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**Working Paper**

## Dynamic Fiscal Policies, Unemployment, and Economic Growth

Diskussionspapier, No. 9

**Provided in Cooperation with:**

Fächerguppe Volkswirtschaftslehre, Helmut-Schmidt-Universität (HSU)

*Suggested Citation:* Josten, Stefan Dietrich (2003) : Dynamic Fiscal Policies, Unemployment, and Economic Growth, Diskussionspapier, No. 9, Universität der Bundeswehr Hamburg, Fächerguppe Volkswirtschaftslehre, Hamburg, <https://nbn-resolving.de/urn:nbn:de:gbv:705-opus-1370>

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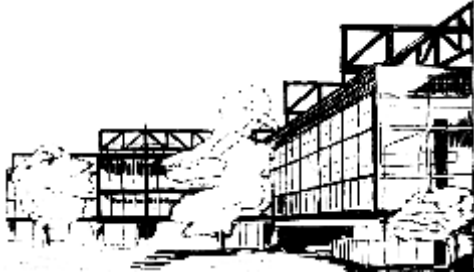
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Discussion Paper No.  
June 2003

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# **Dynamic Fiscal Policies, Unemployment, and Economic Growth**

Stefan Dietrich Josten

# Dynamic Fiscal Policies, Unemployment, and Economic Growth

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**Abstract.** *This paper analyzes the growth and employment effects of dynamic fiscal policies in an overlapping generations model with endogenous growth and imperfect labour markets. With balanced-budget policies, the modelled closed economy grows at a constant rate which is the higher, the lower are the labour tax rate and the unemployment rate. Both government Ponzi games and constant-flow budget policies are shown not to be feasible. Furthermore, while constant-stock fiscal policies are sustainable, an increase in the debt-to-capital ratio is accompanied by higher taxes, a rise in unemployment and lower economic growth.*

*JEL Classification:* E24, J51, H63, O41

*Keywords:* Unemployment; Public debt; Economic growth; Overlapping generations.

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# **Dynamic Fiscal Policies, Unemployment, and Economic Growth**

## *1. Introduction*

The majority of European countries is plagued by chronic budget deficits as well as slow economic growth and high unemployment rates. The most pressing economic problem in Europe today is the apparently endless surge in unemployment over time. Over the last 30 years, the unemployment rate has risen by more than seven percentage points in the EU, while in the US it has risen by just one percentage point when compared to the 1960s and during the 1990s has been lower on average than in the two preceding decades. Per-capita GDP growth fell in both the EU and the US, but the growth slowdown was clearly more pronounced in Europe, and US growth rates accelerated again in the 1990s. Finally, since the mid-1970s most European countries have revealed chronic budget deficits and, in turn, rising debt-to-GDP ratios. In the EU's largest single economy, Germany, the development of national debt since her reunification is widely regarded as detrimental to growth and employment. Here, as well as in other member states of "Euroland", the ratios of government debts and deficits to GDP have given rise to lasting controversies not only during the aspired convergence in the run-up to the European Monetary Union – controversies that caught the interest not only of politicians and professional economists but that of a wider public as well. In contrast to the development of public finances in Europe, the US, after a phase of skyrocketing federal deficits in the 1980s, returned to a balanced federal budget (or even surpluses) during the 1990s without having to face the apprehended recessive costs of fiscal consolidation.

In the mind of most politicians and laymen, these trends in national debt, unemployment and economic growth rates are related to each other. In the theoretical literature, however, these three key issues of economic policy have largely been discussed independently of each other. In particular, up to recent years, most economists have shared the opinion that, since the natural rate of unemployment is invariant to productivity growth (see Phelps (1968)), unemployment is purely a business cycle phenomenon that disappears in the long run. The long period of time over which the

negative relation between economic growth and unemployment rates has been observed in European economies is obviously at odds with this conventional wisdom. Rather, the European experience points to potentially important interactions between equilibrium unemployment and long-term growth. Daveri and Tabellini (2000), for instance, postulate the contemporaneous increase in unemployment and slowdown in economic growth observed in Europe to stem from a common cause: the excessively rapid growth of the cost of labour, caused particularly by higher taxes on labour income.

