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Budgetary Policy and Unemployment Dynamics

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Abstract

We consider a dynamic general equilibrium model with collective wage bargaining and investigate how unemployment dynamics are affected by two types of budgetary policies. In line with traditional reasoning, a balanced–budget rule amplifies fluctuations in the short run, whereas an unbalanced–budget policy dampens them. However, the latter policy strengthens unemployment persistence by its adverse impact on growth, and may even destabilize the adjustment path. If this is the case, a future fiscal consolidation is needed which further raises unemployment. These results are consistent with empirical evidence on a positive cross–country relationship between government borrowing and unemployment persistence.

Keywords: Unemployment, Overlapping generations, Public debt
JEL classification numbers: E24, E62, H62

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1 Introduction

This paper starts out from the well-known fact that unemployment dynamics in OECD countries have been quite diverse over the past few decades. In particular, the unemployment record of many European countries has been dismal, and there is a large literature which attempts to explain this development as resulting from a combination of structural shocks and mechanisms which make the effects of any such shifts more persistent. The most prominent mechanisms of this type advanced in the literature are the insider-outsider hypothesis of Blanchard and Summers (1986), the loss of skill hypothesis of long–term unemployed (Pissarides (1992)), the hypothesis of declining search intensities of long–term unemployed (Layard, Nickell, and Jackman (1991)), and the hypothesis of sluggish changes in labour demand due to adjustment costs (Alogoskoufis and Manning (1988)).[1] Finally, there is a large literature which stresses that adverse structural shocks tend to induce a slowdown in capital accumulation which reinforces the employment losses and adds to unemployment persistence (Bean (1989), Benassy (1997), Burda (1988), Caballero and Hammour (1998), Daveri and Tabellini (2000)). Similarly, these studies point out that, when the shock is over, the recovery of employment depends critically on the speed with which investments in capital respond to the new situation.

The purpose of this paper is to reconsider the capital–shortage hypothesis by linking it explicitly to the stance of fiscal policy. To see the importance of fiscal policy in this context, consider a government which faces a structural shock (such as a wage–setting shock) and decides whether it should keep its budget balanced or not. This decision will affect the overall structure of assets in the economy (i.e. the mix between capital and government bonds), and this mix will in turn be an important determinant of the speed with which the economy can create employment once the shock is over. To demonstrate the importance of this channel, we present a dynamic general equilibrium model in which involuntary unemployment results from wage bargaining and derive dynamic response patterns to structural shocks under balanced and unbalanced budgets. More specifically, we show that in the latter case the recovery in terms of employment is likely to take longer, particularly when crowding out effects have been substantial.

We turn next to a discussion of some empirical findings on the relationship between government borrowing and unemployment persistence. Subsequently, we give a brief outline of our model and its main results.

[1] Evidently, this list is not exhaustive. Acemoglu (2000) argues that credit market imperfections, which he considers to be relatively more severe in Europe, lead to slow reactions to the arrival of new technologies, thereby postponing the creation of new jobs. Blanchard and Wolfers (2000) offer a broad framework which investigates the interaction between macroeconomic shocks and institutional details of labour markets.

Empirical findings

While government budgets for OECD countries as a whole were on average roughly balanced in the 1960s, this changed in the 1970s, with government balances turning significantly into a deficit position. However, despite this trend for the aggregate of OECD countries, developments in individual countries show marked differences.[2] This can be seen from Figure 1 which shows that the average annual net borrowing position of governments (as a fraction of GDP) correlates positively with a country-specific measure of unemployment persistence derived by Scarpetta (1996).[3] In this study, Scarpetta estimates adjustment speeds of labour markets in 17 major OECD countries in a cross–country framework, using annual data for the period 1970-93. In particular, the estimation set–up controls for shifts in the long–run equilibrium rate of unemployment due to changes in labour market policies and institutional features, i.e. adjustment dynamics of unemployment are measured relative to time-varying equilibrium rates of unemployment.[4] Interestingly, the correlation coefficient in Figure 1 rises from 0.4 to a value of 0.6 if one excludes the four non-European countries considered by Scarpetta (the US, Japan, Australia, and Canada). This finding points to the potential importance of wage bargaining-systems which are typical of European countries if one attempts to explain this correlation.

Given the well-known difficulties of estimating slow adjustment dynamics in finite samples in a robust way (in particular, if compared with the alternative of a unit root in ARMA–specifications), in Figure 2 we also present for the same countries a simple scatterplot between average government borrowing and the average *level* of the unemployment rate.[5] Using the unemployment rate itself rather than a measure

[2] According to OECD data, average net borrowing of general government as a percentage of GDP for the entire OECD was 0.2% in 1960-73, 2.4% in 1974-79, 3.4% in 1980-89, and 4.1% in 1990-95. Notable exceptions to this trend are Finland and Norway, showing significant budget surpluses in the 1970s and 1980s.

[3] Data for general government net borrowing according to OECD Economic Outlook and, whenever unavailable, complemented by AMECO–database. Data for unemployment persistence: Scarpetta (1996), equation 11, table 5, p. 66. Data from equation 12 of Scarpetta's study yield similar results.

[4] More specifically, Scarpetta considers structural determinants of equilibrium unemployment such as unemployment benefits, employment protection regimes, union density, and indices of centralization of wage bargaining.

[5] The positive correlation presented in Figure 1 is confirmed, for example, when we use the persistence measure derived in Elmeskov and MacFarlan (1993) from an ARMA(1,x) specification. Scarpetta (1996) also presents, as an alternative to the measure plotted in Figure 1, estimates from an AR(1) model with constant and drift, which gives less satisfactory results. However, the 'persistence rankings' of countries between the AR(1) measure of Scarpetta and the one reported by Elmeskov and MacFarlan are surprisingly different. According to Elmeskov and MacFarlan, Italy has the second–highest and Finland the third–lowest degree of persistence. By contrast, the AR(1) measure of Scarpetta gives Finland the highest and Italy the third–lowest degree of persistence and, upon removing these two countries, the correlation between government borrowing and persistence

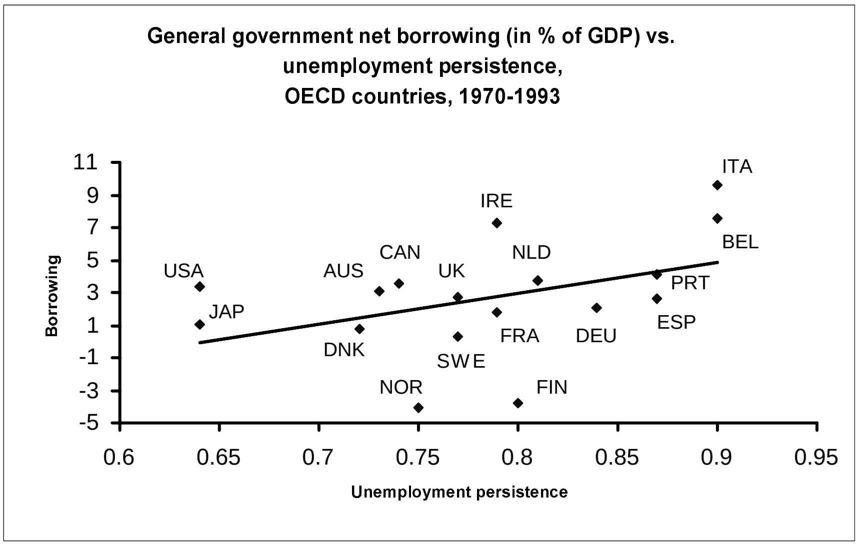


Figure 1: *Government net borrowing vs. unemployment persistence*

of its persistence leads, again, to a significant positive correlation with the fiscal variable.[6] While more detailed empirical work needs to be done to provide further clarification of these findings, particularly with respect to establishing causal relationships, we consider them to be sufficiently suggestive to think about specific ways in which the stance of fiscal policy has an influence on unemployment dynamics.

