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# Fiscal Policy in Unionized Labor Markets

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## Abstract

This paper investigates the effects of fiscal policy on economic activity, welfare, income distribution, and public finances in a dynamic general equilibrium model with a unionized labor market. The paper shows that increases to public employment, wages of public sector employees, unemployment benefits, and labor taxes put pressure on unions' wage claims, leading to higher private sector wages, lower employment and output. The paper also suggests that capitalists benefit from fiscal adjustments, while workers are hurt, especially during the stabilization and in its immediate aftermath. However, both capitalists and workers are better off when the adjustment is achieved by cutting welfare spending and the government wage bill. These types of fiscal consolidations are also the most effective in reducing the primary deficit and public debt.

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# 1 Introduction

Government budgets' composition changed substantially in OECD countries in the last decades. Between 1960 and 1996, labor taxes and government expenditures for welfare payments and public employment increased by 13 and 16 percentage points of GDP respectively, while the ratios of business taxes, public investment, and government consumption to GDP remained almost constant.<sup>1</sup> In the last fifteen years, several governments also undertook large fiscal consolidations that remarkably differed in their composition. For example, the 1987 - 1989 Irish stabilization consisted almost exclusively of cuts to the government wage bill and transfers, while Italy, in the late 1990s, stopped the growth of public debt largely by increasing taxation. The evidence on various episodes of fiscal expansions and contractions in OECD countries shows that differences in fiscal policy composition are associated with different macroeconomic performances and that changes to labor taxes, governments' wage bills and welfare payments play a crucial role in determining changes in economic activity and public finances.<sup>2</sup> Even though this evidence is attracting the attention of the empirical literature and of policy makers, the macroeconomic theory is still overlooking the effects of changing different fiscal policy instruments, particularly those on the spending side of the budget. In fact, macroeconomists have mainly focused on the effects of shocks to revenue items and to government purchases of goods although spending for welfare payments and public employment consistently increased and they currently represent more than 3/4 of total government expenditures in OECD countries. Moreover, macroeconomists have largely ignored the distributional consequences arising from changes to the budget's composition.<sup>3</sup>

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<sup>1</sup>Data are from the OECD Economic Outlook no.62, and are averages across the following countries: Australia, Austria, Belgium, Canada, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Japan, The Netherlands, Norway, Portugal, Sweden, and United States.

<sup>2</sup>See, among others, McDermot and Wescott (1996), Alesina and Perotti (1997a), Alesina et al. (2001), Ardagna (2000), and Giavazzi, Jappelli and Pagano (2000) for empirical contributions, and the European Commission Broad Guidelines of Economic Policies for the year 2000 for a policy document highlighting the importance of budgetary composition.

<sup>3</sup>Jantti (1997) and OECD (1991) provide empirical evidence on the effect of transfers and taxation on income distribution.

These issues are clearly important and the purpose of this paper is to address them. To this end, the paper sets up a dynamic general equilibrium model and simulates the short and long - run effects of shocks to labor and capital taxes, government purchases of goods, public employment, wages of public employees, and unemployment benefits on economic activity, welfare, income distribution, and public finances. The paper focuses on a two sector economy in which private firms produce a homogeneous consumption good using both capital and labor and the government hires public employees to provide public services. The labor market is unionized and heterogeneous agents (capitalists, private and public sector employees, and unemployed workers) populate the economy. Agents heterogeneity allows to investigate welfare and distributional consequences of fiscal policy shocks, which, so far, have not been addressed in the context of a dynamic general equilibrium model, neither in unionized nor in competitive labor market economies.<sup>4</sup> The non competitive labor market framework allows to emphasize a particular channel of transmission for fiscal policy: the effect of changes to policy instruments on unions' wage claims and, via the latter, on employment in the private sector, capital accumulation and output. Previous contributions to the literature have already explored the effects of fiscal policy shocks through this empirically important channel.<sup>5</sup> However, this paper considers a larger set of policy instruments and investigates their consequences on various economic variables, not only in steady state, but also during the transition period. Moreover, the paper contributes to the strand of literature that extends a standard real business cycle model with perfectly competitive output and factors markets to overcome some of its empirical weaknesses.<sup>6</sup> In fact, the model is able to reproduce results about the effect of

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<sup>4</sup>Ohanian (1997), Mendoza and Tesar (1998), and Ardagna (2001) study only the effects of fiscal policy on welfare of a representative agent using a standard neoclassical model with perfectly competitive labor markets.

<sup>5</sup>See Alesina and Perotti (1997b) on the effects of labor taxes on unit labor costs in a static and unionized small open economy; Calmfors and Horn (1986) and Holmund (1997) on the effects of public employment in union models without capital; Daveri and Ma'ezzoli (1999) and Daveri and Tabellini (2000) on the effects of labor and capital taxes and unemployment benefits on long - run balanced growth path equilibria in a unionized one sector endogenous growth model.

<sup>6</sup>See, among others, Baxter and King (1993), Dotsey (1994), Ludvigson (1996), Ohanian (1997), Finn (1998), and Mendoza and Tesar (1998) for the effects of fiscal policy on the macroeconomy in the context of a standard real business

some components of government spending and of labor taxation consistent with the empirical evidence in OECD economies without relying on high and non realistic values for the elasticity of the individual labor supply.

The paper reaches the following results. First, the model predicts that a deficit-financed increase in government purchases of goods crowds out private consumption and have no effects on the supply-side of the economy as in a standard neoclassical model with inelastic individual labor supply. By contrast, increases in public employment, wages of public sector employees, unemployment benefits, and labor taxes affect the economy through the cost side of the firms. In response to a surge in each of these variables, unions ask for higher wages. The increase in labor costs decreases employment in the private sector and the rate of return on capital, pushing the economy into a downturn. Increases in tax rates on capital income also affect negatively capital accumulation and output, but they have no effect on unions wage claims and employment in the private sector. Second, two effects are at work as far as the impact of fiscal policy on welfare and income distribution is concerned. Changes to fiscal policy have a different effect on income (hence, consumption and welfare) both of the representative capitalist and worker, and of each type of worker. This is because heterogeneity exists not only between workers and capitalists, but also among workers. Moreover, fiscal policy shocks affect the distribution of workers between the private and public sector and between employment and unemployment. Hence, they also influence differently total income and welfare of each group of workers. Simulations suggest that fiscal adjustments implemented by cutting spending items reduce workers' utility relative to the pre-policy change equilibrium during the transition, but not in the long-run. By contrast, workers' utility decreases at any time horizon when labor taxes increase. Capitalists always benefit from fiscal consolidations; however, the gain is larger when the adjustment is on the spending side of the government cycle model with perfectly competitive output and factor markets. See Burnside et al. (2000) for an empirical assessment of this model; Ramey and Shapiro (1998) for a two-sector neoclassical model with costs of shifting capital across sectors; Rotemberg and Woodford (1992) and Devereux et al. (1996) for models with imperfect competition in output markets and increasing returns.

budget. Income inequality decreases in the short - run when public employment, wages of public employees and unemployment benefits increase, but the effect switches sign after some years. The opposite occurs when tax rates on labor income increase. Finally, the paper shows that cuts in public employment, wages of public sector employees and unemployment benefits are more effective in reducing the primary deficit and public debt than are increases in tax rates.

The paper is organized as follows. Section 2 presents the model and the parameters used for the calibration. Section 3 details the responses of output, employment, capital, consumption, welfare, income distribution, primary deficit, and public debt to changes in the fiscal policy items discussed above. Section 4 presents some sensitivity analysis and extensions to the benchmark model. The last section concludes.

## 2 The model

### 2.1 The set-up

Infinitely lived individuals, perfectly competitive firms, monopolistic unions, and a government populate a closed economy. Households have perfect foresight and derive their lifetime utility from consumption of privately produced goods. There are  $N_k$  capitalists and  $N_w$  workers in the economy. Capitalists own the firms and their source of income is from capital and public bonds. They choose consumption and investment to maximize their utility over an infinite horizon. Workers, instead, consume all their disposable income in each period. They can be employed in the private or public sector or can be unemployed. In the former case, workers offer inelastically one unit of labor and receive the wage rate prevailing in each sector. In the latter, they receive a subsidy from the government. Workers are organized in unions, which set the wage rate for private sector employees to maximize the expected utility of their members subject to firms' labor demand. Firms are perfectly competitive and produce a homogeneous consumption good combining capital and labor with a constant return to scale technology.

Technological progress is labor augmenting and grows exogenously at a positive rate.<sup>7</sup> The government purchases final goods from the private sector, hires labor to produce public services, sets the wage rate of public employees, pays unemployment benefits and makes lump-sum transfers to capitalists. The government finances its spending requirements by taxing labor and capital and by issuing debt. Public services may affect the productivity of capital and labor employed in the private sector.

### 2.1.1 The household

The representative capitalist maximizes the following intertemporal utility function

$$\sum_{t=0}^{\infty} \beta^t \log(c_{kt}) \quad (1)$$

subject to his budget constraint and the equation for the capital accumulation process.

$$b_{t+1} = (1 + r_t^b)b_t + (1 - \delta_k)r_t k_t - c_{kt} - \phi_t + \mathcal{B}_t \quad (2)$$

$$k_{t+1} = (1 - \delta)k_t + \phi_t \quad (3)$$

$c_k$  represents the purchases of consumption goods by the representative capitalist, and  $\phi$  his investment in capital goods.  $b$  are public bonds,  $k$  capital goods,  $r^b$  and  $r$  are the real rate of return of public bonds and capital respectively.  $x$  is the gross growth rate of technological progress,<sup>8</sup>  $\beta$  is the subjective discount factor, and  $\delta$  is the rate at which capital depreciates.  $\mathcal{B}$  are lump-sum transfers and  $\delta_k$  is the tax rate on capital income. Income from public bonds is not taxed, depreciation allowances are zero, and there are no costs for installing new capital. Maximizing (1) subject to the constraints (2) and (3), simplifying and rearranging terms, we obtain equations (4) and (5).

$$c_{kt}^{-1} = \beta^{-1} x^{1-\beta} c_{k,t+1}^{-1} (1 + r_{t+1}^b) \quad (4)$$

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<sup>7</sup>Assuming this form of technological progress and functional forms for preferences and technology that support balanced-growth path equilibria, in what follows I transform all quantity variables (except employment) into stationary ones, dividing them through the state of technology. Hence, without loss of generality, I present only the specification for the detrended model. The transformed variables are written in lower case.