In contrast to the academic negligence about the unemployment-growth link, the interactions between government debt and economic growth have been subject of a long-lasting debate in economics reaching back to the days when that field of study was known as “political economy”. In exogenous growth models of overlapping generations, it is possible to make a case for public debt because a balanced growth path may be dynamically inefficient (see Diamond (1965)). As long as the economy's interest rate is less than its growth rate, crowding out of private capital formation caused by government borrowing will improve intertemporal allocation by putting the economy closer to the golden rule and improving the welfare of current as well as future generations. King and Ferguson (1993), as well as Grossman and Yanagawa (1993), show that this possibility no longer holds in endogenous growth models of overlapping generations where the sustained steady-state growth stems from an externality which implies constant returns to capital at the aggregate level (AK-technology). As was pointed out by Josten (2000), in such a framework both Ponzi debt games and a policy of constant per-capita public debt are feasible under certain conditions, but will reduce the long-run growth rates of capital, output and consumption and, accordingly, will harm future generations' welfare.

However, while instructive for the analysis of public debt policies in a full-employment economy, the above mentioned growth models of overlapping generations assume a perfectly competitive labour market and are, thus, not well suited to addressing issues pertaining to dynamic fiscal

policies and *unemployment*. The aim of the present paper is, therefore, to introduce labour market imperfections – in the form of wage setting institutions, e.g. a unionized labour market – into an AK-technology endogenous growth model, which allows to analyze the effects of various dynamic fiscal policies on both economic growth *and* unemployment. It proceeds as follows: Section 2 develops the formal framework of analysis, starting with decentral optimizing decisions of individual generations and moving to aggregate variables describing macroeconomic behaviour. Section 3 analyzes the economy's equilibrium growth path in the absence of national debt and explores the sustainability as well as the unemployment and growth effects of three particular forms of dynamic fiscal policy. Section 4 concludes by providing a summary of results.

## 2. The Model

### 2.1 Households and savings

Consider a two-period overlapping-generations (OLG) model economy closed to international trade. In every period  $t = 0, 1, 2, \dots$  there exist two generations of economic agents: an old generation, born in the previous period and a young generation, born in  $t$ . All individuals possess a life-expectancy of two periods and their number is constant over time. Preferences of a representative generation- $t$  individual are defined over her consumption when young and old,  $c_{1t}$  and  $c_{2t+1}$ , respectively, and will be represented by a Cobb-Douglas utility function:

$$U_t(c_{1t}, c_{2t+1}) = \ln c_{1t} + \beta \ln c_{2t+1}, \quad (1)$$

where  $\beta$  is a non-negative subjective discount-factor.<sup>1</sup>

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<sup>1</sup> Log preferences are, of course, a special assumption in that they rule out any direct dependency of savings decisions on the interest rate. However, I consider this assumption to be well defensible both on theoretical and empirical grounds. Theoretically, ever since Diamond's (1965) seminal work Cobb-Douglas (logarithmic) preferences have been widely employed in growth-theoretical analyses of public debt policy. From that literature it is well known that a direct dependency of individual saving decisions on the interest rate does not qualitatively change the general-equilibrium financial crowding-out result on which this paper's growth effects rest (see e.g. Diamond (1965), p. 1134f. or Ihori (1996), p.32f.). In addition, the bulk of empirical evidence suggests that the real-world effects of interest rates on savings are small and hard to find (see e.g. Campbell and Mankiw (1989)).

Only young individuals can work and they all belong to a trade union. Individual labour supply is normalized to unity. If employed, a generation- $t$  individual in her youth earns a wage income net of taxes,  $w_t(1-\tau_t)$ , where  $\tau_t$  is rate of the proportional labour income tax. Due to existing labour market imperfections, however, a young economic agent may not be able to find any employment. If unemployed, she earns an unemployment subsidy,  $u_t$ .

In the second and last period of their lives, households are retired and consume according to the value of resources they carry into old age through saving in the previous period. Retirees are never taxed. Thus, old agents born in  $t$  earn a return of  $(1+r_{t+1})$  on their savings, which is not taxable.