Outline of the model and the results

Motivated by these empirical findings, we develop a dynamic general equilibrium model in order to investigate the interaction between budgetary policy, capital formation and unemployment resulting from collective wage bargaining. We assume a standard neoclassical production technology with a low elasticity of substitution between the two homogenous inputs labour and capital, implying that a lower capital stock raises equilibrium unemployment. As a consequence of this feature, adverse shocks followed by declining capital investment induce persistent unemployment dynamics.

The government runs an unemployment insurance system which is financed by a wage–income tax or, alternatively, by the issuing of government bonds. The government's choice between these two instruments has non–trivial consequences for

for the AR(1) specification again becomes satisfactory. We take this as evidence of the problems to obtain robust estimates of slow labour market adjustments in pure time series specifications, as discussed, for example, in Roed (1996) or Bianchi and Zoega (1998).

[6] Figure 2 uses OECD data on standardized unemployment rates. Data for Denmark, Ireland: 1982-99; for Portugal: 1983-99.

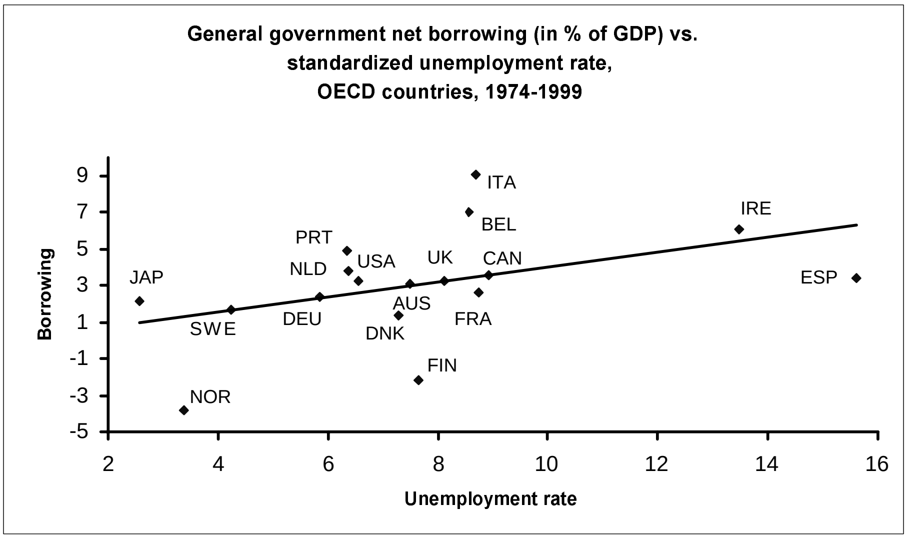


Figure 2: *Government net borrowing vs. unemployment rate*

two reasons: First, unemployment benefits are not (perfectly) indexed to net wages. Thus, similarly to Pissarides (1998), higher wage taxes lead under decentralized wage bargaining to higher gross wages, thereby reducing employment in the short run. Second, our dynamic framework is an overlapping generations economy without bequest motives. This implies that Ricardian equivalence does not hold and bonds are perceived as net wealth, i.e. shifts from bonds to higher taxes lead to more investment in physical capital, thereby raising future employment. Thus, the effects of the two policies on employment and output operate in opposite directions.[7] Given these characteristics of the model, we consider two distinct budgetary policies. First, we assume the government maintains *balanced budgets* by adjusting the wage–income tax rate appropriately. Under such a policy, stability features of steady states coincide exactly with those of the perfectly competitive benchmark model with full employment. Provided that the usual stability condition of the benchmark economy is satisfied, a dynamically efficient steady state (at which the interest rate exceeds the growth rate) is a saddle in the two–dimensional capital–bonds dynamics. A dynamically inefficient steady state (at which the interest rate falls below the growth rate) is a sink. In both cases, adjustment dynamics to the steady state are stable since the balanced budget policy keeps the economy on the

[7] The adverse effect of loose budgetary policy on growth is particularly pronounced in the closed–economy framework of our paper. However, the effect would also operate in a small open economy if capital is imperfectly mobile or if capital markets require a risk premium on external debt (see van der Ploeg (1996)).

stable saddle path. Second, we consider a policy of *unbalanced budgets* under which the government keeps the tax rate fixed and reacts to shocks by running deficits or surpluses. Stability features of steady states are altered decisively. A dynamically efficient steady state is again a saddle, but turns out to be *unstable* in the adjustment dynamics. When the government runs a deficit in response to an adverse shock, the economy would diverge on a path with explosive debt accumulation and declining capital stock, unless corrective fiscal measures are implemented in the future. Furthermore, a dynamically inefficient steady state can be unstable as well, provided that the interest rate exceeds a lower threshold value. But even if a dynamically inefficient steady state is stable, adjustment dynamics turn out to be more persistent under the unbalanced–budget policy.

To relate these results qualitatively to the empirical findings, we investigate how temporary wage pressure (as an important stylized feature of most OECD countries in the 1970's and early 1980's) affects unemployment dynamics under the two regimes of balanced and unbalanced budgets. On impact, such a shock leads to higher unemployment under both regimes, but the automatic stabilizers of the unbalanced–budget policy tend to mitigate the adverse employment effects. However, the deficit spending leads in this case to a sharper decline in capital, inducing a slower recovery of employment in the aftermath of the shock. If the interest rate is low enough, dynamics are stable, and the government deficit will be self–correcting when the shock is over, but unemployment dynamics tend to be more persistent than under balanced budgets. Thus, a scenario of this type yields predictions which are qualitatively in line with the evidence reported in Figure 1. By contrast, if the interest rate exceeds a certain threshold value, debt dynamics are unstable, and consolidation measures are needed at some point in the future to restore sustainability. Such contractive fiscal adjustments then lead to a temporary rise in unemployment. Evidently, the timing of these consolidation efforts will determine the exact shape of the unemployment path. In any case, we show that combinations of loose fiscal policies today and (strong) consolidations in the future may easily generate paths of unemployment rates which are, on average, higher than under a balanced–budget rule. Fiscal experiments of this type may explain, at least to a certain extent, the correlation reported in Figure 2. However, bearing in mind the general problems of interpreting bivariate correlations between macroeconomic variables as reported in our figures, these explanations should not be seen as exclusive but rather as complementary to those discussed in the opening paragraph.

The remainder of the paper is structured as follows. Section 2 introduces the model and derives the labour market equilibrium. Sections 3 and 4 analyze the equilibrium dynamics under balanced and unbalanced budgets, respectively. Section 5 shows for both policies the response pattern to a temporary wage–setting shock. In a dynamically inefficient economy, there exists also a golden–rule steady state with positively valued government bonds, in addition to the steady states with zero government debt. Such steady states are briefly considered in Section 6. In Section 7 we discuss our results in relation to the literature, and Section 8 offers conclusions. Proofs not included in the text are contained in the Appendix.

2 The model

Consider an overlapping generations economy which comprises a continuum $[0, N]$ of consumers living for two periods and a continuum $[0, 1]$ of firms. Consumers supply labour when they are young and consume in both lifetime periods. Firms produce a composite consumption/investment good from inputs of capital and labour. The government pays unemployment benefits which are financed by a wage–income tax and by the emission of one–period bonds. Markets for capital and goods are perfectly competitive, but wages are the outcome of a bargain at the sector level. The economy consists of a large number M of symmetric sectors, in each of which a single trade union (representing a mass N/M of young consumers) and a single employers' federation (representing a mass $1/M$ of firms) bargain over the wage. After wages are negotiated, employment is decided at the level of the firm ("right–to–manage model"). There is also some turnover of workers between sectors, similarly to Layard, Nickell, and Jackman (1991, Chapter 2). This implies that wages paid in other sectors and the aggregate unemployment rate matter for wage formation in each sector. As a consequence, there is positive unemployment in any equilibrium. In detail, the economy is described as follows.