<sup>8</sup> $X_{t+1} = X_t x$  where  $X$  is the state of the technology and  $x$  its gross rate of growth.

$$r_{t+1}^b = (1 - \lambda_{kt+1})r_{t+1} + \lambda_{kt+1} \quad (5)$$

Workers' utility depend on consumption of private goods:  $U = \log(c_{wt})$ . For simplicity, we assume that, in each period, a worker spends all his disposable income on private consumption. Workers can be employed in the private or public sector, or they can be unemployed. If employed in the private or public sector, they offer inelastically one unit of labor, and receive the wage rate  $w_p$  and  $w_g$ , respectively. If they are unemployed, they receive a subsidy  $u$  from the government. Labor income is taxed at a rate  $\lambda_N$ , unemployment benefits are not taxed.<sup>9</sup> The following equations describe the consumption level of the three types of workers.

$$c_{pt} = w_{pt}(1 - \lambda_{Nt}) \quad (6)$$

$$c_{gt} = w_{gt}(1 - \lambda_{Nt}) \quad (7)$$

$$c_{ut} = u_t \quad (8)$$

Given the level of private and public sector employment, workers are randomly assigned to one sector or the other or are unemployed. Workers in the private or public sector do not have different skills, nor jobs have different characteristics that affect preferences, and the model does not explain why workers receive a different salary in the two sectors. Workers are ex - ante identical. They become ex - post heterogenous, once the level of employment in the private and public sector is fixed, because they receive a different income according to their status. The labor force is organized in unions.

### 2.1.2 The private sector

Unions unilaterally set wages in the private sector to maximize the expected utility of their members. Entrepreneurs choose the profit maximizing level of employment and capital. Unions are small compared

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<sup>9</sup>Although this assumption is too extreme for many countries, relaxing it does not change the qualitative nature of the results. In order to have an effect of labor taxes on the wage rate of the private sector, the crucial assumption is that governments tax unemployed benefits at a rate lower than that on labor income. This is the case in most countries.



to the size of the economy and set wages at the firm level. As it is known, the monopoly union model does not lead to an efficient wage - employment outcome. However, the literature has used it to study the effects of fiscal policy in non competitive labor markets. It simplifies the analysis and gives results that qualitatively do not differ from those that one obtains in a model in which unions and firms bargain over the wage and the employment level.<sup>10</sup>

The timing of the game between firms and unions is the following. The capital stock is chosen at the beginning of the period before unions choose wages. Once wages have been set, firms choose the profit maximizing level of employment along the labor demand curve. Unions are myopic and solve a static optimization problem in each period. Hence, they do not internalize the effects of the wage rate on capital accumulation, output and employment. The model also assumes that unions take fiscal policy variables as given when they choose the optimal wage rate. Daveri and Mazzoli (1999) and Daveri and Tabellini (2000) rely on a similar set of assumptions. Because unions are small and negotiate wages at the firm level, it is not unreasonable to assume that they take the rental price of capital and fiscal policy variables as given and that they neglect the effect of their choice on aggregate variables. Clearly, this set-up gives a simplified picture of the wage setting procedures in OECD countries. However, it makes the model analytically handle, avoiding time - consistency problems that would arise if unions maximized an intertemporal utility function.<sup>11</sup>

Firms produce a homogeneous consumption good with capital and labor, taking prices as given. The production function is Cobb-Douglas

$$y_t = k_t^a N_{pt}^{1-a} \quad (9)$$

$y$  represents output,  $k$  the aggregate capital stock,<sup>12</sup>  $N_p$  the number of workers employed in the private

<sup>10</sup>See, for example, Alesina and Perotti (1997b) for a discussion on monopolistic union models versus alternatives.

<sup>11</sup>Van der Ploeg (1987) shows that the solution to the one period union model is the time consistent contract in a dynamic game in which the union has an intertemporal utility function and acts as a Stackelberg leader.

<sup>12</sup>The aggregate capital stock is the sum of the capital stock that each capitalist of this economy accumulates. Hence,  $k = N_k \bar{k}$ :

sector, and  $a$  the capital share.

Given the timing above, the equilibrium level of employment, capital and the wage rate can be obtained solving the game between firms and unions backwards. The representative firm employs labor according to the marginal productivity rule,

$$(1 - \alpha) \frac{y_t}{N_{pt}} = w_{pt} \quad (10)$$

Unions choose  $w_p$  to maximize

$$\frac{N_{pt}}{N_w} \log(w_{pt}(1 - \alpha_{Nt})) + \frac{N_w - N_{pt}}{N_w} U_t^A \quad (11)$$

subject to equations (9) and (10).

$U^A$  is the expected utility unions members receive when they are not employed in the private sector (i.e.: members' reservation utility),  $N_w$  is the total number of workers (by assumption equal to unions' membership), and  $\frac{N_{pt}}{N_w}$  measures the probability of being employed in the private sector.

Substituting (9) in (10) and the resulting equation in (11), we can derive the first order condition for the union:

$$\log(w_{pt}(1 - \alpha_{Nt})) = U_t^A + \alpha \quad (12)$$

Thus, the equilibrium gross wage rate in the private sector,  $w_p$ , depends on workers' expected utility when they are not employed in the private sector,  $U^A$ , and on the tax rate on labor income,  $\alpha_N$ . A ceteris paribus increase in members' reservation utility or in the tax rate on labor income puts pressure on unions' claims for private sector workers' wages.

$U^A$  is the weighted average of workers' utility if employed in the public sector and if unemployed, with weights equal to the probability of being employed in the public sector and of being unemployed.

$$U_t^A = p_t \log(w_{gt}(1 - \alpha_{Nt})) + (1 - p_t) \log(u_t) \quad (13)$$

where, in equilibrium,  $p_t = \frac{N_{gt}}{N_{wi} N_{pt}}$

Hence,

$$\log(w_{pt}(1 - \zeta_N)) = \frac{N_{gt}}{N_{wi} N_{pt}} \log(w_{gt}(1 - \zeta_N)) + \frac{(N_{wi} N_{pt} - N_{gt})}{N_{wi} N_{pt}} \log(u_t) + a \quad (14)$$

Ceteris paribus, an increase in public employment,  $N_g$ , increases the probability of workers being employed in the public sector and decreases the one of being unemployed. If unemployment compensations,  $u$ , are lower than the after-tax wage in the public sector,  $w_g(1 - \zeta_N)$ , unions' members reservation utility increases, leading to higher wages in the private sector. Similarly, an increase in the pre-tax wage in the public sector,  $w_g$ , (or in unemployment benefits,  $u$ ) has a ceteris paribus positive effect on  $w_p$ , because it raises workers' expected utility if not employed in the private sector. A ceteris paribus increase in the tax rate on labor income,  $\zeta_N$ , has, instead, two opposite effects on the gross wage unions demand for private sector workers. On the one hand, the surge in  $\zeta_N$  reduces the net wage of the worker, leading to an increase in the pre-tax real wage faced by the employer (see equation 12). On the other, it reduces the after-tax wage of a public sector worker, decreasing workers' reservation utility and moderating unions' wage demand. Differentiating (12) with respect to  $\zeta_N$ , however, one can show that the first effect dominates and, hence, wages for private sector workers increase in response to a ceteris paribus increase in  $\zeta_N$  too.

Finally, firms choose the optimal level of capital subject to the wage rate set by the union. Because the optimal wage rate in (14) does not depend on the capital stock, the standard first order condition for the firm holds.

$$a \frac{y_t}{k_t} = r_t \quad (15)$$

### 2.1.3 The government

The government uses public employees to produce services  $SG$  with one unit of labor input per unit of output. Hence, the number of public workers  $N_g$  is also equal to the services produced. For simplicity,

in the benchmark model, public services do not affect agents' utility or the productivity of labor and capital used by private sector firms. Thus, public employment related expenses are a pure waste as in Finn (1998). In section 4.3, I relax this assumption and public employees produce services that have a positive effect on private production.<sup>13</sup>

Wages for the public sector employees,  $w_g$ , are exogenously set in the model. For simplicity, the paper assumes that the government unilaterally fixes them. In most countries, wage changes in the public sector are the outcome of negotiations between governments' officials and public employees' unions. Certainly, it is a shortcut of this paper not model this process and to take its outcome as exogenous. However, this strategy allows to model the wage setting procedure in the private sector and to study the effect of changes of public wages on the economy without further complicating the theoretical framework. Moreover, as far as wages and employment in the public sector are determined independently from wages and employment in the private sector, assuming that the former are exogenous does not affect the results of the model. Recent empirical work by Alesina et al. (2001) suggests that the direction of causality goes from public sector wages and employment to wages and employment in the private sector. Needless to say, the strength and robustness of this evidence is ultimately an important empirical question that this paper cannot address. The theoretical literature has also followed different approaches than the one of this work in modeling the wage setting practices in the private and public sector. However, they present drawbacks for the purpose of this paper. Calmfors and Horn (1986) introduce public employment in a monopolistic union model, but they assume that the union chooses the same wage rate for workers in the public and private sector and that labor is the only factor of production. Holmud (1997) allows for different wages, but he models the wage bargaining between unions, firms and the government in a model without capital accumulation. On the one hand, extending Holmud (1997) would complicate the analysis beyond the scope of this work and increase the number of

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<sup>13</sup>For reasonable parameter values that measure the productivity of public workers, results in section 4.3 are consistent with those of the benchmark model.

parameters to keep track in the calibration exercise. On the other, following Calmfors and Horn (1986) one cannot study the effect that changes in government wages have on the economy, shutting down a channel that is empirically important. In fact, the evidence around episodes of large fiscal contractions suggests that not only changes in public employment but also changes in wages of public employees are important determinants of countries' macroeconomic performance during and after the tightening. Alesina and Ardagna (1998), for example, show that, in several cases, public sector wages have been cut and that governments that reduced their wage bills experienced stronger economic activity. Alesina et al. (2001) provide econometric evidence that changes to the government wage bill have a positive and statistically significant effect on wages in the private sector and, through the latter, a negative and statistically significant effect on profits and investment in the private sector. Hence, the assumption that wages for public sector workers are determined exogenously and independently of wages in the private sector allows to develop a theoretical model that is handleable and can rationalize this empirical evidence.

The government also purchases goods  $g$  from the private sector, pays an unemployment subsidy  $u$  to the unemployed workers and lump-sum transfers  $l_s$  to capitalists. It finances public spending by taxing labor and capital taxes and by issuing debt  $b$ . Equation (16) describes the government budget constraint.<sup>14</sup>

$$b_{t+1}X = b_t(1 + r_t^b) + N_{gt}w_{gt} + (N_w + N_{pt} + N_{gt})u_t + g_t + \lambda_{Nt}(w_{pt}N_{pt} + w_{gt}N_{gt}) + \lambda_{kt}r_tk_t + l_{st} \quad (16)$$

The government chooses public spending and tax rates exogenously. In each period, it fixes the tax rates  $\lambda_N$  and  $\lambda_k$ , the purchases of goods as a share of output  $\bar{g}$ , public employment as a share of total population<sup>15</sup>  $\bar{N}_g$ , and the wage rate of the public sector employees and unemployment benefits as a

<sup>14</sup> $b$  is the aggregate stock of public debt the government issues ( $\dot{b} = \theta N_k$ ) and  $l_s$  is the total amount of lump-sum transfers it pays ( $l_s = \beta N_k$ ).