With these assumptions, the individual budget constraints of a household, born in period  $t$ , in her youth and old age, respectively, are given by

$$c_{1t}^i + s_t^i \leq y_t^i \quad (2a)$$

$$c_{2t+1}^i \leq (1+r_{t+1})s_t^i, \quad (2b)$$

where  $i$  denotes either employed ( $E$ ) or unemployed ( $U$ ). The young-age income of an employed individual is given by  $y_t^E = w_t(1-\tau_t)$ , while the income of an unemployed young individual amounts to  $y_t^U = u_t$ . Savings of a young individual with income  $y_t^i$  are denoted by  $s_t^i$ .

Maximizing her lifetime-utility (1), a representative generation- $t$  household chooses an intertemporal allocation of consumption which can compactly be described by the following individual savings function:

$$s_t^i = \frac{\beta}{1+\beta} y_t^i, \quad (3)$$

according to which an individual's savings are equal to a constant fraction of her income.

## 2.2 Firms and goods production

Production is carried out by a large number of identical competitive firms. They operate with an *AK-technology* which transforms private factor inputs into an homogenous good:

$$y_t = A_Y k_t l_t^{1-\alpha}, \quad (4)$$

where  $\alpha \in (0,1)$ ,  $y$  is the level of output divided by the labour force  $N$ ,  $l \leq 1$  is the fraction of employed individuals in the young population (the employment rate),  $A_Y$  denotes a productivity parameter and  $k$  denotes capital intensity, i.e. the ratio of physical capital to the labour force. Models with AK-technologies have been extensively studied in the endogenous growth literature, and the technological assumptions that give rise to them are well known. A simple example is given in Romer (1986) where each individual firm faces constant returns to scale, but positive external effects in average capital keep the marginal product of capital constant and thus give rise to sustainable positive growth rates. The actual presence of externalities in production is still a debated issue in macroeconomics.<sup>2</sup>

Profit-maximizing competitive firms hire labour and capital up to the point where the respective factor's net marginal product equals the relevant input price. Assuming physical capital to depreciate fully on use, the interest rate is thus given by

$$1 + r_t = \frac{\partial y_t}{\partial k_t} = A_Y l_t^{1-\alpha}. \quad (5a)$$

In a similar vein, from a representative firm's FOCs with respect to labour, the labour demand function (in terms of the employment rate  $l$ ) can be derived as

$$l_t = \left[ (1-\alpha) \frac{A_Y k_t}{w_t} \right]^{1/\alpha}. \quad (5b)$$

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<sup>2</sup> See Caballero and Lyons (1992) for evidence in favour of the existence of production externalities. Other studies, however, report only mixed (see Basu and Fernald (1995)) or even opposite (see Burnside (1996)) evidence.



### 2.3 Government and fiscal policy

Let  $B_{t+1}$  denote the aggregate amount of public debt, issued in  $t$  and maturing in period  $t+1$ . In any period  $t$  government spends  $G_t$  on goods, transfers the subsidy  $u_t$  to every unemployed young household, pays interest on its outstanding debt,  $B_t$ , and collects labour income tax payments from each employed young household. Any resulting excess of government layouts over its tax receipts is financed by borrowing from the private sector. In summary, the government faces the following dynamic budget identity:

$$B_{t+1} = (1 + r_t)B_t + G_t + (1 - l_t)Nu_t - \tau_t w_t l_t N_t. \quad (6)$$

Combining (6) and the usual no-Ponzi-game condition

$$\lim_{T \rightarrow \infty} \prod_{i=0}^T (1 + r_{t+i})^{-1} B_{t+T} = 0$$

leads to the familiar government intertemporal budget constraint that demands the current value of debt to be equal to the present discounted value of future primary surpluses. To concentrate on *dynamic* fiscal policies, it will be assumed for the following that per capita public consumption and unemployment subsidies are given linear functions of average per capita income. Thus,  $G_t/N = gy_t$  and  $u_t = \sigma y_t$ , where  $g$  and  $\sigma$  are parameters controlled by the government. Denoting public debt per member of the labour force (“worker”) by  $b := B/N$ , the government budget identity in intensive form follows as

$$b_{t+1} = (1 + r_t)b_t + gy_t + (1 - l_t)\sigma y_t - \tau_t w_t l_t. \quad (7)$$