Consumers and trade unions

Each consumer born at date t supplies one unit of indivisible labour when young and wishes to consume in periods t and $t + 1$. Consumers save part of their labour income for retirement by holding capital shares or government bonds which pay a gross real rate of return R_{t+1}. An employed person receives a (real) net wage $w_t(1 - \tau_t)$ whereas an unemployed person receives the (real) unemployment benefit a. Workers are randomly allocated to jobs. Their von Neumann–Morgenstern utility function $u(c_t, c_{t+1})$ is assumed to be linearly homogenous, strictly quasi–concave and differentiable. Thus, each young consumer's savings behaviour is described by a savings function $s(R_{t+1})I_t$ where $I_t \in \{w_t(1 - \tau_t), a\}$ denotes the first–period income, and the consumer's indirect utility is $v(R_{t+1})I_t$ where $v(R_{t+1}) \equiv u(1 - s(R_{t+1}), s(R_{t+1})R_{t+1})$. We assume $s' \geq 0$, i.e. savings are non–decreasing in the interest rate.

We assume that all young consumers are union members. Hence, each trade union represents a mass N/M of young consumers. However, not all workers are eventually employed in their home sector, but there is some turnover of workers between sectors. A fraction $0 < \pi < 1$ of the initially created work relationships turns out to be unproductive, and these relationships are separated immediately. The resulting vacancies are then filled with (unemployed) persons from other sectors. Thus, if $\ell_t \leq N/M$ jobs are created in some sector, only $(1-\pi)\ell_t$ union members receive the negotiated sector net wage $w_t(1-\tau_t)$, and $N/M - (1-\pi)\ell_t$ members are either employed in another sector or unemployed. Their expected income, denoted w_t^*, will be determined in equilibrium below. The trade union's objective is to maximize the expected utility of a representative member which is $V_t \equiv v(R_{t+1})\left(w_t(1-\tau_t)(1-\pi)\ell_t + w_t^*(N/M - (1-\pi)\ell_t)\right) M/N$. Since the number of sectors is large, trade unions ignore their impact on the aggregate unemployment rate (and thus on w_t^*) and on aggregate investment (and thus on next period's capital return R_{t+1}).[8] When negotiations break down, the union's fallback payoff is $\overline{V}_t \equiv v(R_{t+1})w_t^*$. Therefore, the union surplus of a successful negotiation is

$$V_t - \overline{V}_t = v(R_{t+1})(1-\pi)(w_t(1-\tau_t) - w_t^*)\ell_t M/N. \tag{1}$$

Firms and employers' federations

Firms produce the output good from capital and labour using the constant returns production technology $Y_t = F(K_t, L_t) = L_t f(k_t)$ where $k_t = K_t/L_t$ is the capital intensity.[9] The intensive–form production function f is assumed to be increasing and strictly concave. Capital investment is decided a period in advance and thus before wages are negotiated. However, since the investment decision of any single firm has a negligible effect on aggregate labour demand in its sector, firms ignore the impact of their investment decision on the outcome of wage negotiations.[10] Thus firms take the (perfectly foreseen) wage and the interest rate as given, and so we obtain the usual marginality conditions

$$\begin{aligned} w_t &= w(k_t) \equiv f(k_t) - k_t f'(k_t)\,, \\ R_t &= R(k_t) \equiv 1 - \delta + f'(k_t)\ , \end{aligned}$$

where δ is the depreciation rate.

Firms in each sector are represented by an employers' federation. The federation's objective is the profit of each of its members,

$$\Pi_t \equiv F(K_t, L_t) - w_t L_t = (f(K_t/(M\ell_t)) - w_t)M\ell_t\ , \tag{2}$$

[8] In particular, compared with centralized bargaining this assumption tends to increase the equilibrium unemployment rate (see, for example, Calmfors and Drifill (1988)).

[9] Since there is a mass 1 of identical firms, K_t and L_t denote the capital stock and employment both at the aggregate level and at the firm level.

[10] Thus, since employers' federations represent a large number of firms, we can abstract from the typical hold–up problem of firm–specific bargaining as discussed, for instance, by Coloma (1999) and Devereux and Lockwood (1991).

using $L_t = M\ell_t$. The fallback payoff of the employers' federation is $\overline{\Pi}_t = 0$.

The wage bargain
Given the capital stock in each sector K_t/M, the trade union and the employers' federation negotiate the sector wage taking into account that employment is chosen by firms. Sector employment $\ell_t = L_t/M$ and the sector wage are related by the labour demand schedule $w_t = w(K_t/(M\ell_t))$. The outcome of this bargain is determined by the Nash bargaining solution which maximizes the Nash product $(\Pi_t - \overline{\Pi}_t)^{\beta}(V_t - \overline{V}_t)^{1-\beta}$. $\beta \in [0,1]$ denotes the bargaining power of the employers' federation. Instead of maximizing over wage and employment, we use the identities $w_t = w(k_t)$ and $k_t = K_t/(M\ell_t)$ to reformulate the Nash program in terms of the sector's capital intensity. Using (1), (2), and ignoring constants, the Nash program becomes

$$\max_{k_t \geq K_t/N} (k_t f'(k_t))^{\beta}(w(k_t)(1-\tau_t) - w_t^*)^{1-\beta} k_t^{-1} \ .$$

The Nash product is zero at k^* such that $w(k^*)(1-\tau_t) = w_t^*$ and it is zero at $k = \infty$ since $w(k)/k$ tends to zero as $k \to \infty$. Hence a maximum necessarily exists. We assume that the Nash product is strictly quasi–concave (which is the case, for example, when the production function has constant elasticity of substitution) so that an interior (or unemployment) solution of the Nash program is characterized by the first–order condition

$$\beta \frac{f''(k_t)k_t}{f'(k_t)} + (1-\beta)\left(\frac{k_t w'(k_t)(1-\tau_t)}{w(k_t)(1-\tau_t) - w_t^*} - 1\right) = 0 \ . \tag{3}$$

Below it will be shown that there can only be an unemployment outcome in a symmetric equilibrium. Thus it is sufficient to consider an interior solution.

The government
The government pays a fixed unemployment benefit a to each unemployed person and levies a proportional wage–income tax at rate τ_t.[11] For the sake of simplicity, we abstract from other components of government spending, as well as from other tax instruments (see Section 7 for a discussion). The per capita deficit $d_t = a(1 - L_t/N) - \tau_t w_t L_t/N$ is financed by issuing bonds. Let b_t denote the real value of the (per capita) stock of government bonds maturing at date t. The government faces a flow budget constraint given by

$$b_{t+1} = R_t b_t + d_t \ ,$$

[11] It may be assumed alternatively that the government fixes the replacement ratio $a/(w(1-\tau))$ rather than the level of benefits. In this case, however, the short–run equilibrium unemployment rate is independent of the tax rate (see Pissarides (1998)).

assuming that in a perfect capital market the return rates on government bonds and on capital shares coincide. We do not impose an intertemporal budget constraint by requiring that any debt must be repaid by future surpluses. Note, however, that such a constraint would be satisfied at any steady state with zero debt and zero deficit to be considered below, whereas it is not satisfied at the golden–rule steady state of Section 6.

We consider two types of policies:

(BB) Balanced budgets: the government adjusts the tax rate in each period such as to balance out benefit expenditures and tax revenues, i.e. $d_t = 0$ for all t.