<sup>15</sup>Total population is equal to  $N_k + N_w = 1$  and it is also equal to the labor force.

share of the wage in the private sector,  $\overline{w}_g$  and  $\overline{u}$  respectively.<sup>16</sup> Hence,

$$g_t = \overline{g}_t y_t \quad (17)$$

$$N_{gt} = \overline{N}_{gt} \quad (18)$$

$$w_{gt} = \overline{w}_{gt} w_{pt} \quad (19)$$

$$u_t = \overline{u}_t w_{pt} \quad (20)$$

Given equations (17) - (20) and the tax rates  $\lambda_N$  and  $\lambda_k$ , the government issues new debt to satisfy its budget constraint given by equation (16). The government also faces a no - Ponzi game constraint,  $\lim_{T \rightarrow \infty} \frac{1}{1+r_t^b} (1+r_t^b) b_T = 0$ , which implies that the present value of government expenditures equals the present value of tax revenues plus the initial stock of public debt. The government sets lump - sum transfers  $Is$  to balance its budget constraint intertemporally.<sup>17</sup>

Finally, in each period, the law of motion for the aggregate capital stock

$$k_{t+1} x = k_t (1 - \delta) + i_t \quad (21)$$

and the economy's resource constraint hold.

$$y_t = N_k c_{kt} + N_{pt} c_{pt} + N_{gt} c_{gt} + (N_w + N_{pt} + N_{gt}) c_{ut} + i_t + \overline{g}_t y_t \quad (22)$$

where  $i$  represents aggregate investment.<sup>18</sup>

<sup>16</sup>One could also assume that the government chooses the number of public workers, wages, and unemployment benefits in absolute terms. However, this choice would make the calibration of the model more cumbersome. Moreover, equations (17) - (20) ensure that the processes for the exogenous fiscal policy variables are stationary.

<sup>17</sup>Note that public debt is "Ricardian" in the sense that, given its initial value and the values of the exogenous fiscal policy instruments, public debt's time path does not affect equilibrium allocations. Hence, setting lump - sum transfers so that the no - Ponzi game condition holds affects only public debt's time path. See also section 2.4.

<sup>18</sup>Note that government spending for public employees enters the economy's resource (equation (22)) through public employees' consumption, but not as part of the public sector demand. Public employees are used to produce services  $SG$  that are a pure waste in the benchmark model.

## 2.2 Solving the model

The sequence of endogenous quantity and price variables  $\{b_{t+1}; k_{t+1}; c_{kt}; c_{pt}; c_{gt}; c_{ut}; N_{pt}, y_t, i_t, r_t, w_{pt}, r_{t+1}^b\}$  that solves the first order conditions for households, unions and firm's problems (equations (4) - (8), (10), (14), and (15)), equations (9), (16) - (22), the sequence of the exogenous variables  $\{\zeta_{Nt}, \zeta_{kt}, \bar{N}_{gt}, \bar{w}_{gt}, \bar{u}_t, \bar{g}_t, \bar{t}_{gt}\}$ , and the initial values of the predetermined ones  $\{b_t; k_t\}$  define the equilibrium for the economy described in section 2.1. Numerical solutions of changes to the exogenous fiscal policy variables involve the computation of the long - run, balanced - growth path equilibria before and after the change occurs and of the transitional dynamics between the two steady - state equilibria. Equations (4) - (10) and (14) - (22) define a system of stationary non - linear difference equations that describe the dynamic behavior of the economy. As shown in the appendix, I simplify them into a system of three non - linear difference equations. To determine the solution for the endogenous variables, I loglinearize the simplified set of equilibrium conditions around the steady - state values of the variables and apply the method of Blanchard and Kahn (1980). The appendix shows the equations defining the balanced - growth path equilibrium of the economy, the simplified set of equilibrium conditions, and the log - linearized system of difference equations used to determine the solution for the endogenous variables.

The equation for employment in the private sector deserves attention. Substituting equations (18) - (20) in equation (14) and solving for  $N_p$  gives:

$$N_{pt} = N_w \cdot \frac{\bar{N}_{gt} [\log(\bar{w}_{gt}) + \log(1 - \zeta_{Nt}) - \log(\bar{u}_t)]}{\log(1 - \zeta_{Nt}) - \log(\bar{u}_t) - a} \quad (23)$$

Equation (23) captures the effect of fiscal policy on the economy through the labor market channel.  $N_{pt}$  is a function of the exogenous fiscal policy variables  $\bar{N}_{gt}, \bar{w}_{gt}, \bar{u}_t, \zeta_{Nt}$ , and the technology parameter  $a$ . Hence, changes to public employment, wages of government employees, unemployment benefits and tax rates on labor income influence the equilibrium level of employment in the private sector and, as a consequence, the equilibrium of the economy. Given the timing of the game between unions and firms and the assumptions about unions' behavior discussed above, the capital stock does not affect

the equilibrium level of employment in the private sector. Certainly, this is a simplification because employment and investment decisions are likely to influence each other. Notwithstanding, as the next section shows, the model predicts results consistent with the empirical evidence in OECD countries.

## 2.3 Welfare analysis

To compute the welfare cost of a particular policy, the paper follows Ohanian (1997) and calculates the additional level of consumption to give to each agent of the economy so that his utility obtained with the policy change equals that in the pre-policy change case. More specifically, the paper finds the value of  $\alpha_i$  that satisfies the following equation:

$$\sum_{t=0}^{\infty} \beta^t \log(c_{it}^a (1 + \alpha_i)) - \bar{U}_{i0}^a = 0 \quad (24)$$

where:  $\bar{U}_{i0}$  is defined as the utility level in the pre-change scenario  $\bar{U}_{i0} = \log(c_{i0})$ ;  $c_{it}^a$  is consumption of agent  $i$  at the time and after the policy change;  $i$  refers to the representative capitalist, employee of the private sector, employee of the public sector and unemployed worker; and  $J = 200$ .

The paper also computes the additional level of consumption to give to the representative worker and household so that their utility obtained with the policy change equals that in the pre-policy change case. Hence, it finds the value of  $\alpha$  that solves the following equations.

$$\sum_{t=0}^{\infty} \beta^t \bar{U}_{wt}^a - \bar{U}_{w0}^o = 0 \quad (25)$$

$$\sum_{t=0}^{\infty} \beta^t [N_k \log(c_{kt}^a (1 + \alpha) + \bar{U}_{wt}^a) - [N_k \log(c_{k0} (1 + \alpha) + \bar{U}_{w0}^o)] = 0 \quad (26)$$

where

$$\begin{aligned} \bar{U}_{wt}^a &= N_w \left[ \frac{N_{pt}^a}{N_w} \log(c_{pt}^a (1 + \alpha)) + \frac{N_{gt}^a}{N_w} \log(c_{gt}^a (1 + \alpha)) + \frac{(N_w i N_{pt}^a i N_{gt}^a)}{N_w} \log(c_{ut}^a (1 + \alpha)) \right] \\ \bar{U}_{w0}^o &= N_w \left[ \frac{N_{p0}}{N_w} \log(c_{p0}) + \frac{N_{g0}}{N_w} \log(c_{g0}) + \frac{(N_w i N_{p0} i N_{g0})}{N_w} \log(c_{u0}) \right] \end{aligned}$$



## 2.4 Calibration

Table 1 shows the parameter values used to calibrate the model at a yearly frequency. The calibration of the values for the technology and preferences' parameters follows the literature and sets  $\alpha = 1/3$ ,  $\beta = 0.1$ , and  $\gamma = 0.98$ . For the benchmark model, the remaining parameters are the unweighted average data of ten European countries (Belgium, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, United Kingdom) in the period 1965 - 1995. Section 4 calibrates the model using US data in the same period. Tax rates on labor and capital income are from Daveri and Tabellini (2000) and Daveri and Mazzoli (1999) who provide an update of the series by Mendoza et al. (1994). The other data are from the OECD Economic Outlook no. 62.

The benchmark model sets the tax rate on labor income,  $\tau_N$ , at 36.67% and the one on capital income,  $\tau_K$ , at 32.09%. The value of public employment as a share of the labor force,  $\bar{N}_g$ ; and the wage premium between wages in the private and public sector,  $\bar{w}_g$ ; are equal to 16.76% and 112.42%, respectively. The replacement rate,  $\bar{u}$ ; is the ratio of per - capita transfers to the compensation workers in the private sector receive and it is equal to 25.17%. Government spending for - nal goods as a share of GDP,  $\bar{g}$ , is equal to 5.70%. In the initial steady - state, I set lump - sum transfers so that the initial value of the debt - to - GDP ratio is equal to 50.36%, the average value of the ten European countries between 1965 and 1995. I keep lump - sum transfers constant at this value for 100 periods. Then, I adjust them to ensure that the no - Ponzi game condition holds.<sup>19</sup> The average real per - capita growth rate of output is equal to 2.41%. Total population is normalized to 1 and  $N_w$  and  $N_k$  are equal to 0.83

<sup>19</sup>Lump - sum transfers from  $t = 1; \dots; J$  are set to satisfy the following equation:

$$\begin{aligned} & b_0(1 + r_0^b) + N_{g0}w_{g0} + (N_w - N_{p0} - N_{g0})u_0 + g_0 + \tau_N(N_{p0}w_{p0} + N_{g0}w_{g0}) + \tau_K r_0 k_0 + l_{s0} \\ & + \sum_{t=1}^n f_{Ngt}w_t + (N_w - N_{pt} - N_{gt})u_t + g_t + \tau_N(N_{pt}w_{pt} + N_{gt}w_{gt}) + \tau_K r_t k_t - \sum_{s=1}^t (1 + r_s)^{t-1} \\ & + l_{s0} - \sum_{s=1}^t (1 + r_s)^{t-1} + \sum_{t=T_1+1}^n l_{st} - \sum_{s=1}^t (1 + r_s)^{t-1} = 0 \end{aligned}$$

where variables at  $t = 0$  assume the value in the pre - policy change balanced - growth equilibrium,  $T_1 = 100$ , and  $J = 200$ :

and 0.17 respectively, where 0.17 is the average value of the ratio of self-employed workers to the labor force in the ten European countries between 1965 and 1995.<sup>20</sup> Section 4 checks the robustness of the results to the parameters used to calibrate the model.

Table 2 shows the employment and unemployment rate and the ratios of capital, investment, and consumption to GDP both as in the data and as the steady - state values of the model. I calibrate the latter using the average of the variables in Table 1 in each sub - period and from 1965 to 1995. When I use the average data over the all period, the steady - state value of the capital - to - output ratio is equal to 1.56, the ones of investment and total consumption as a share of GDP are 0.19 and 0.75, respectively. The sum of the employment rate in the private and public sector is 0.54 and the unemployment rate is 0.13. In the data, the average capital - to - output ratio across European countries over the period 1965 - 1995 is 2.02, private investment as a share of GDP is 0.19, public investment as a share of GDP is 0.03, private consumption, net export, and government consumption are 0.58, 0.0014, and 0.19, respectively.<sup>21</sup> The ratio of employment in the private and public sector to the labor force is 0.60 and the unemployment rate 0.06. Thus, the model implies a lower capital - to - output ratio and employment rate and a higher unemployment rate, but it fits well the data of private investment and private consumption, both as a share of GDP. In fact, in the model, the ratio of consumption - to - GDP is the residual component of the national income identity being public investment and net export zero.

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<sup>20</sup>Basically, I am measuring the number of capitalists populating the economy using the fraction of the population in the ten European countries that does not receive any dependent labor income. The qualitative nature of the results does not change if I calibrate the model setting, for example,  $N_k$  equal to 0.33, where 0.33 is the average value of the profits - to - GDP ratio in the ten European countries between 1965 - 1995.