### 2.4 Labour market equilibrium

The labour market is treated in accordance with Daveri and Tabellini (2000). Wages are set by monopolistic unions operating at the firm or sector level and taking as given fiscal policy variables and the interest rate. Neglecting risk aversion, unions are postulated to maximize the expected income of their young members subject to the labour demand function (5b). Given production

function (4), the optimal net wage for the union results as a constant mark-up over the unemployment subsidy (see Daveri and Tabellini (2000), p. 98):

$$w_t = \frac{u_t}{(1-\alpha)(1-\tau_t)}. \quad (8)$$

Bearing in mind that  $u_t = \sigma y_t$ , equilibrium employment follows from (5b) and (8) as

$$l_t^* = \frac{(1-\alpha)^2(1-\tau_t)}{\sigma}. \quad (9)$$

According to (9), in equilibrium there is a positive rate of unemployment, i.e.  $l_t^* < 1$ . A higher tax rate leads unions to enforce a higher gross wage rate, which in turn induces firms to reduce employment. A higher replacement rate  $\sigma$  also raises unemployment because it is followed by a proportionate increase in gross wages.

### 2.5 Capital market equilibrium and dynamics

Private financial wealth at the beginning of period  $t+1$  comes from savings in  $t$ . For the capital market to clear in any given period, this supply of capital must be met by an equal amount of demand; the latter one consists of the stock of physical capital planned for period  $t+1$  and the amount of public debt that matures in  $t+1$ . Thus, in per worker terms the capital market equilibrium requires:

$$k_{t+1} + b_{t+1} = s_t^E l_t + s_t^U (1-l_t) = \frac{\beta}{1+\beta} [(1-\tau_t)l_t w_t + (1-l_t)u_t]. \quad (10)$$

Utilizing equations (4), (5), (7) and (8), the dynamical impact of national debt on the stock of capital for an *arbitrary* fiscal policy is described fairly general by the non-autonomous dynamic system:

$$k_{t+1} + b_{t+1} = \frac{\beta}{1+\beta} A_Y k_t l_t^{*(1-\alpha)} [(1-\tau_t)(1-\alpha) + (1-l_t^*)\sigma] \quad (11a)$$

$$b_{t+1} = A_Y l_t^{*(1-\alpha)} b_t + g A_Y k_t l_t^{*(1-\alpha)} + (1-l_t)\sigma A_Y k_t l_t^{*(1-\alpha)} - \tau_t (1-\alpha) A_Y k_t l_t^{*(1-\alpha)}, \quad (11b)$$

where  $l_t^*$  is given by (9) as a function of the tax rate  $\tau_t$ .

### 3. Dynamic Fiscal Policies, Unemployment, and Growth

#### 3.1 Balanced-budget policies

As a case of reference, let us consider first a fiscal policy which keeps the government budget balanced at all times. With  $\forall t; b_t = 0$ , combining equations (9) and (11b) implies a constant proportional tax rate:

$$\forall t; \tau_t = \tau = \frac{g + \sigma - (1 - \alpha)^2}{\alpha(1 - \alpha)}. \quad (12)$$

Accordingly, the equilibrium rate of employment is time-invariant as well, and the capital stock evolves according to:

$$k_{t+1} = \frac{\beta}{1 + \beta} A_Y l^{*(1-\alpha)} [(1 - \tau)\alpha(1 - \alpha) + \sigma] k_t.$$

The corresponding growth rate is given by

$$1 + \gamma := 1 + \frac{k_{t+1}}{k_t} = \frac{\beta}{1 + \beta} A_Y l^{*(1-\alpha)} [(1 - \tau)\alpha(1 - \alpha) + \sigma]. \quad (13)$$

Obviously, the equilibrium growth rate is constant over time and will be positive as long as the productivity parameter  $A_Y$  is sufficiently large. Furthermore, the equilibrium growth rate is permanently affected by changes in unemployment: Since higher unemployment decreases the average income of young households, which in turn induces less savings by the young, the equilibrium growth rate is higher, the larger is the employment rate  $l^*$ . To summarize:

**PROPOSITION 1 (EQUILIBRIUM GROWTH WITH BALANCED BUDGET).**

*When fiscal policies are restricted to keep the government budget balanced, the model economy's time-invariant equilibrium growth rate is given by*

$$1 + \gamma = \frac{\beta}{1 + \beta} A_Y l^{*(1-\alpha)} [(1 - \tau)\alpha(1 - \alpha) + \sigma].$$

*It is the higher, the lower are the labour income tax rate and the unemployment rate of the economy.*

Comparing (13) to (5a), dynamic inefficiency (or capital over-accumulation) can be excluded for this model economy: Since  $(\beta/(1+\beta))[(1-\tau\alpha(1-\alpha)+\sigma)] > 1$ , the economy's growth rate is always smaller than the equilibrium interest rate.