(UB) Unbalanced budgets: the government fixes the tax rate and runs budget surpluses or budget deficits. If government debt becomes unsustainable in the long run due to permanent budget deficits, tax rates are adjusted in a discretionary manner.

The equilibrium

$N - (1-\pi)L_t$ persons do not find employment in their home sector. With some probability φ_t each of them finds a job in some other sector. Given that there are πL_t vacancies left, this probability is

$$\varphi_t = \frac{\pi L_t}{N - (1-\pi)L_t} = \frac{\pi(1-u_t)}{\pi(1-u_t)+u_t} , \qquad (4)$$

where $u_t = 1 - L_t/N$ denotes the unemployment rate. Thus the expected income of a person who is not employed in his home sector is

$$w_t^* = \varphi_t w_t(1-\tau_t) + (1-\varphi_t)a . \qquad (5)$$

Note that the unemployment rate is positive in equilibrium. If $u_t = 0$, all persons are employed with probability one, $\varphi_t = 1$, and therefore the union's fallback wage coincides with the net wage of the other sectors. Since any outcome of the wage bargain must pay some markup over the fallback wage whenever unions have bargaining power ($\beta < 1$), such a wage cannot be set in equilibrium. Thus, some unemployment is required to restrain the wage demands of unions.

Inserting (4) into (5) shows that the fallback wage is decreasing in the unemployment rate since higher unemployment makes it more difficult for an unemployed person to find a job in another sector. Combining this with the bargaining solution (3) and solving for the unemployment rate yields

$$u_t = u(k_t,\tau_t) \equiv \frac{\pi\mu(k_t,\tau_t)}{1-(1-\pi)\mu(k_t,\tau_t)} ,$$

where

$$\begin{aligned}\mu(k,\tau) &\equiv \frac{(1-\beta)\frac{w'(k)k}{w(k)}}{1-\beta\left(1+\frac{f''(k)k}{f'(k)}\right)} \cdot \frac{w(k)(1-\tau)}{w(k)(1-\tau)-a} \\ &= \mu_1(k)\cdot\mu_2(k,\tau)\end{aligned}$$

Note that $0 \leq u(k,\tau) \leq 1$ if and only if $0 \leq \mu(k,\tau) \leq 1$, and that u is increasing in μ. To ensure existence and uniqueness of a short–run equilibrium, we impose the following assumption:

$$\mu_1' \leq 0 \text{ and } 0 \leq \lim_{k\to\infty} \mu(k,\tau) < 1 \text{ for all } \tau \leq \tau_{\max} \tag{A1}$$

$\tau_{\max}$ is some upper bound on the tax rate that is imposed whenever $w(k)$ is bounded above in order to guarantee that μ (and u) is positive for sufficiently large k. The assumption implies that μ and u are decreasing in k and converge to some non-negative constant less than unity if $k \to \infty$. As will be shown below, this assumption implies that a higher capital stock lowers unemployment.

Assumption (A1) is fulfilled, for instance, if the production function has constant elasticity of substitution $\sigma \leq 1$ and if $\tau_{\max}$ is such that $\lim_{k\to\infty} w(k) > a/(1-\tau_{\max})$. In particular, if $\sigma < 1$ (capital and labour are complements) μ and u converge to zero when $k \to \infty$, and if $\sigma = 1$ (Cobb–Douglas) μ and u converge to a positive constant less than unity.[12] To see why u decreases in k, note that there are two effects operating. First, if capital and labour are complementary inputs, a higher capital stock boosts employment. Second, a higher capital stock shifts labour demand outwards which leads to higher equilibrium employment since benefits are not indexed to wages. Note that if the production function has constant elasticity of substitution $\sigma > 1$, assumption (A1) is not satisfied since then $\mu_1' > 0$. However, as reported in Rowthorn (1999), most empirical studies are in favour of elasticities of substitution below unity.[13]

For convenience, we introduce the following notation for the public deficit:

$$d(k,\tau) \equiv au(k,\tau) - \tau w(k)(1-u(k,\tau)) \ .$$

3 Balanced budgets

We consider first the case in which the government adjusts tax rates in each period in order to balance its budget, i.e. we suppose that $d(k_t,\tau_t) = 0$ in every period. There are two effects of a tax rise on the public deficit: at a given employment level higher taxes reduce the deficit, but a higher tax rate also depresses employment

[12] In fact, if $\sigma = 1$, $\mu_1(k)$ is a positive constant less than unity, whereas $\mu_2(k,\tau)$ is decreasing and tends to unity when $k \to \infty$. Thus μ and u converge to positive constants less than unity. If $\sigma < 1$, $\mu_1(k)$ is decreasing and tends to zero, whereas $\mu_2(k,\tau)$ is decreasing and, assuming $\lim_{k\to\infty} w(k) > a/(1-\tau_{\max})$, converges to a positive constant when $k \to \infty$. Thus μ and u converge to zero.

[13] However, Caballero and Hammour (1998) point out the possibility of values of σ exceeding unity for uncommitted capital, stressing the importance of distinguishing between high ex–ante and low ex–post values of the elasticity in vintage models. For a discussion of the role of the elasticity of substitution in a related model, see Kaas and von Thadden (2001).

which lowers revenues, increases benefit outlays and the deficit. It turns out that the deficit in fact behaves like an inverted Laffer curve: for low tax rates the first effect dominates and the deficit falls with higher tax rates, whereas the negative effect dominates at higher tax rates. In particular, the following lemma shows that there are two tax rates balancing the budget, provided that unemployment benefits are not too large, i.e. smaller than some upper bound $\overline{a}$.

Lemma *Let $k \geq \underline{k}$ and $a \leq \overline{a}$ where $\underline{k}$ satisfies $u(\underline{k}, 0) < 1$ and where $\overline{a}$ is sufficiently small. At sufficiently low and at sufficiently high tax rates the deficit is positive. There are exactly two positive tax rates $0 < \tau_1(k) < \tau_2(k) < 1 - a/w(k)$ such that $d(k, \tau_i(k)) = 0$, $i = 1, 2$. Moreover, $\tau_1'(k) < 0$.*
Proof: Appendix.

It is natural to assume that the government chooses the smaller tax rate to balance its budget. At the larger tax rate, unemployment is higher and both the unemployment rate and the deficit could be reduced by lowering the tax rate. Such a tax rate is therefore not a likely outcome of a political decision process. Denote by $u_B(k) \equiv u(k, \tau_1(k))$, $k \geq \underline{k}$, the unemployment rate at balanced budgets. Since $u(k, \tau)$ is decreasing in k (from (A1)) and increasing in τ and because of the lemma, we have $u_B' < 0$. From the identity $k = K/(N(1-u))$ we obtain the following equation which determines the capital intensity (or equivalently the unemployment rate) in the short–run equilibrium:

$$u_B(k_t) = 1 - \frac{K_t}{Nk_t} \ . \tag{6}$$

Equation (6) determines a unique short–run equilibrium capital intensity k_t for any level of the capital stock K_t. In fact, the left hand side is well defined for all $k \geq \underline{k}$, is decreasing and converges to a non–negative constant less than unity for $k \to \infty$, whereas the right hand side is increasing in k and converges to unity for $k \to \infty$. The two equilibrium curves are illustrated in Figure 3. If the capital stock falls or if the labour supply increases, the RHS shifts up, unemployment increases, and the capital intensity and the wage rate fall. On the other hand, a wage push induced by stronger union power in wage negotiations (a lower β) or by more generous benefit spending (a higher a) shifts up the LHS, raises the unemployment rate, the capital intensity and the wage rate.
We turn now to the dynamics of the capital stock and to the analysis of long–run equilibria. Since the budget is balanced by assumption, the aggregate income of the young generation in period t is

$$w_t(1-\tau)L_t + a(N - L_t) = w_t L_t \ . \tag{7}$$

A fraction $s(R_{t+1})$ of this income is saved in the form of capital shares or government