<sup>21</sup>0.19 includes the ratio of non - wage government spending as a share of GDP ( $\bar{g}$  in the model) that is equal to 0.057 in the data.

### 3 Policy experiments

This section shows the results of a permanent, unanticipated, debt-financed increase of each of the exogenous fiscal policy variables, keeping the others fixed at their initial steady-state level. The top part of Table 3 details the response of output, the capital stock, investment, employment in the private sector, number of unemployed workers, the rate of return on capital, the wage rate in the private sector, and total private consumption. The second part shows the welfare costs and the change in the Gini coefficient due to the policy shock. The bottom part of the table looks at the effect of fiscal policy on public finances.

The paper simulates the model for 200 periods and gives data as percentage deviations from the pre-policy change balanced-growth equilibrium for all variables except the ratios of public debt, primary deficit, primary expenditure and revenues to GDP. I express the latter as percentage points deviations. Impact effects correspond to changes at the time of the increase in the fiscal policy item. Long-run effects measure deviations between the pre and post-policy change balanced-growth equilibria.

#### 3.1 Effects on the macroeconomy

Consider, for example, the effect of a 1% increase in public employment (columns 3 and 4). The change reduces employment in the private sector by 0.55% on impact. Given that the level of the capital stock is fixed at the time of the policy change, the capital-labor ratio increases, leading to a higher wage rate and lower rate of return on capital. Output in the first period of the transition is lower than its value in the initial steady-state by 0.37%, and investment decreases too. Because unions solve a static problem and employment in the private sector depends only on fiscal policy and technology parameters,  $N_p$  converges to the new steady-state value at the time of the policy change. As investment goes down, the capital stock falls, further reducing output. But, as capital decreases, its rate of return goes up. In the new steady-state,  $w_p$  and  $r$  are back to their initial values. Output, employment in the private sector, and the capital stock are lower than in the pre-policy change equilibrium by 0.55%.

The increase in public employment does not compensate for the decrease in private employment and unemployment increases as well. Malley and Moutos (1998) find a similar result. They analyze the effect of public employment on private and aggregate employment in Sweden during the period 1964 - 1990. They show that the sharp increase in public employment crowded out employment in the private sector and contributed to the increase in unemployment.

Columns 5 - 8 show that a 1% increase in public employees' wages and unemployment benefits have the same qualitative effect of a 1% increase in public employment. In fact,  $\overline{w}_g$  and  $\overline{u}$  influence the macroeconomy through the labor market channel in the same way as public employment. By contrast, an increase in government consumption of goods,  $\overline{g}$ , does not have any effect on the supply - side of the economy, neither on impact nor in the long - run. Because the union is myopic and government consumption of goods does not influence workers' utility, employment in the private sector does not depend on  $\overline{g}$  and output and the capital stock remain unchanged. The increase in  $\overline{g}$  generates only a negative wealth effect that crowds out capitalists' consumption (columns 1 - 2).

In summary, columns 1 - 8 show that changes in government purchases of goods, on the one hand, and in public employment, wages of public employees and unemployment benefits, on the other, have different effects on the economy. Hence, as Finn (1998) and Ardagna (2001) show in a competitive labor market economy, it is crucial to consider them separately. Changes in the first spending item influence only capitalists' consumption, changes in the others crowd out employment in the private sector, induce a slow down in economic activity, and increase the number of unemployed workers.

The effects of an increase in tax rates on labor and capital income are in columns 9 - 12. A 1% increase in  $\zeta_N$  influences employment, output, investment and the capital stock similarly to a 1% increase in public employment, wages of public sector workers and unemployment benefits. Note, however, that the effects from a 1% increase in the former are smaller than the ones from a 1% increase in the latter. As far as the increase in the tax rates on capital income is concerned, it reduces the net of tax return on saving, leading to an increase in capitalists' consumption at the time of the policy change.

However, on impact,  $\zeta_k$  does not affect employment in the private sector. Given that the level of the capital stock is fixed at the time of the policy change, output, the capital - labor ratio, hence,  $r$  and  $w_p$ , do not change. Workers' consumption does not vary as well, because their disposable income remains at the initial value. Driven by the increase in capitalists' consumption, total private consumption increases by 0.17% on impact and aggregate investment decreases by 0.67%. Over time, the decrease in saving and investment reduces the capital stock and output and it decreases the capital - labor ratio. In the new balanced - growth path equilibrium,  $r$  is higher and  $w_p$  is lower than in the pre - policy change case.

The above predictions are consistent with the evidence on fiscal policy in OECD countries.<sup>22</sup> Even though the modelling of the wage setting is far from being an accurate and detailed description of practices in developed countries, the paper is able to reproduce the correlation observed in the data between fiscal policy shocks to  $\bar{N}_g$ ,  $\bar{w}_g$ ,  $\bar{u}$ , and  $\zeta_N$  and macroeconomic variables even when the individual labor supply is perfectly inelastic and lump-sum taxation is used to finance changes in fiscal policy. As Dotsey (1994) and Ludvigson (1996) show, in a standard real business cycle model, instead, a deficit financed spending or tax change generates a positive effect on the real wage and a negative one on investment and output only if the individual labor supply assumes very high, hence, unrealistic values. The only case in which the elasticity of the individual labor supply does not drive the results is the case of a shock to public employment.<sup>23</sup> Also, results discussed above go through if not only capitalists but also workers invest in capital and public bonds and smooth their consumption over time, provided that unions consider the rate of returns on these assets as exogenous. In this case, the union problem does not change and unions ask for higher wages in response to increases to public employment, wages of public sector employees, unemployment benefits, and labor taxes. However, if unions take into account

<sup>22</sup>See, for example, Alesina et al. (2001), and Daveri and Tabellini (2000).

<sup>23</sup>See, for example, Rotemberg and Woodford (1992) and Ramey and Shapiro (1998) for general equilibrium models that generate predictions consistent with the empirical evidence in the US. These models assume competitive labor markets but departure from the standard neoclassical approach in other dimensions.

the effect of higher wage rates on the rate of return on capital and on public debt, results are likely to become weaker. In fact, in this case, unions would face a trade-off: a higher  $w_p$  increases workers' income, consumption, and, hence, utility, but, at the same time, it decreases  $r$  and  $r^b$  with the opposite effect on members' utility. Similarly, if unions were not myopic and did not take as given fiscal policy variables and the alternative utility workers receive if they are not employed in the private sector, they would internalize that an increase in  $w_p$  raises the probability of workers being unemployed. This would lead to a lower expected utility for unions' members. As a consequence, unions would mitigate their wage claims.<sup>24</sup>

### 3.2 Effects on welfare and income distribution

Let's begin with the welfare effects due to a 1% increase in public employment (columns 3 and 4). As discussed in section 3.1, the wage rate of private sector employees,  $w_p$ , increases. Because income of public sector and unemployed workers is linked to  $w_p$ , income, consumption, and utility of all types of workers increase in the short-run. However, in the new steady-state equilibrium, workers' utility converges to its value before the increase in  $\bar{N}_g$  because the wage rate goes back to its pre-policy change level. Note that, even though life-time utility of a public and a private sector employee and an unemployed worker increases, welfare of the representative worker decreases. In fact, although the probability of being employed in the public sector increases, the probability of being employed in the private sector decreases and the one of being unemployed goes up. This outweighs the positive effect of the higher wage rate on workers' welfare and the expected life-time utility of the representative worker goes down. Income inequality, measured by the change in the Gini coefficient, decreases in the short-run. However, it is higher in the post-policy change equilibrium than in the pre-policy change one. Table 1 shows that public employment has sharply increased since the mid-sixties. Between 1965

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<sup>24</sup>A proper treatment of these issues requires a more complex model which also addresses time consistency problems. This is beyond the scope of this work.

and 1995, the average value of the ratio of government employees to the labor force changed from 13% to almost 19% in the European countries in the sample. One of the arguments in the literature to explain this trend suggests that governments use public employment to redistribute resources across groups or geographical regions and that the size of redistribution through this channel is large. For example, Alesina et al. (1999) argue that about one half of the wage bill of Southern Italy can be seen as a pure transfer from the North. Consistently with this literature, in the model, public employment redistributes resources from capitalists to workers. However, as discussed above, this policy benefits the latter and decreases income inequality only temporarily.

Effects on welfare and income distribution due to a 1% increase in public employees' wages and in unemployment benefits are similar to the ones following a 1% increase in public employment. The only exception is the increase in income inequality occurring at the time of the increase in  $\bar{w}_g$ . Welfare costs due to a 1% increase in labor taxes differ among agents. Among workers, unemployed are the only ones who gain from the increase in labor taxes. Their disposable income goes up on impact, because unemployment subsidies are tied to the wage rate in the private sector and because they are tax - exempt. Welfare of private sector and public sector workers, instead, decreases both on impact and in the steady - state, since the increase in the wage rate is smaller than the one in taxation and, thus, consumption decreases. Workers' aggregate consumption goes down as well. By contrast, more resources are available to capitalists whose consumption and utility increase. The Gini coefficient goes up on impact, but, in the long - run, it decreases by 1.5%. Income inequality also decreases in response to an increase in the tax rate on capital income.

In summary, increases in government employment, unemployment benefits and wages of public sector employees hurt capitalists but increase life - time welfare of each type of worker. The opposite occurs when tax rates raise. However, if we consider that fiscal policy also changes the probability of being employed and that workers are ex-ante identical (hence, in each period they can be either employed

or unemployed) their expected life - time utility decreases even when  $\bar{N}_g$ ,  $\bar{w}_g$ , and  $\bar{u}$  increase. Thus, these measures generate a welfare cost for the representative worker too. Note that we are considering deficit financed increases in public spending. If tax rates on labor income financed spending increases, as it has happened in the European countries in the sample, welfare costs would be even higher for the representative worker.

### 3.3 Effects on public finances

Columns 1 - 8 show that the largest deterioration in public finances occurs when wages of the public sector employees raise. A 1% increase in public employment has almost the same effect on the primary deficit and public debt than the increase in  $\bar{w}_g$ , while the effect from a 1% increase in unemployment benefits is smaller. Increases in labor and capital tax rates also reduce primary deficit and public debt. It is interesting to note that the change in primary deficit and public debt following a 1% change in the capital tax rate is lower, in absolute value, than the change in any spending item except government consumption. Hence, the model suggests that, in order to improve public finances, governments should tackle public employment, wages of public sector employees, unemployment benefits and labor tax rates. Changes to government consumption and tax rates on capital income play only a minor role. The next section concentrates on the effects from the first group of fiscal policy items and compares fiscal consolidations that differ in their composition.