### 3.2 Government Ponzi games and constant-flow fiscal policies

Issuing government debt implies that the government has to pay interest and must eventually reimburse the principal. This can be done in two different ways: Either one taxes future generations, a policy which amounts to implicitly performing an intergenerational transfer. Alternatively, the government can follow a so-called “*Ponzi scheme*” by issuing in every period new debt in order to reimburse the preceding debt plus interest. In the case where future generations are taxed, two kinds of policy rules are considered in the literature. On the one hand, *constant-stock fiscal policies*, as studied e.g. by Diamond (1965) in his seminal work on public debt policy, maintain constant per capita debt and adjust taxes to meet this objective; section 3.3 will explore the role of a constant debt-to-capital ratio in our model economy. On the other hand, *constant-flow fiscal policies* fix the size of the primary deficit, and debt changes over time. As in the case of government Ponzi games, because of the debt dynamics they imply, the question of sustainability (or feasibility) of such policies becomes central. Therefore, in the remainder of this section, we concentrate on the question of whether Ponzi games and constant-flow fiscal policies are feasible in an economy with AK-technology and unemployment.

#### **Government Ponzi games**

In a government Ponzi game, the government in every period pays off the outstanding public debt plus interest by issuing new debt. Therefore, the growth rate of government debt equals the interest rate:

$$\forall t; \frac{b_{t+1}}{b_t} = (1 + r_t). \quad (14)$$

Government per worker budget identity (7) then again implies the constant tax rate (12):

$$\forall t; \tau_t = \tau = \frac{g + \sigma - (1 - \alpha)^2}{\alpha(1 - \alpha)}.$$

Accordingly, both the employment rate and the interest rate are time-invariant as well. Denote by  $b_1$  the initial per-worker debt issued by the government to finance a one-time lump-sum transfer payment to old economic agents. Public debt per worker at  $t$  can then be expressed as

$$b_t = b_1(1 + r)^{t-1}. \quad (15)$$

From (11a), in our model economy with a government Ponzi scheme the aggregate capital stock evolves according to:

$$k_{t+1} = \frac{\beta}{1 + \beta} A_Y l^{*(1-\alpha)} [(1 - \tau)\alpha(1 - \alpha) + \sigma] k_t - b_1(1 + r)^t. \quad (16)$$

Thus, the growth rate of our model economy with a government Ponzi game,  $\tilde{\gamma}$ , is systematically connected to the growth rate  $\gamma$  that would prevail in an economy with a permanently balanced government budget:

$$1 + \tilde{\gamma} = (1 + \gamma) - \frac{b_1(1 + r)^t}{k_t}.$$

Can such a debt policy be sustained in our model economy? Tirole (1985) and O'Connell and Zeldes (1988) have shown that in *exogenous growth* OLG economies government Ponzi games are feasible if and only if the long-run equilibrium is dynamically inefficient due to capital over-accumulation. Furthermore, since debt crowds out capital, Ponzi games are welfare improving when feasible. King and Ferguson (1993), as well as Josten (2000), demonstrate that in *full-employment* OLG models with AK-technology Ponzi debt games are feasible under certain conditions, but will reduce the long-run growth rates of capital, output and consumption. The following proposition shows that the range of feasible debt policy regimes is further restricted once labour market imperfections and unemployment are taken into account:

**PROPOSITION 2. (NON-FEASIBILITY OF GOVERNMENT PONZI GAMES)**

*Government Ponzi games are not feasible in an OLG economy with AK-technology and unemployment.*

**Proof.** From (16), it follows that

$$\frac{k_{t+1}}{b_{t+1}} = \frac{(1+\gamma)k_t}{(1+r)b_t} - 1.$$

Government Ponzi games are feasible if and only if the sequence  $\{k_t/b_t\}_{t=0}^{\infty}$  is bound strictly above zero (see King and Ferguson (1993), p. 103). Necessary and sufficient conditions for this are:

- (i) the growth rate of public debt, which equals the interest rate, is less than the growth rate that would exist in the reference economy with a permanently balanced budget, i.e.  $\gamma > r$ ; and
- (ii) the initial ratio of public debt to physical capital is not too high:

$$\frac{b_1}{k_0} \leq \gamma - r.$$

However, comparing (13) to (5a), we have already excluded dynamic inefficiency (capital over-accumulation) for the model economy with balanced-budget fiscal policies. Thus, the reference economy's growth rate is always smaller than the equilibrium interest rate, and neither condition (i) nor condition (ii) can be met. Therefore, government Ponzi games are not feasible. **q.e.d.**

The economic reasoning behind this result is quite obvious: A government Ponzi game does not affect the private economic agents' savings decisions. On the other hand, however, in any given period a certain fraction of aggregate savings will be absorbed by the public debt, which crowds out physical capital accumulation. If  $r$  is greater than the economy's growth rate, government debt will increase faster than the capital stock, and the Ponzi scheme will eventually be rendered infeasible: The debt will grow so large that it totally crowds out physical capital and the government will be unable to find buyers for any of it.

### Constant-flow budget policies

We explore in this section the role of *permanent* budget deficits in an economy with production and unemployment, placing particular emphasis on the question of the sustainability of such a policy. Let us assume that the ratio of the primary deficit to aggregate output is fixed at some constant value  $\delta$ , i.e. that the public budget policy follows the constant-flow rule:

$$b_{t+1} - (1 + r_t)b_t = \delta y_t. \quad (17)$$

With this constant-flow fiscal policy, the government budget identity (7) again implies a constant tax rate:

$$\forall t; \tau_t = \tau = \frac{g + \sigma - \delta - (1 - \alpha)^2}{\alpha(1 - \alpha)} \quad (18)$$

which differs from the tax rate under balanced-budget or Ponzi-scheme policy regimes only by the negative summand  $\delta$  in its numerator, indicating tax rate (18) to be lower than tax rate (12). The dynamic system resulting from (11) and (17):

$$k_{t+1} + b_{t+1} = \frac{\beta}{1 + \beta} A_Y l^{*(1-\alpha)} \left[ (1 - \tau)(1 - \alpha) + (1 - l^*)\sigma \right] k_t \quad (19a)$$

$$b_{t+1} = \delta A_Y l^{*(1-\alpha)} k_t + A_Y l^{*(1-\alpha)} b_t \quad (19b)$$

is autonomous and linear in its two state variables,  $k$  and  $b$ .

However, as in the case of a government Ponzi scheme, such a fiscal policy rule is not sustainable:

#### **PROPOSITION 3 (NON-FEASIBILITY OF CONSTANT-FLOW FISCAL POLICIES).**

*The constant-flow fiscal policy rule of a constant ratio of the primary deficit to aggregate output is not feasible in an OLG economy with AK-technology and unemployment.*

**Proof.** The steady state of the dynamic system (19) is given by the solution to:

$$b = \left( \frac{\beta}{1+\beta} A_Y l^{*(1-\alpha)} [(1-\tau)(1-\alpha) + (1-l^*)\sigma] - 1 \right) k \quad (20a)$$

$$k = \frac{1 - A_Y l^{*(1-\alpha)}}{\beta A_Y l^{*(1-\alpha)}} b. \quad (20b)$$

Inserting (20a) into (20b), one can easily find that the only existing long-run equilibrium is the degenerate solution  $k = b = 0$ . **q.e.d.**

According to (17), constant-flow budget policies will induce government debt to grow at a rate that is even higher than the interest rate. Accordingly, government debt will increase faster than the economy's capital stock, and again fiscal policy will eventually be rendered infeasible: The debt will grow so large that it totally crowds out physical capital and the government will be unable to find buyers for any of it.