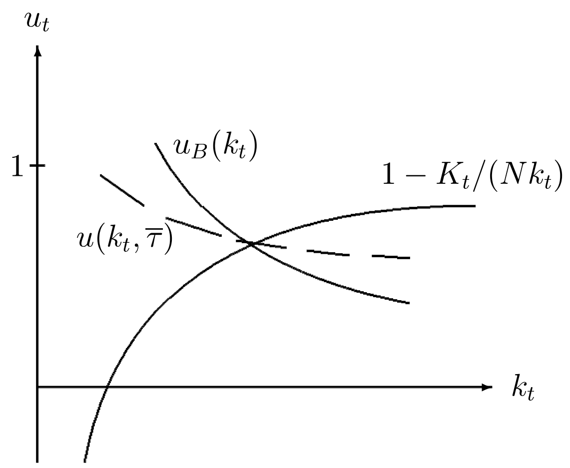


Figure 3: *Short-run equilibrium*

bonds. Thus capital market equilibrium implies

$$K_{t+1} + Nb_{t+1} = s(R_{t+1})w_t L_t \ .$$

Using (6) and the definitions of R and w, this can be written in per capita terms as

$$k_{t+1}(1 - u_B(k_{t+1})) + b_{t+1} = s(R(k_{t+1}))w(k_t)(1 - u_B(k_t)) \ . \tag{8}$$

The government budget constraint (in per capita terms) is

$$b_{t+1} = R(k_t)b_t \ . \tag{9}$$

Equations (8) and (9) define an implicit two–dimensional dynamical system in (k_t, b_t), similar to the perfectly competitive Diamond model with government bonds which obtains if we set $u_B \equiv 0$. It is easy to see that steady states $(\overline{k}, \overline{b})$ are naturally related to steady states of the competitive model and that stationary capital intensities are the same under unemployment as under full employment.[14] As a result, stationary interest rates and (gross) wages do not depend on labour market conditions and are the same as under perfect competition. First, there are steady states with zero government bonds:

$$\overline{k} = s(R(\overline{k}))w(\overline{k}) \text{ and } \overline{b} = 0 \ . \tag{10}$$

Second, there is a "golden–rule" steady state in which

$$R(\overline{k}) = 1 \text{ and } \overline{b} = (s(R(\overline{k}))w(\overline{k}) - \overline{k})(1 - u_B(\overline{k})) \ . \tag{11}$$

[14] This result depends on our assumption of homothetic utility, implying that savings are a linear function of income.

For this and the following two sections we restrict our analysis to the first type of steady states in which the stock of government bonds is zero. Golden–rule steady states are discussed in Section 6. It can be easily verified that the eigenvalues of the Jacobian of the dynamical system (8) and (9) evaluated at a steady state (10) are

$$\lambda_1 = R(\overline{k}) \ , \ \lambda_2 = \frac{(1 - u_B(\overline{k}))\eta_w(\overline{k}) - u_B(\overline{k})\eta_{u_B}(\overline{k})}{(1 - u_B(\overline{k}))(1 - \eta_s(R(\overline{k}))\eta_R(\overline{k})) - u_B(\overline{k})\eta_{u_B}(\overline{k})} \ , \tag{12}$$

where $\eta_h(x) \equiv h'(x)x/h(x)$ denotes the elasticity of some function h at x. λ_2 is also the eigenvalue of the one–dimensional model with zero government bonds. Since under our assumptions $\eta_w > 0$, $\eta_s \geq 0$, $\eta_R < 0$ and $\eta_{u_B} < 0$, λ_2 is positive. Moreover, λ_2 is less than unity if and only if

$$\eta_w(\overline{k}) < 1 - \eta_s(R(\overline{k}))\eta_R(\overline{k}) \ . \tag{13}$$

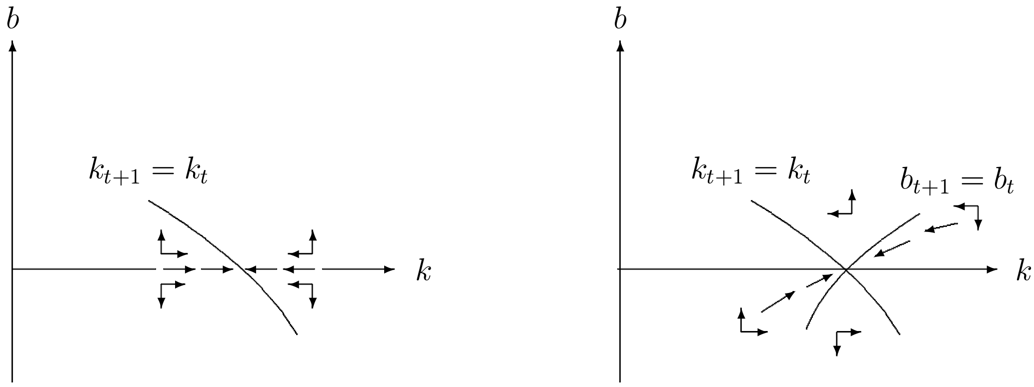
Note that this condition is independent of labour market parameters and coincides with the usual stability condition of the competitive Diamond model. For instance, if the production function has constant elasticity of substitution $\sigma < 1$ and if the interest elasticity of savings is zero (which is the case if the intertemporal utility function is Cobb Douglas), there are typically two positive steady states with zero government bonds of which only the larger one satisfies (13) and is therefore stable. As in the competitive model (see, for example, Azariadis (1993, Chapter 7)), such a steady state is either a saddle or a sink.

Proposition 1 *Consider a steady state $(\overline{k},\overline{b})$ of (8) and (9) satisfying (10) and (13). Then, as for the perfectly competitive Diamond economy, the steady state is a saddle if it is dynamically efficient ($R(\overline{k}) > 1$) and it is a sink if it is dynamically inefficient ($R(\overline{k}) < 1$).*

Thus, whenever the interest rate exceeds the growth rate of the economy (which is zero since we abstract from technological progress and population growth), bond dynamics are unstable. Note, however, that even a dynamically efficient steady state is stable to perturbations of the economy, since the $b = 0$ axis is the stable manifold, as illustrated in Figure 4 (a). If a shock perturbs the economy, the capital intensity would ultimately converge back to its steady state value, provided that the government balances its budget in each period.

4 Unbalanced budgets

Suppose now that the government does not adjust the tax rate to balance its budget in each period. More specifically, suppose the economy is in a steady state $(\overline{k}, \overline{b} = 0)$



(a) Balanced budgets

(b) Unbalanced budgets

Figure 4: *Local dynamics at a dynamically efficient steady state (R>1)*

and the government keeps the tax rate fixed at $\overline{\tau} = \tau_1(\overline{k})$. Instead of (6), the short–run equilibrium capital intensity and unemployment rate are now determined by

$$u(k_t, \overline{\tau}) = 1 - \frac{K_t}{Nk_t} \ .$$

Again under assumption (A1), this equation determines a unique short–run equilibrium capital intensity k_t for any level of the capital stock K_t. As shown in Figure 3, the two equilibrium curves are similar to the ones under a balanced–budget rule, but the left–hand side $u(., \overline{\tau})$ is now a flatter curve than $u_B(.)$. The reason is as follows: Suppose that, starting from a balanced budget, the capital stock falls, raising the unemployment rate and driving the budget into deficit. If the government balances its budget, it needs to raise the tax rate which further increases unemployment. Thus, a balanced–budget rule generally amplifies the shock in the short–run, whereas a fixed tax rate acts as an "automatic stabilizer", in accordance with traditional Keynesian arguments. As we show below, the opposite is the case in the long run: an unbalanced budget rule amplifies the persistence of unemployment and may even destabilize the economy.