### 3.4 Fiscal contractions

The top part of figure 1 plots the response of employment in the private sector, the capital stock, output, total private consumption and the ratios of public debt and primary deficit - to - GDP following a fiscal contraction achieved by cutting  $\bar{N}_g$ ,  $\bar{w}_g$ ,  $\bar{u}$  or by increasing  $\lambda_N$ . Consistently with the empirical literature on fiscal adjustments, the composition of the stabilization matters for its outcome. First, cuts to public employment, wages of public sector workers and unemployment benefits generate a boom



in economic activity, while increases in labor taxes lead to a contraction. Second, the improvement in the primary balance - to - GDP ratio is larger and the reduction of public debt is faster when the consolidation concentrates on the spending side of the budget. The bottom part of Figure 1 shows how agents' utility changes in response to different types of fiscal contractions. Capitalists' utility always increases, but the welfare gain is larger when public employment and wages of public sector workers decrease. By contrast, workers suffer from fiscal stabilizations, at least in the short - run. When labor taxes increase, workers' expected utility decreases on impact and in the new steady - state. When  $\bar{N}_g$ ,  $\bar{w}_g$ , and  $\bar{u}$  are cut, workers are hurt less. At the time of the policy shock, the reduction in their expected utility is lower. Moreover, after some years, workers's expected utility is higher than its value in the initial steady - state: the benefit from the higher probability of being employed in the private or public sector dominates the cost due to the reduction in disposable income. The last chart shows the percentage change in the Gini coefficient. At the time of the policy change, income inequality increases in all cases except when wages of government employees go down. Over time, inequality decreases and the decrease is larger for fiscal stabilizations achieved by reducing the government wage bill and unemployment benefits than by increasing labor taxes.

Alesina, Perotti and Tavares (1998) show that voters do not punish governments that implement fiscal adjustments curbing government expenditures. Results summarized in this section seem to point in the same direction. In fact, both capitalists and workers are better off when governments cut public employment, wages of public sector employees and unemployment benefits than when they raise labor taxes, the only exception being unemployed workers whose utility increases in the latter case.<sup>25</sup>

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<sup>25</sup>We can move one step further and interpret the above results to get hints on political economy aspects of fiscal stabilizations. Suppose, for example, that voters choose how to balance the budget. Consider a country in which the median voter is a capitalist. Figure 1 suggests that he would vote in favor of a decrease in wages of public sector workers because he would benefit the most from this policy. Of course, public sector workers would strongly oppose it. If the median voter were, instead, a public or private sector worker, he would vote for a decrease in unemployment benefits. Consider, now, how this result depends, for example, on the degree of flexibility of the labor market. In countries with very static and sclerotic labor markets, with high unemployment duration, very low degree of mobility between jobs and

## 4 Sensitivity and extensions

This section discusses some sensitivity analysis and extensions to the benchmark model. First, I calibrate the model setting fiscal policy variables at their minimum values across the European countries in the sample and at their average values in the sub - periods 1965 - 1970 and 1991 -1995. Second, I use average US data over the period 1965 - 1995 and compare the effects of fiscal policy in Europe and the US. Third, I allow public employment to influence the productivity of private production. Fiscal policy experiments are the same as in section 3.

### 4.1 Fiscal reforms in different time periods

The qualitative nature of the results does not change when I use the minimum values of the fiscal policy variables across the European countries in the sample. The absolute value of the changes differs. It is increasing in the level of the fiscal policy variables: a 1% increase in policy instruments has a lower impact on the macroeconomy, public finances, welfare and income inequality when I calibrate the model using the minimum values of the fiscal policy variables than when I use the average values over all sub - periods.

I also checked whether the effects of each policy shock differ across time periods, calibrating the model with data in the years 1965 - 1970 and 1991 - 1995. As Table 1 shows, all fiscal policy variables, except the ratio of wages in the public and private sector, increase over time, while the real per capita growth rate and the ratio of self employed workers to the labor force decline. Results are similar to those in the benchmark model and they are stronger when I use the most recent data. Hence, *ceteris paribus*, the effect of a fiscal reform implemented between 1991 and 1995 is larger than that which the between being a given type of worker or a capitalist, there are good chances that the median voter chooses his preferred policy thinking that he will remain in his status for all his life. By contrast, it seems reasonable that a worker will vote considering that he can change status easily and that fiscal policy also influences the probability of finding a new job in countries with more flexible labor markets, low unemployment duration, lower firing costs. In the latter case, for example, not only a capitalist but also a public or private sector worker could vote in favor of a reduction of government wages.

same reform would have had should it had taken place between 1965 and 1970.

## 4.2 Fiscal reforms in different countries

I calibrate the model using US average data over the period 1965 - 1995.<sup>26</sup> Table 4 shows the results. Both the impact and the steady state effect of a 1% increase in public employment, wages of public sector employees, unemployment benefits and labor taxes are smaller in the US than in Europe, while the opposite occurs when tax rates on capital income increase. These results are consistent with those in section 4.1. In fact, all fiscal variables, except tax rates on capital income and the ratio of government consumption to GDP, are lower in the US than in Europe.

Differences in economic policies are often blamed for differences in the macroeconomic performance of the European countries versus the US. The model provides an answer to the following question: what would have been the economic situation in Europe (US) if fiscal policy variables were, on average, equal to those in the US (Europe)? Figure 2 plots the response of the economy to this change in fiscal policy.<sup>27</sup> Consider, first, the case in which fiscal policy in Europe "becomes" that of the US; that is the case in which I calibrate the initial steady state equilibrium using average data of the European countries in the sample and the final one with the averages of the US data. At the time of the policy change, employment in the private sector and output increase by 18% and 12%, respectively, and, in the long-run, they are 9% higher than in the pre-policy change equilibrium. The capital stock, instead, decreases by 7% in the steady state. All agents in the economy, except the unemployed workers, benefit from the policy shift and income inequality substantially decreases.<sup>28</sup> Finally, public finances improves

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<sup>26</sup>Data are shown at the bottom of Table 4.

<sup>27</sup>While steady state effects are quite instructive, impact effects have to be taken with caution, because the dynamics of the model is worked out loglinearizing the system around steady state values and changes in fiscal policy variables are sizeable in this experiment.

<sup>28</sup>Note that the experiment implies a decrease in public employment, wages of public sector employees, unemployment benefits and labor taxes and an increase in tax rates on capital income and government consumption. As discussed in section 3.2, income inequality goes up in steady state when spending on welfare and government employment increase

leading to a decline in the debt - to - GDP ratio. If we consider the case in which fiscal policy in the US "becomes" the one in Europe, results are opposite. For example, in steady state, employment in the private sector goes down by almost 14%, output by about 7% and the capital stock increases by about 10%.

How do these results compare with actual data? Using series from the OECD Economic Outlook from 1965 to 1995 for real output, real capital stock in the business sector, employment in the private sector, population, and purchasing power parity (PPP), I calculate the first three variables (in PPP value) as a share of population and I average them both across the ten European countries in Table 1 and in the US. I, then, compute the percentage change in per capita output, capital stock and employment in the private sector between the average values in Europe and in the US. Interestingly, results discussed above match the data pretty well. In fact, on average, over the period 1965 - 1995, real per capita income, and employment in the private sector as a share of population were 48% and 19% higher in the US than in Europe, while the capital stock was 24% lower in the former country than in the latter. In the model, these numbers are 9%, 18%, and -7%. Hence, ceteris paribus, the model can explain about 20% of the difference between Europe and the US in real per capita income, around 30% of the difference in the capital stock, and almost 100% of the difference in private sector employment. Considering that we are explaining long - run values only in terms of differences in fiscal policy and that we are disregarding many variables that are important determinants of long - run growth and standard of livings, results look quite encouraging. Also, it is interesting to note how fiscal policy changes have a greater power in explaining differences in employment rates. As a matter of fact, there is quite a large literature that explains differences in structural unemployment between the US and Europe in terms of differences in generosity of the welfare state, labor taxation and flexibility of the labor market. because of the negative effects these changes have on employment, while it goes down when tax rates raise. Hence, in this experiment, the effect on inequality of lower spending and higher capital tax rates more than compensate the one due to a decrease in labor taxation.

### 4.3 Productivity of public services

In order to take into account that services produced by public employees can influence the productivity of labor and capital, I modify the production function described by equation (9) following Barro (1990).<sup>29</sup>

$$y_t = k_t^{\alpha} N_{pt}^{1-\alpha} (\bar{N}_{gt})^{\beta} \quad (28)$$

The parameter  $\beta$  measures the productivity of public employment in the production of private goods. I calibrate the model setting  $\beta$  equal to 1/3, 2/3, and 1, not to hinge on a particular parameter value. Figure 3 shows the impulse response functions to a 1% increase in public employment when  $\beta$  assumes the above values. For comparison, Figure 3 also plots the impulse response functions for the benchmark model ( $\beta = 0$ ).

Changing the parameter  $\beta$  has effect on the percentage of that employment in the private sector, capital, output, total private consumption, public debt, primary deficit, utility of the different agents, and the Gini coefficient deviate from the initial steady - state values. As expected, the negative effect on the macroeconomy is smaller if public employment contributes to the productivity of private employment and capital. Ceteris paribus, we obtain the same qualitative results than in the benchmark model (i.e.: a negative effect on economic activity following an increase in  $\bar{N}_g$ ) if  $\beta$  is smaller or equal to 0.58. For  $\beta$  greater than 0.58, instead, a 1% increase in  $\bar{N}_g$  leads to an increase in private sector employment, capital, output, and total private consumption. To my knowledge, there are no papers that calibrate the productivity of public workers. Finn (1998) considers a model in which public capital affects the production of private goods, and fixes the parameter that measures the productivity of public capital in the production function to about one half of the parameter that measures the productivity of private capital. Using the same criteria and setting  $\beta$  equal to 1/3, results of the benchmark model still hold.<sup>30</sup>

<sup>29</sup>Equations in section 2 and in appendix hold except equation (36) that becomes

$$k^* = \left(\frac{y^*}{k^*}\right)^{\frac{1}{\alpha-1}} N_p^{\alpha} \bar{N}_g^{1-\alpha} \beta^{\frac{\alpha}{\alpha-1}} \quad (27)$$

<sup>30</sup>Note that results about the effects of changes to the other fiscal policy variables except public employment do not

Figure 3 also shows that capitalists and workers' utility is increasing in the coefficient that measures the productivity of public workers. On impact, income inequality decreases more when  $\beta$  is equal to 1 than when it is equal to 0. Over time, the increase in the Gini coefficient is lower when public employment affects the productivity of private employment and capital.

## 5 Conclusions

This paper studies the effects of fiscal policy on economic activity, welfare, income distribution, and public finances in a dynamic general equilibrium model with a unionized labor market. Consistently with the empirical evidence on fiscal policy in OECD countries, the paper shows that, in response to an increase in public employment, wages of public sector employees, unemployment benefits, and labor taxes unions demand higher wages. Employment in the private sector decreases and the economy contracts. The paper also suggests that capitalists benefit from fiscal adjustments, while workers are hurt especially during the stabilization and in its immediate aftermath. However, both capitalists and workers are better off when the fiscal stabilization is implemented by cutting welfare spending and the government wage bill rather than by increasing labor taxes. Moreover, the model predicts that policies that redistribute income in favor of one type of workers can damage workers as a group. In fact, the benefit that the targeted group receives from higher disposable income can be more than compensated by the cost due to the effect that fiscal policy has on the employment rate. As a result, the life-time expected utility of a worker decreases.