### 3.3 Constant-stock fiscal policies

In this section we concentrate on constant-stock fiscal policies that maintain a constant debt-to-capital ratio. Denoting this given ratio by  $\delta$ , public budget policy follows the rule  $b_t = \delta k_t$ . For this fiscal policy, the government budget identity (11b) can be written as

$$1 + \hat{\gamma}_t := \frac{k_{t+1}}{k_t} = A_Y \left( \frac{(1-\alpha)^2 (1-\tau_t)}{\sigma} \right)^{1-\alpha} \left[ 1 + \frac{g + \sigma + \alpha(1-\alpha)(1-\tau_t) - 1}{\delta} \right]. \quad (21)$$

For any given tax rate  $\tau_t$ , (21) shows the economy's growth rate,  $\hat{\gamma}_t$ , that is required for that given tax rate to be implied by the dynamics inherent to the government budget identity. Equation (11a) becomes

$$1 + \hat{\gamma}_t = \frac{\beta}{1+\beta} A_Y \left( \frac{(1-\alpha)^2 (1-\tau_t)}{\sigma} \right)^{1-\alpha} \left[ \frac{\sigma + \alpha(1-\alpha)(1-\tau_t)}{1+\delta} \right]. \quad (22)$$



For any given tax rate  $\tau_t$ , (22) indicates the economy's growth rate as implied by physical capital accumulation.

To show that constant-stock fiscal policies are feasible it is sufficient to show that a simultaneous solution to (21) and (22) exists which gives both an equilibrium tax rate between zero and one and a strictly positive equilibrium growth rate of the economy. Equating (21) and (22), the time-invariant equilibrium tax rate follows as

$$\forall t; \tau_t = \tau = 1 - \frac{(1+\delta)((1-\alpha)-(g+\sigma)) - \delta(1+\delta-s\sigma)}{\alpha(1-\alpha)(1+\delta(1-s))}, \quad (23)$$

where  $s$  denotes the individual propensity to save,  $\beta/(1+\beta)$ . The tax rate in (23) is strictly positive and is strictly smaller than unity for any debt-capital ratio that is not "too large" in the following sense:

$$\delta < \left[ (g + \alpha + \sigma(1-s))^2 + 4(1-\alpha-g-\sigma) \right]^{1/2} - \frac{1}{2}(g + \alpha + \sigma(1-s)).$$

Given (23), the economy always grows at a constant rate:

**PROPOSITION 4 (EQUILIBRIUM GROWTH WITH CONSTANT-STOCK FISCAL POLICY).**

*A constant-stock fiscal policy is feasible as long as the time-invariant debt-to-capital ratio*

*satisfies:  $\delta < \left[ (g + \alpha + \sigma(1-s))^2 + 4(1-\alpha-g-\sigma) \right]^{1/2} - \frac{1}{2}(g + \alpha + \sigma(1-s))$ .*

*On the equilibrium growth path, the economy grows at the uniform and time-invariant rate:*

$$1 + \hat{\gamma} = \frac{\beta}{1+\beta} A_Y \left( \frac{(1-\alpha)^2(1-\tau)}{\sigma} \right)^{1-\alpha} \left[ \frac{\sigma + \alpha(1-\alpha)(1-\tau)}{1+\delta} \right] = \frac{1+\gamma}{1+\delta}, \quad (24)$$

where  $\tau$  is given in (23).

The equilibrium growth rate is positive as long as  $A_Y$  is sufficiently large. Safe for the denominator  $1+\delta$  (instead of 1) in the last bracket, it is identical to the growth rate that would prevail in the reference economy with balanced budget policies. Accordingly, for any positive national debt, it is

smaller than the reference economy's growth rate:  $\hat{\gamma} < \gamma$ . It is affected by the constant-stock public debt policy both directly and indirectly:

**PROPOSITION 5 (GROWTH EFFECTS).**

*For the above proposed constant-stock fiscal policy, an increase in the debt-to-capital ratio decreases the economy's rate of growth.*

**Proof.**

The debt-to-capital ratio affects the economy's growth rate both directly and indirectly via the tax rate:

$$\frac{d\hat{\gamma}}{d\delta} = \frac{\partial\hat{\gamma}}{\partial\tau} \frac{\partial\tau}{\partial\delta} + \frac{\partial\hat{\gamma}}{\partial\delta}.$$