Consider now the dynamics under unbalanced budgets. Instead of (7), the aggregate income of the young generation in period t is now $w_tL_t + Nd_t$. Thus, the dynamic equations (8) and (9) are replaced by

$$k_{t+1}(1 - u(k_{t+1}, \overline{\tau})) + b_{t+1} = s(R(k_{t+1}))\,(w(k_t)(1 - u(k_t, \overline{\tau})) + d(k_t, \overline{\tau})) \ , \qquad (14)$$

and

$$b_{t+1} = R(k_t)b_t + d(k_t, \overline{\tau}) \ . \qquad (15)$$

Obviously, the steady state $(\overline{k}, \overline{b} = 0)$ of the dynamical system (8) and (9) discussed in Proposition 1 is also a steady state of (14) and (15). The other steady states of the balanced budget dynamics (i.e. the golden–rule steady state to be discussed below or other steady states with zero government debt) are also steady states of the dynamics with unbalanced budgets, but obviously for different tax rates. Moreover, for the fixed tax rate $\overline{\tau}$, (14) and (15) typically also have a steady state with a permanent fiscal deficit or surplus. Such steady states will however not be considered in this paper (see Chalk (2000) for an elaborate analysis of steady states with permanent deficits in the competitive Diamond model).
We now extend Proposition 1 to the case of unbalanced budgets. Steady states as discussed in Proposition 1 are again either a saddle or a sink, but now the condition for a sink is stronger than with balanced budgets and deviates from the perfectly competitive case.

Proposition 2 *Consider a steady state $(\overline{k}, \overline{b})$ of (14) and (15) satisfying (10) and (13). Then stability features correspond no longer to the benchmark case of a perfectly competitive economy. The steady state is a saddle if*

$$R(\overline{k}) > 1 + \frac{d_k(\overline{k}, \overline{\tau})}{(1 - u(\overline{k}, \overline{\tau}))(1 - \eta_s(R(\overline{k}))\eta_R(\overline{k}) - \eta_w(\overline{k})) - s(R(\overline{k}))d_k(\overline{k}, \overline{\tau})} \equiv \overline{R} \ .$$

The steady state is a sink if $R(\overline{k}) < \overline{R}$. Hence, since $\overline{R} < 1$, a dynamically efficient steady state is a saddle, whereas a dynamically inefficient steady state is a saddle or a sink. In all these cases, off-steady state dynamics are monotone. If the steady state is a saddle, the stable manifold is upward–sloping in (k, b) space.

Proof: Appendix.

To understand intuitively why the stable manifold is an upward–sloping curve, consider the following argument in the dynamically efficient case ($R(\overline{k}) > 1$): when k falls below $\overline{k}$, the deficit $d(k, \overline{\tau})$ becomes positive at the fixed tax rate since employment and the wage rate are falling. Correspondingly, the interest factor rises: $R(k) > R(\overline{k}) > 1$. If some (k, b) with $b \geq 0$ was on the stable manifold, bond dynamics would be unstable since $R(k)b + d(k, \overline{\tau}) > b \geq 0$. Hence, $b < 0$ is needed for stable bond dynamics, and therefore the stable manifold is upward–sloping. Figure 4 (b) illustrates the stable manifold and the curves $k_{t+1} = k_t$ and $b_{t+1} = b_t$. By similar reasoning, $R(\overline{k}) < 1$ is not sufficient to stabilize the economy, since the issued bonds crowd out capital, thereby raising its marginal product in a possibly destabilizing way. Overall dynamics will remain stable, only if, at the outset, $R(\overline{k})$ is sufficiently small ($R(\overline{k}) < \overline{R} < 1$).[15] Note that, in contrast to the golden–rule steady state to be

[15] Chalk (2000) argues similarly that permanent fiscal deficits need not be sustainable, even if the interest rate falls short of the growth rate.

discussed in Section 6, the real value of bonds cannot adjust by changes in the price level to restore stability along the stable manifold. Starting out from $b = 0$, a jump of the price level cannot bring about a positive value of government asset holdings which would be needed to counteract the budget deficit after a fall in the capital intensity. Thus, saddle–path stability in Proposition 2 implies that perturbations which lead on impact to a government deficit can only be stabilized by appropriate fiscal adjustments at some point in the future.

5 Adjustment after a temporary wage pressure

Consider a temporary wage pressure which is induced, for instance, by stronger union power in wage negotiations (a fall in β). Specifically, suppose the economy is in a steady state of the type discussed in Propositions 1 and 2 and there is an unanticipated wage pressure in period t only, while from period $t+1$ onwards labour market conditions are as before. In terms of Figure 3, this means that the curves u_B and $u(., \overline{\tau})$ shift up in period t, and are back at their original position afterwards. Thus, under both budgetary policies, the wage shock raises the capital intensity and the unemployment rate on impact, but unemployment increases more under balanced budgets. Since the stock of bonds maturing in t is predetermined at $b_t = 0$, the wage pressure leads under both budgetary rules to a state $(k_t, 0)$ with $k_t > \overline{k}$.

Under *balanced budgets* (BB), the government adjusts the tax rate such that the deficit in period t (and thereby the stock of bonds in period $t+1$) is zero. Assuming that $\eta_w(\overline{k}) < 1$, higher unemployment depresses the income of the young generation,[16] savings are declining, and the capital stock in the next period falls. Thus in period $t+1$, when the wage pressure is over, the upward–sloping curve in Figure 3 shifts upwards, and the capital intensity falls below its steady state level. Irrespective of whether the steady state is a saddle or a sink, the capital intensity converges back to the steady state, since the stability condition (13) is satisfied. Unemployment remains above its "natural" level along the adjustment path. Thus, unemployment dynamics exhibit "persistence" in the sense that temporary shocks have lasting effects on unemployment.

Consider now an *unbalanced budgets* policy (UB). Assuming $\eta_w(\overline{k}) < 1$ and by a similar argument as in footnote 16, the budget runs into deficit on impact, and the stock of bonds in period $t+1$ becomes positive. Savings are declining and are now partly absorbed by government bonds. Hence, the upward–sloping curve in Figure

[16] In fact, higher wages and higher unemployment are counteracting effects on the income of the young generation. However, since $w(k)(1 - u_B(k)) = w(k)K/(Nk)$, the young generation's income falls with the increase of k provided that $\eta_w < 1$, which is only a slightly stronger condition than (13).

3 shifts further up under (UB), and in period $t+1$ the capital intensity undershoots its stationary level by more than under (BB). Whether unemployment in period $t+1$ is higher or lower under (UB) is ambiguous and depends on the shape of the curves in Figure 3: on the one hand, the fixed tax rate under (UB) tends to keep unemployment low but, on the other hand, the lower capital stock depresses employment more. With a sufficiently low elasticity of substitution between labour and capital, the second effect dominates, and unemployment in period $t+1$ is higher under (UB) than under (BB). In most of our simulation studies this result has been confirmed indeed.
To discuss the long–run dynamics in more detail, suppose first that the steady state under (UB) is a sink , i.e. $R < \overline{R}$. According to Proposition 2, the economy converges monotonically back to the steady state, similar to the adjustment under (BB). The low interest rate guarantees that the deficit and government debt are reduced automatically, without any need of future tax adjustments. However, the speed of adjustment to the new steady state tends to be lower under (UB) than under (BB): If the interest factor is close to $\overline{R}$, adjustment to the steady state follows an eigenvalue close to one (this follows from the proof of Proposition 2 which shows that the larger eigenvalue equals unity at $R = \overline{R}$). In contrast, the relevant eigenvalue under (BB) is λ_2 given by (12) which is strictly smaller than one.
Figure 5 illustrates the result of a stylized simulation experiment. We assume a CES production function