The paper can be extended along different dimensions. First, a more detailed description of the labor market that models wage setting in the public sector would allow to analyze the effects of fiscal policies on the macroeconomy in a more general framework. Second, the paper assumes that the government sets fiscal policy exogenously. One could study the political economy of fiscal reforms, endogenizing the instruments chosen to reach given targets. Predictions about the effects of fiscal policy depend on the assumption about the productivity of public workers.

items on welfare and income distribution suggest that agents prefer different budgetary composition according to their status and according to the probability of remaining in that status for all their life. The latter is likely to depend on the strength of the economy, on the degree of flexibility of the labor market, on institutions that influence social mobility, just to mention a few factors. Looking at the interaction between labor market characteristics, degree of social mobility and budgetary composition is certainly an interesting topic for future research.

## A Appendix

### A.1 The balanced - growth path

Equations (29)-(36) define the steady - state equilibrium for this economy. Along the balanced - growth path, quantity variables grow at rate  $x$ . Equation (4) shows that the rate of return on capital, hence on public debt, is a constant along the balanced - growth path.

$$r^a = \frac{1}{(1 - i_k^a)} (x + i + \pm) \quad (29)$$

This result can be replaced in (15) to obtain the constant output-to-capital ratio.

$$\frac{y^a}{k^a} = \frac{r^a}{a} \quad (30)$$

Equation (23) defines the steady - state level of employment in the private sector.

$$N_p^a = N_w + i \frac{\bar{N}_g^a [\log(\bar{w}_g^a) + \log(1 - i_N^a) - \log(\bar{u}^a)]}{\log(1 - i_N^a) - \log(\bar{u}^a) - a} \quad (31)$$

Substituting it in equation (10) gives the steady - state wage rate in the private sector as a share of output.

$$\frac{w_p^a}{y^a} = (1 - a) \frac{1}{N_p^a} \quad (32)$$

The capital accumulation equation (21) can be used to determine the constant investment - to - output ratio,

$$\frac{i^a}{y^a} = (x + \pm + i - 1) \left( \frac{y^a}{k^a} \right)^{i-1} \quad (33)$$

and the resource constraint determines the representative capitalist's consumption - to - output ratio.

$$\frac{c_k^a}{y^a} = \frac{1}{N_k} \left( 1 - N_p^a \frac{w_p^a}{y^a} (1 - i_N^a) - \bar{N}_g^a \bar{w}_g^a \frac{w_p^a}{y^a} (1 - i_N^a) - (N_w + N_p^a + \bar{N}_g^a) \bar{u}^a \frac{w_p^a}{y^a} - \frac{i^a}{y^a} - \bar{g}^a \right) \quad (34)$$



Finally, the steady - state relation among public expenditures, tax revenues and public debt is described by

$$\frac{b^a}{y^a} (x_i (1 - \lambda_k^a) r_i (1 + \pm)) = \overline{N_g^a} \overline{w_g^a} \frac{w_p^a}{y^a} + (N_w \text{ i } N_p^a \text{ i } \overline{N_g^a}) \overline{u^a} \frac{w_p^a}{y^a} + \overline{g^a} \quad (35)$$

$$\text{ i } \lambda_N^a \left( \frac{w_p^a}{y^a} N_p^a + \overline{N_g^a} \overline{w_g^a} \frac{w_p^a}{y^a} \right) \text{ i } \lambda_k^a r^a \frac{k^a}{y^a} + \frac{I_s^a}{y^a}$$

and equation (9) defines the steady - state capital stock.

$$k^a = \left( \frac{y^a}{k^a} \right)^{\frac{1}{a-1}} N_p^a \quad (36)$$

## A.2 Transitional dynamics

The set of equilibrium conditions given by equations (4) - (10), (14) - (22) can be simplified as follows.

The equation for employment in the private sector can be obtained substituting equations (18) - (20) in equation (14) and solving for  $N_p$ .

$$N_{pt} = N_w \text{ i } \frac{\overline{N_{gt}} [\log(\overline{w_{gt}}) + \log(1 - \lambda_{Nt}) \text{ i } \log(\overline{u_t})]}{\log(1 - \lambda_{Nt}) \text{ i } \log(\overline{u_t}) \text{ i } a} \quad (37)$$

Substituting equations (6) - (10) and (17) - (21) in equation (22), we can rewrite the economy's resource constraint as:

$$k_t^a N_{pt}^{1-a} = N_k c_{kt} + \overline{N_{gt}} \overline{w_{gt}} (1 - \lambda_{Nt}) + (N_w \text{ i } N_{pt} \text{ i } \overline{N_{gt}}) \overline{u_t}^a (1 - a) k_t^a N_{pt}^{1-a} + k_{t+1} x \text{ i } k_t (1 - \pm) + \overline{g_t} k_t^a N_{pt}^{1-a} \quad (38)$$

Finally, substituting equations (5), (9), and (15) in equation (4) gives

$$c_{kt}^1 = \overline{x}^1 c_{kt+1}^1 (1 + (1 - \lambda_{kt+1}) a k_{t+1}^{a-1} N_{pt+1}^{1-a} \text{ i } \pm) \quad (39)$$

Equations (37) - (39) define the system of stationary non - linear difference equations for the endogenous variables  $k_{t+1}$ ;  $c_{kt}$ ;  $N_{pt}$ . These three equations are log - linearized around the steady - state values of the variables.

In writing the log - linear equations,  $\hat{N}_{pt}$  denotes  $\log(N_{pt}=N_p^s)$ ,  $\hat{k}_t$  denotes  $\log(k_t=k^s)$  and so on, where  $N_p^s$ ,  $k^s$  are the steady - state values of the variables. The log - linear approximations to equations (37) - (39) can be written as:

$$\hat{N}_{pt} = \alpha_{Np} \hat{N}_{gt} + \alpha_{Nc} \hat{c}_t + \alpha_{Nk} \hat{k}_t + \alpha_{Nw} \hat{w}_t + \alpha_{Nu} \hat{u}_t \quad (40)$$

$$\hat{k}_{t+1} = \delta \hat{k}_t + \alpha_{kN} \hat{N}_{pt} + \alpha_{kc} \hat{c}_t + \alpha_{kN} \hat{N}_{gt} + \alpha_{kw} \hat{w}_t + \alpha_{ku} \hat{u}_t + \alpha_{kg} \hat{g}_t \quad (41)$$

$$\hat{c}_{kt+1} = \alpha_{ck} \hat{k}_{t+1} + \alpha_{cNp} \hat{N}_{pt+1} + \alpha_{cc} \hat{c}_t + \alpha_{cN} \hat{N}_{gt+1} + \alpha_{ck} \hat{k}_{t+1} \quad (42)$$

where the coefficients  $\alpha_{jz}$  are functions of the parameters and the steady - state values of the endogenous and exogenous variables of the system.  $\alpha_{jz}$  measures the impact effect on the  $j$ th variable of a deviation from steady - state in the  $z$ th variable.

The system of log - linear difference equations (40) - (42) can be further simplified substituting equation (40) in equations (41) and (42). Hence, we obtain a system of two difference equations in two unknowns  $\hat{k}_{t+1}$ ;  $\hat{c}_{kt+1}$ , where the capital stock  $k$  is predetermined at time  $t$  and capitalists' consumption  $c_k$  is not. The system can be rewritten in the following form:

$$A \begin{bmatrix} \hat{k}_{t+1} \\ \hat{c}_{kt+1} \end{bmatrix} = B \begin{bmatrix} \hat{k}_t \\ \hat{c}_t \end{bmatrix} + C \begin{bmatrix} \hat{N}_{gt} \\ \hat{w}_t \\ \hat{u}_t \\ \hat{g}_t \\ \hat{N}_{gt+1} \\ \hat{w}_{gt+1} \\ \hat{u}_{t+1} \\ \hat{g}_{kt+1} \end{bmatrix} \quad (43)$$

Under the assumption that the exogenous variables  $\hat{N}_{gt}$ ,  $\hat{w}_{gt}$ ,  $\hat{u}_t$ ,  $\hat{g}_t$  are stationary, Blanchard and Kahn (1980) show that (43) has a unique stationary solution if the matrix  $A^{-1}B$  has one eigenvalue with modulus less than one. For the calibrated parameters' values discussed in section 2.4, this condition is satisfied. The solution to the log - linear system (43) is determined using the formulas of Blanchard and Kahn (1980).

The solution for  $N_{pt}$  is obtained from (40). Given the solutions for the capital stock  $k_t$ , employment in the private sector  $N_{pt}$ , and the level of consumption of the representative capitalists  $c_{kt}$ , the path for the variables  $k_t$ ,  $N_{pt}$ , and  $c_{kt}$  are respectively equal to  $\exp(\lambda k)k^\alpha$ ,  $\exp(\lambda N_{pt})N_{pt}^\alpha$ , and  $\exp(\lambda c_{kt})c_{kt}^\alpha$ . The solution for  $f_{cpt}$ ;  $c_{gt}$ ;  $c_{ut}$ ;  $y_t$ ;  $i_t$ ;  $r_t$ ;  $w_{pt}$ ;  $r_{t}^b$  are computed using equations (5) - (10), (15), (17) - (21). Finally, given the time path for  $f_{kt}$ ;  $N_{pt}$ ;  $w_{pt}$ ;  $r_t$ ;  $r_{t}^b$ ;  $\lambda_{Nt}$ ;  $\lambda_{kt}$ ;  $N_{gt}$ ;  $w_{gt}$ ;  $u_t$ ;  $g_t$ ;  $l_{st}g$  and the values for  $x$  and  $N_k$ , the path for public debt  $b_t$  is obtained solving the first - order difference equation (16). The solution uses the forward expansion as in Sargent (1979) and satisfies the no - Ponzi game condition  $\lim_{T \rightarrow \infty} \frac{1}{T} \sum_{t=0}^T (1 + r_t^b)b_T = 0$ :

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**Table 1: Calibration**

<b>Preferences and Technology parameters</b>							
	$\beta$	$\alpha$	$\delta$				
	0.98	1/3	0.1				
<b>Macroeconomic and fiscal policy variables</b>							
	1965-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	Average
Real per capita growth rate	3.94	2.79	2.58	1.47	2.69	0.64	2.41
Self employed/labor force	21.34	17.89	16.18	15.74	14.84	13.83	16.73
Effective tax rates on labor income	28.1	32.67	36.69	39.12	41.5	42.6	36.7
Effective tax rates on capital income	23.79	27.44	33.67	35.95	36.88	34.8	32.09
Replacement rate	17.42	21.5	24.64	26.94	28.51	32.1	25.17
Wage public employees/wage private employees	130.79	120.23	110.03	105.9	102.31	104.59	112.42
Public employment/labor force	12.99	15.15	17.13	18.25	18.82	18.71	16.76
Gov. non-wage consumption/GDP	4.83	5.26	5.71	5.93	6.08	6.57	5.70
Debt/GDP	41.25	37.45	39.51	52.5	59.04	70.54	50.36

**Table 2: Macroeconomic variables**

	1965-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	Average
<b>Average data</b>							
Capital stock/GDP	1.85	1.90	2.01	2.11	2.09	2.19	2.02
Investment/GDP	0.20	0.20	0.19	0.17	0.18	0.17	0.19
Total consumption/GDP	0.58	0.58	0.59	0.58	0.58	0.58	0.58
Dependent employment rate	0.64	0.65	0.62	0.57	0.58	0.57	0.60
Unemployment rate	0.02	0.03	0.05	0.08	0.08	0.11	0.06
<b>Steady state variables generated by the model</b>							
Capital stock/GDP	1.58	1.62	1.51	1.58	1.42	1.71	1.56
Investment/GDP	0.22	0.21	0.19	0.18	0.18	0.18	0.19
Total consumption/GDP	0.73	0.74	0.75	0.76	0.76	0.75	0.75
Dependent employment rate	0.58	0.57	0.55	0.51	0.49	0.39	0.54
Unemployment rate	0.07	0.10	0.12	0.15	0.17	0.29	0.13

Countries in the sample: Belgium, Finland, France, Germany, Italy, The Netherlands, Norway, Spain, Sweden, UK  
Source: OECD Economic Outlook n. 62; Daveri and Maffezzoli (1999); Daveri and Tabellini (2000).