After some tedious algebra, it follows from (23) that  $\partial\tau/\partial\delta > 0$ . Furthermore, (24) obviously implies  $\partial\hat{\gamma}/\partial\tau < 0$  as well as  $\partial\hat{\gamma}/\partial\delta < 0$ . Thus, the overall effect is  $d\hat{\gamma}/d\delta < 0$ . **q.e.d.**

The decrease in the economy's growth rate goes hand in hand with a worsening of the economy's employment prospects:

**PROPOSITION 6 (EMPLOYMENT EFFECTS).**

*For the above proposed constant-stock fiscal policy, an increase in the debt-to-capital ratio increases the economy's unemployment rate.*

**Proof.**

The debt-to-capital ratio affects the economy's unemployment rate via the tax rate. From (9) and (23) we have:

$$\frac{dl^*}{d\delta} = \frac{\partial l^*}{\partial\tau} \frac{\partial\tau}{\partial\delta} = -\frac{(1-\alpha)^2}{\sigma} \frac{\partial\tau}{\partial\delta} < 0. \quad \mathbf{q.e.d.}$$

How can these results be explained? The equilibrium growth rate is reduced by an increase in the debt-to-capital ratio both directly and indirectly. First, an increase in public debt slows down the rate of physical capital accumulation directly by absorbing a higher fraction of aggregate savings.

Secondly, issuing debt effectively amounts to an intergenerational transfer mechanism, since in a dynamically efficient economy government has to tax future generations to pay interest and eventually reimburse the principal of the national debt. Therefore, the equilibrium tax rate will increase when the debt-to-capital ratio rises. The monopolistic trade unions try to compensate for the rising tax burden on labour income by a higher gross wage, which in turn forces firms to cut employment. Both higher taxes and lower employment decrease the average disposable income of young individuals, which, in turn, leads to less savings and, thus, slows down capital accumulation and economic growth. All in all, an increase in the debt-to-capital ratio is accompanied by higher taxes, a rise in unemployment and lower economic growth.

#### 4. Conclusion

This paper analyzed the growth and employment effects of dynamic fiscal policies in an overlapping generations model with endogenous growth and imperfect labour markets. With balanced-budget policies, the modelled closed economy grows at a constant rate which is the higher, the lower are the labour tax rate and the unemployment rate. Both government Ponzi games and constant-flow budget policies were shown not to be feasible. Furthermore, while constant-stock fiscal policies are sustainable, an increase in the debt-to-capital ratio was shown to be accompanied by higher taxes, a rise in unemployment and lower economic growth.

The above analysis has notable implications for both economic theory and real-world policy. Theoretically, it extends existing results on public debt to a more complex framework of analysis. In particular, it emphasizes the potential importance of factor market imperfections for theoretical studies of the effects of dynamic fiscal policy. By introducing wage-setting institutions on the *labour market* into an otherwise dynamic general-equilibrium model, it serves as an analytical complement to Josten (2001) which studied the intertemporal effects of national debt policy in the presence of *capital-market* imperfections. As a general rule one should, of course, be rather cautious

with respect to real-world policy implications of a single theoretical piece. Still, however, the present paper's results point to the fact that in a world with imperfect labour markets and equilibrium unemployment, the range of dynamic fiscal policies that can be sustained in the long run is even more narrow than suggested by conventional full-employment growth models. This insight will be of particular importance for those countries – like e.g. Japan, Italy or Belgium – which have run up a large public debt in the past and in which the (not so) simple arithmetics of government solvency require a sustained fiscal consolidation. Furthermore, the surge in European unemployment undoubtedly has more than one cause the most significant of which lie outside the realm of national debt policies. Nevertheless, the above analysis suggests that overly excessive government deficits and debt, by intertemporally implying rising labour taxes which, in turn, will be shifted onto higher real wages, contribute to higher unemployment and slower economic growth. In a world of imperfect labour markets and long-term unemployment, the long-run costs of fiscal deficits may, thus, be still more significant than nowadays assumed by most economists and some public policy makers. Hence, even for those countries – like Germany or various other member states of the EMU – in which the intertemporal government budget constraint still leaves a considerable degree of latitude with respect to their use of fiscal instruments, the case for institutional restraints on budgetary policies, like e.g. the European Stabilization and Growth Pact, is reinforced by the present paper.

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