$$F(K,L) = \Big(\alpha(A_K K)^{(\sigma-1)/\sigma} + (1-\alpha)(A_L L)^{(\sigma-1)/\sigma}\Big)^{\sigma/(\sigma-1)}$$

with elasticity of substitution $\sigma = 0.6$ and $A_K = A_L = 100$, $\alpha = 0.5$. Furthermore, the depreciation rate is $\delta = 0.6$, labour market parameters are $\beta = 0.1$, $\pi = 0.2$, $a = 173.37$, $N = 10$, and the savings rate is $s = 0.3$ (resulting from a Cobb–Douglas intertemporal utility function). These parameters imply a steady state unemployment rate $u = 8.06\%$, tax rate $\tau = 6.17\%$ and wage rate $w(\overline{k}) = 246.37$, such that the steady state replacement ratio is 75%. The interest factor is $R = 0.589 < \overline{R} = 0.713$. In period 3, β falls to 0.05 and from period 4 onwards it is back at $\beta = 0.1$. The two curves show the adjustment dynamics of the capital intensity and of the unemployment rate. The solid curves are the time series under (BB), and the dashed curves under the (UB) policy. Unemployment increases less in the period of the shock under (UB), but exceeds the level under the (BB) policy in all following periods. Moreover, under (UB) adjustment to the steady state is slower and unemployment dynamics exhibit more persistence than under (BB).
These results become even more pronounced if the interest factor exceeds the critical level $R > \overline{R}$, i.e. if the steady state is a saddle under the (UB) dynamics, in which case adjustment dynamics are unstable. Since $k_{t+1} < \overline{k}$ and $b_{t+1} > 0$, (k_{t+1}, b_{t+1}) is not on the upward–sloping saddle path, and the dynamics are diverging on a path

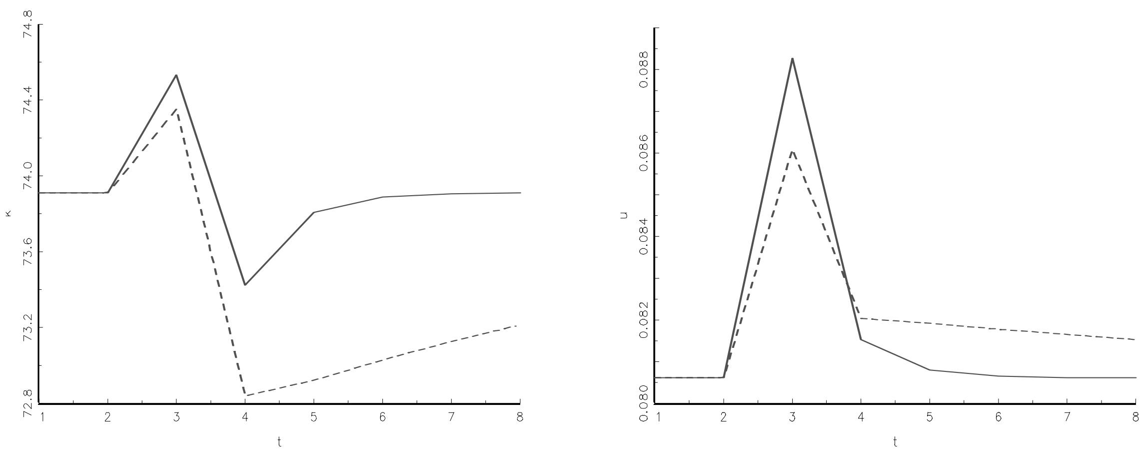


Figure 5: *Adjustment dynamics after a temporary wage pressure in the case* $R < \overline{R}$ *with balanced (solid) and unbalanced (dashed) budgets.*

with falling capital stock, rising interest rates and ever increasing government debt (see Figure 4 (b)). In particular, note that the real value of bonds cannot adjust (by an appropriate adjustment of the price level) to restore stability of the steady state. To achieve stability and to guarantee a sustainable fiscal stance in the long run, the government has to resort to a fiscal consolidation in later periods. In our model, this means that future tax increases are needed to pay back the accumulated debt of the previous periods. Such tax adjustments affect unemployment adversely during the consolidation phase. The later the fiscal consolidation is carried out, the more the tax rates need to be raised, and the stronger are the effects on future unemployment. While the exact time path of unemployment depends on the timing of consolidation efforts, it is quite likely that the average rate of unemployment during the transition will be larger than under (BB).

We illustrate these findings with another simulation study in Figure 6.[17] The solid lines show the adjustment of k, u, b and τ under (BB), and the dashed lines the (UB) dynamics which are now unstable. Note that unemployment in period 4 after the shock is just slightly higher under (UB), but increases later because of further increases in government debt and a declining capital stock. The dotted line shows the time paths induced by a policy which relies on (UB) in period 3 and switches in period 4 to a complete fiscal consolidation, i.e. the government raises the tax rate so as to pay back all debt issued in the period of the shock. After that, the

[17] All model parameters are as before, apart from $\alpha = 0.6$, $\delta = 0.2$, and $a = 230.38$, leading to steady state values $u = 10.48\%$, $\tau = 8.07\%$, and $w(\overline{k}) = 334.17$, such that the steady state replacement ratio is again 75%. The interest factor is now $R = 1.032 > \overline{R} = 0.573$, and we consider the same β–shock as before.

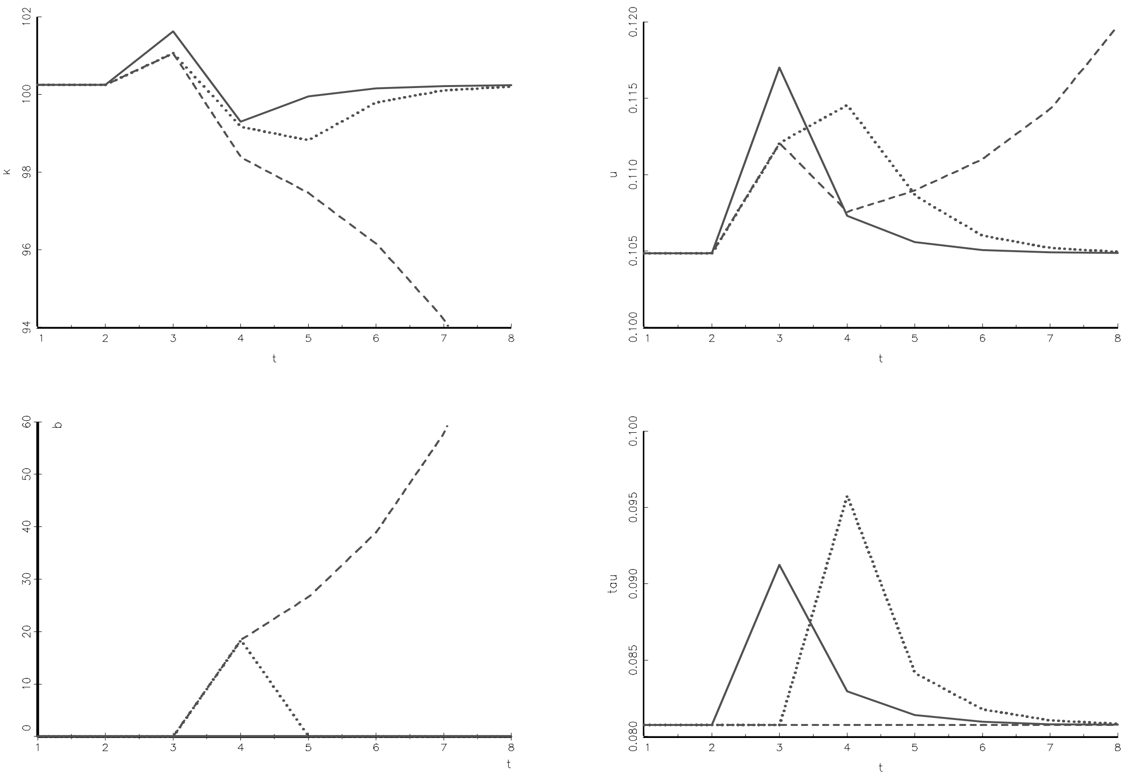


Figure 6: *Adjustment dynamics of k, u, b and τ after a temporary wage pressure in the case $R > \overline{R}$ with balanced budgets (solid), unbalanced budgets (dashed), and initially unbalanced budgets in period 3 with complete consolidation in period 4 (dotted).*

government returns to a (BB) policy, i.e. it maintains a zero deficit from period 5 onwards. The consolidation not only strengthens persistence of the unemployment path, but it also raises the mean rate of unemployment during the transition, in particular in comparison with the (UB) dynamics in Figure 5.