**Table 3: Effects of 1% increase in fiscal policy items – benchmark model.**

	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$\Delta g$		$\Delta N_g$		$\Delta w_g$		$\Delta u$		$\Delta \tau_N$		$\Delta \tau_k$	
<b>Macroeconomy</b>												
<i>Output</i>	0	0	-0.37	-0.55	-0.35	-0.53	-0.28	-0.41	-0.16	-0.24	0	-0.24
<i>Capital stock</i>	0	0	0	-0.55	0	-0.53	0	-0.41	0	-0.24	0	-0.71
<i>Investment</i>	0	0	-0.52	-0.55	-0.50	-0.53	-0.39	-0.41	-0.23	-0.24	-0.67	-0.71
<i>Private sector employment</i>	0	0	-0.55	-0.55	-0.53	-0.53	-0.41	-0.41	-0.24	-0.24	0	0
<i>Unemployment</i>	0	0	1.00	1.00	2.21	2.21	1.72	1.72	1.00	1.00	0	0
<i>Rate of return on capital</i>	0	0	-0.37	0	-0.35	0	-0.28	0	-0.16	0	0	0.48
<i>Private sector workers' wage rate</i>	0	0	0.19	0	0.18	0	0.14	0	0.08	0	0	-0.24
<i>Total consumption</i>	-0.076	-0.076	-0.33	-0.55	-0.32	-0.53	-0.25	-0.41	-0.14	-0.24	0.17	-0.11
<b>Welfare costs</b>												
<i>household</i>		0.07		0.51		0.56		0.34		0.25		0.08
<i>capitalist</i>		0.40		2.63		2.94		1.72		-1.50		-0.49
<i>worker</i>		0		0.09		0.08		0.06		0.61		0.20
<i>private sector employee</i>		0		-0.03		-0.03		-0.02		0.56		0.20
<i>public sector employee</i>		0		-0.03		-1.00		-0.02		0.56		0.20
<i>unemployed</i>		0		-0.03		-0.03		-0.99		-0.01		0.20
<b>Income distribution</b>												
<i>Gini coefficient</i>	0	0.49	-0.14	2.79	0.26	3.53	-0.06	1.88	0.42	-1.50	-0.28	-1.04
<b>Public finances</b>												
<i>Debt/GDP</i>	0	1.70	0.19	10.3	0.18	11.6	0.14	6.77	0.08	-6.67	0	-3.0
<i>Primary deficit/GDP</i>	0.06	0.06	0.3	0.3	0.34	0.34	0.19	0.19	-0.25	-0.25	-0.11	-0.11
<i>Primary spending/GDP</i>	0.06	0.06	0.43	0.43	0.47	0.47	0.22	0.22	0.11	0.11	0	0
<i>Revenue/GDP</i>	0	0	0.13	0.13	0.13	0.13	0.04	0.04	0.35	0.35	0.11	0.11
<i>Primary spending</i>	0.17	0.17	0.92	0.73	1.06	0.88	0.40	0.26	0.16	0.08	0	-0.24
<i>Revenue</i>	0	0	-0.06	-0.25	-0.05	-0.23	-0.19	-0.33	0.64	0.56	0.24	0.007

Data are given as percentage deviations from the pre - policy change balanced - growth equilibrium for all variables except debt/GDP, primary deficit/GDP, primary spending/GDP, and revenue/GDP which are percentage points deviations. Impact effects correspond to changes at the time of the increase in the fiscal policy item. Long - run effects measure deviations between the post and pre - policy change balanced - growth equilibria. For Debt/GDP and Gini coefficient, the long - run effect corresponds to the percentage deviations of the two variables relative to the pre - policy change equilibrium twenty-five years after the policy change occurred. The welfare cost of a policy is computed as the percentage change in consumption needed to equate lifetime utility after the policy change to lifetime utility in the pre - policy change case. Primary deficit: a positive change in the primary deficit means that the primary balance deteriorates with respect to its value in the pre - policy change balanced - growth equilibrium.

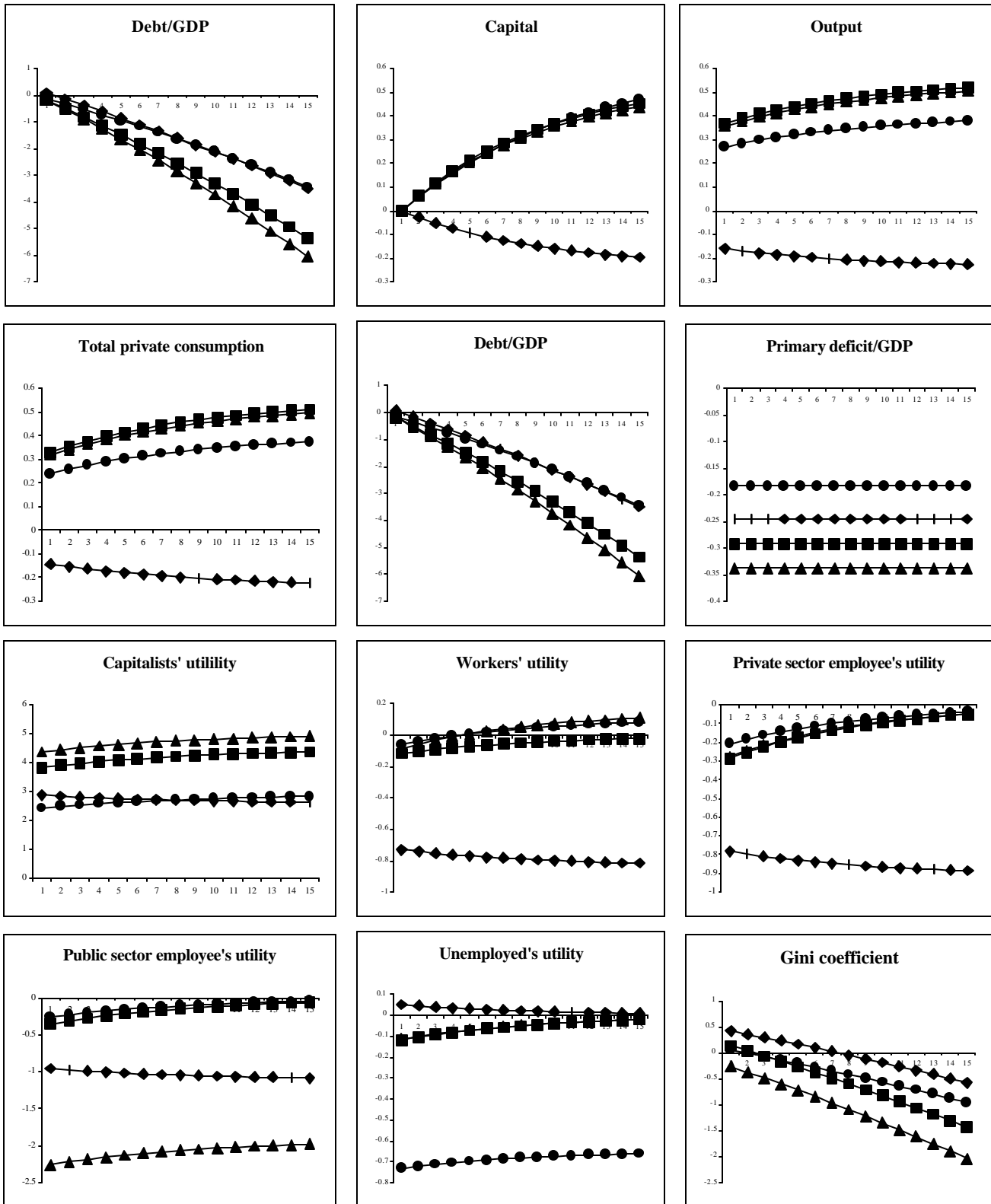
**Table 4: Effects of 1% increase in fiscal policy items – US average data.**

	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect	Impact effect	Long-run effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$\Delta g$		$\Delta N_g$		$\Delta w_g$		$\Delta u$		$\Delta \tau_N$		$\Delta \tau_k$	
<b>Macroeconomy</b>												
<i>Output</i>	0	0	-0.19	-0.28	-0.11	-0.17	-0.04	-0.06	-0.01	-0.02	0	-0.37
<i>Capital stock</i>	0	0	0	-0.28	0	-0.17	0	-0.06	0	-0.02	0	-1.1
<i>Investment</i>	0	0	-0.28	-0.28	-0.17	-0.17	-0.06	-0.06	-0.02	-0.02	-1.1	-1.1
<i>Private sector employment</i>	0	0	-0.28	-0.28	-0.17	-0.17	-0.06	-0.06	-0.02	-0.02	0	0
<i>Unemployment</i>	0	0	1	1	2.38	2.38	0.83	0.83	0.28	0.28	0	0
<i>Rate of return on capital</i>	0	0	-0.19	0	-0.11	0	-0.04	0	-0.01	0	0	0.74
<i>Private sector workers' wage rate</i>	0	0	0.09	0	0.06	0	0.02	0	0.007	0	0	-0.37
<i>Total consumption</i>	-0.09	-0.09	-0.17	-0.28	-0.10	-0.17	-0.03	-0.06	-0.01	-0.02	0.23	0.21
<b>Welfare costs</b>												
<i>household</i>		0.04		0.16		0.13		0.03		0.20		0.23
<i>capitalist</i>		0.42		1.23		1.11		0.18		-1.26		-0.51
<i>worker</i>		0		0.06		0.03		0.01		0.34		0.31
<i>private sector employee</i>		0		-0.01		-0.008		-0.003		0.34		0.31
<i>public sector employee</i>		0		-0.01		-0.98		-0.003		0.34		0.31
<i>unemployed</i>		0		-0.01		-0.008		-0.97		-0.001		0.31
<b>Income distribution</b>												
<i>Gini coefficient</i>	0	0.52	-0.04	1.41	0.29	1.61	0.02	0.24	0.25	-1.36	-1.09	-1.18
<b>Public finances</b>												
<i>Debt/GDP</i>	0	1.99	0.09	5.50	0.05	5.06	0.02	0.82	0.006	-6.07	0	-3.73
<i>Primary deficit/GDP</i>	0.07	0.07	0.15	0.15	0.15	0.15	0.02	0.02	-0.20	-0.20	-0.14	-0.14
<i>Primary spending/GDP</i>	0.07	0.07	0.20	0.20	0.20	0.20	0.023	0.023	0.005	0.005	0	0
<i>Revenue/GDP</i>	0	0	0.05	0.05	0.05	0.05	0.002	0.002	0.21	0.21	0.14	0.14
<i>Primary spending</i>	0.3	0.3	0.71	0.62	0.76	0.70	0.06	0.04	0.01	0.003	0	-0.37
<i>Revenue</i>	0	0	-0.04	-0.14	0.01	-0.04	-0.03	-0.05	0.59	0.58	0.40	0.03

Data are given as percentage deviations from the pre - policy change balanced - growth equilibrium for all variables except debt/GDP, primary deficit/GDP, primary spending/GDP, and revenue/GDP which are percentage points deviations. Impact effects correspond to changes at the time of the increase in the fiscal policy item. Long - run effects measure deviations between the post and pre - policy change balanced - growth equilibria. For Debt/GDP and Gini coefficient, the long - run effect corresponds to the percentage deviations of the two variables relative to the pre - policy change equilibrium twenty-five years after the policy change occurred. The welfare cost of a policy is computed as the percentage change in consumption needed to equate lifetime utility after the policy change to lifetime utility in the pre - policy change case. Primary deficit: a positive change in the primary deficit means that the primary balance deteriorates with respect to its value in the pre - policy change balanced - growth equilibrium.

