.4 Δl = +1.6 $\Delta\gamma$ = + 0.04	$\Delta\sigma_c$ = -2.5 Δl = -0.4 $\Delta\gamma$ = +0.09	$\Delta\sigma_c$ = -3.0 Δl = 0.0 $\Delta\gamma$ = 0.0	$\Delta\sigma_c$ = -3.0 Δl = +0.15 $\Delta\gamma$ = +0.37	-	$\Delta\sigma_c$ = +2.0 Δl = +3.0 $\Delta\gamma$ = +0.07
Δv	Δv = -28.2 Δl = +7.0 $\Delta\gamma$ = + 0.17	Δv = -23.5 Δl = +3.8 $\Delta\gamma$ = +0.20	Δv = -23.3 Δl = +4.4 $\Delta\gamma$ = +0.11	Δv = -24.9 Δl =+5.0 $\Delta\gamma$ = +0.51	Δv = -24.5 Δl =+4.6 $\Delta\gamma$ = +0.11	-

Notes [a] To obtain the simulation results in this table, we adopted a CES utility specification following Mendoza et al. (1997, eq. 6)
[b] All changes in fiscal policy variables and changes in the employment rate (in hours) and the growth rate are changes in percentage points compared to the core euro area benchmark described in Table 2.
[c] The upper line in each cell indicates the precise size of the compensation.