US data used to calibrate the model are averages over the period 1965 – 1995. Tax rates on labor and capital income are from Daveri and Tabellini (2000) and Daveri and Maffezzoli (1999). They are equal to 25.63% and 42.33%, respectively. The remaining data are from the OECD Economic Outlook no. 62. Real per capita growth rate = 1.97%; self employed/labor force = 9.07%; replacement rate = 15.81%; wage public employees/wage private employee = 108.77%; public employment/labor force = 14.75%; government non wage consumption/GDP = 6.65%; debt/GDP = 46.73%.

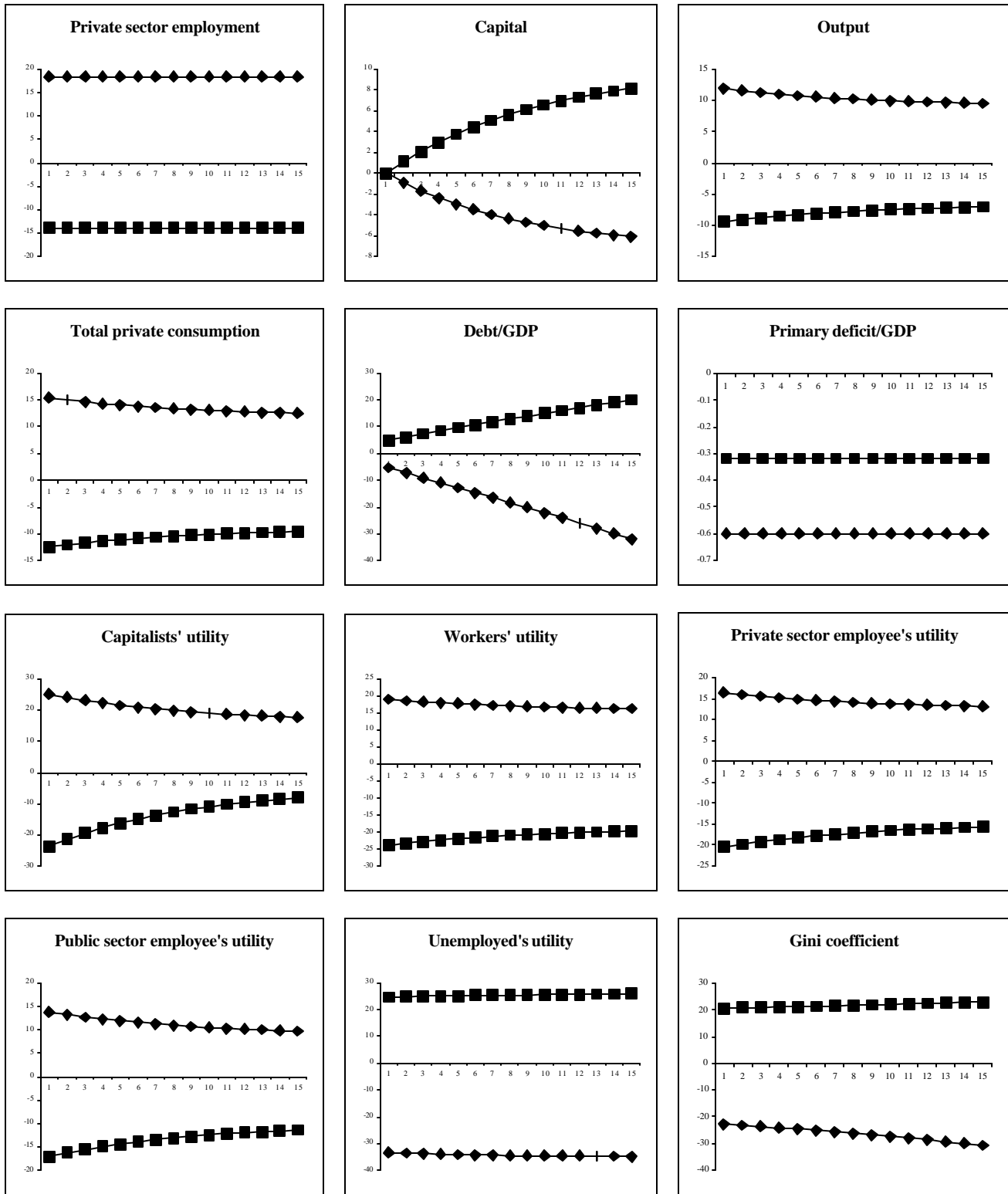
**Figure 1: Fiscal contractions – benchmark model**



Figures show variables as percentage deviations from to the pre - policy change balanced - growth equilibrium except for the debt/GDP and primary deficit/GDP charts that plot variables as percentage point deviations from to the pre - policy change balanced - growth equilibrium.

◆ 1% increase in  $\tau_N$ ; ■ 1% decrease in  $N_g$ ; ▲ 1% decrease in  $w_g$ ; ● 1% decrease in  $u$ .

**Figure 2: Fiscal policy in Europe and in the United States**

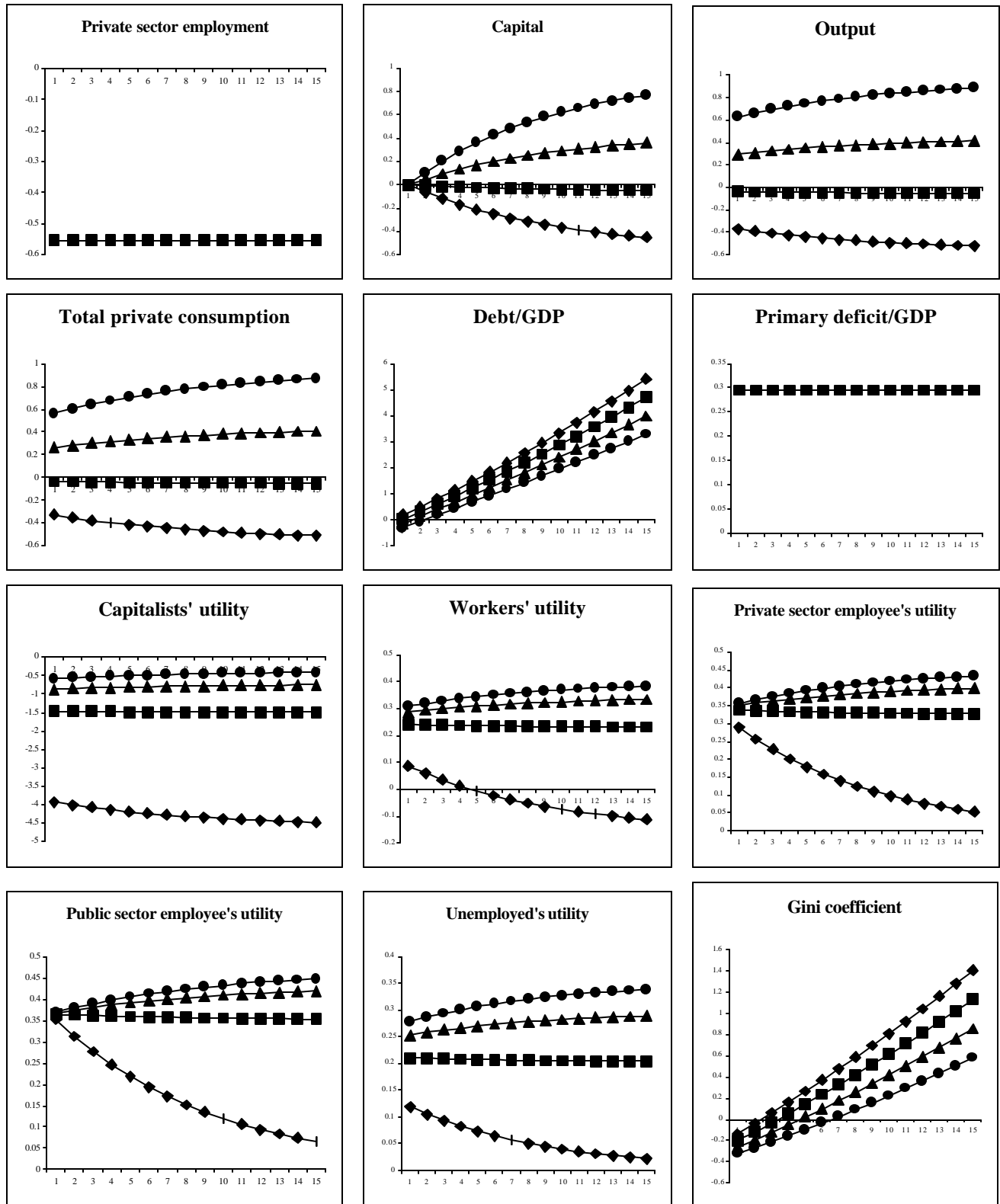


Figures show variables as percentage deviations from to the pre - policy change balanced - growth equilibrium except for the debt/GDP and primary deficit/GDP charts that plot variables as percentage point deviations from to the pre - policy change balanced - growth equilibrium.

◆ Fiscal policy instruments change from the average values of the European countries in the sample to the average values of the US over the period 1965 – 1995.

■ Fiscal policy instruments change from the average values of the US to the average values of the European countries in the sample over the period 1965 – 1995.

**Figure 3: Effect of 1% increase in public employment**



Figures show variables as percentage deviations from to the pre - policy change balanced - growth equilibrium except for the debt/GDP and primary deficit/GDP charts that plot variables as percentage point deviations from to the pre - policy change balanced - growth equilibrium.

◆  $\theta=0$  (benchmark model); ■  $\theta=1/3$ ; ▲  $\theta=2/3$ ; ●  $\theta=1$