6 The golden–rule steady state

The trade-off discussed in the previous section becomes less apparent if one considers the golden–rule steady state with positive bond holdings which exists in a dynamically inefficient economy besides the steady state with zero debt.[18] Now

[18] In principle, $R = 1$ could also prevail at steady states with a zero deficit at which the government acts as a net lender to the private sector ($b < 0$). However, this constellation is of less

both budgetary rules share the feature that dynamics are saddle–path stable, as in the fully competitive model with a frictionless labour market.

Proposition 3 *Consider a steady state $(\bar{k}, \bar{b})$ of (8) and (9) satisfying (11) and (13), with $\bar{b} > 0$. Then, the steady state is a saddle under either budgetary rule and exhibits monotone adjustment along the stable manifold. Moreover, the stable eigenvalue is smaller under the unbalanced budgets dynamics than under the balanced budgets dynamics.*

Proof: Appendix.

As a common feature of the two rules, the interpretation of this result depends critically on how one assesses the potentially stabilizing role of price level adjustments. In particular, with the nominal value of debt and the nominal interest rate being predetermined, the required off-steady state adjustments in the real value of bonds can always be brought about by appropriate changes of the price level. Indeed, in nominal terms the government's budget constraint is $B_{t+1} = I_t B_t + p_t d_t$, where I_t denotes the (predetermined) nominal interest rate and p_t the price level. Thus, the real value of bonds issued in period t, $b_{t+1} = B_{t+1}/p_t = I_t(p_{t-1}/p_t)b_t + d_t$, can adjust by an appropriate jump of the price level so that (k_{t+1}, b_{t+1}) falls onto the saddle path (provided that $b_t > 0$). However, given the existence of multiple steady states, there is no compelling reason why prices should adjust exactly in this manner. If the price level does not adjust or adjusts in a different manner, bond dynamics would either become unstable (in which case no intertemporal equilibrium would be feasible) or the economy would converge to another steady state (which is in the (BB) dynamics the dynamically inefficient steady state). Since there are an infinite number of such equilibrium paths, it seems particularly unlikely that the price level adjusts exactly such that the economy is on the saddle path of the golden–rule steady state (cf. the discussion of multiple steady states in the Diamond model by Blanchard and Fischer (1989, pp. 226)).
Yet, suppose in the following that the price level adjusts in the period of the wage shock such that economy is on the saddle path from period $t+1$ onwards. No future tax adjustments are needed since stability is achieved by the adjustment of the price level alone. Similar to the previous cases, the shock raises unemployment in period t by more under the (BB) policy. But in contrast to steady states with zero debt, Proposition 3 implies that adjustment to the steady state is slower under the (BB) dynamics. Thus, the (UB) policy not only leads to lower unemployment on impact, but also in the adjustment dynamics.
Figure 7 supports these findings by a simulation study.[19] The experiment reveals

interest, since the steady state of Proposition 1 would then be dynamically efficient.

[19] Parameters are the same as in the first simulation exercise apart from $\delta = 0.4$ and $a = 159.02$ which implies a Golden Rule steady state $(\bar{k}, \bar{b}) = (24.78, 21.51)$ with $w = 159.34$, $u = 12.31\%$,

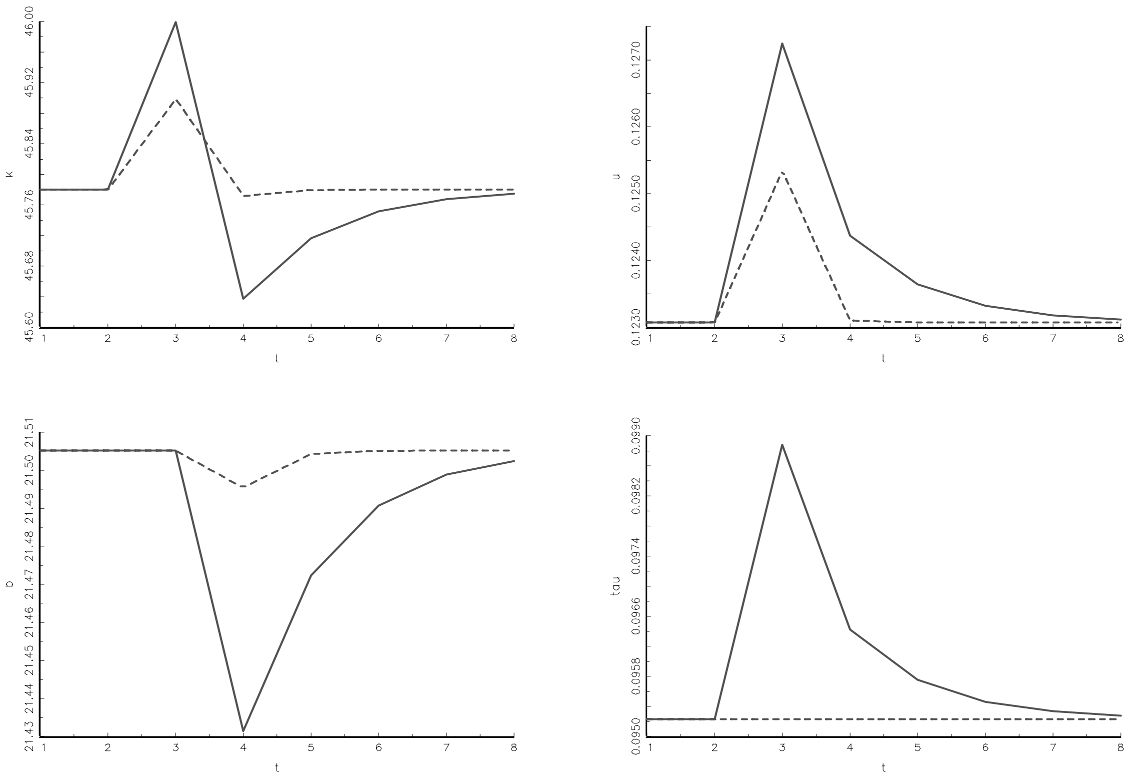


Figure 7: *Adjustment dynamics after a temporary wage pressure at the golden-rule steady state with balanced (solid) and unbalanced (dashed) budgets.*

that the adjustment of the price level is strong enough to ensure that the real value of debt in period $t+1$ falls *below* its steady state level, even under (UB) when the government runs a deficit in period t. Moreover, the fall in the capital intensity in period $t+1$ is weaker under (UB), and thus unemployment is lower. As a result, unemployment is lower under (UB) than under (BB) in all periods along the adjustment path. But note again that this extreme result hinges on the assumption of stabilizing price adjustment, without which the golden–rule steady state would be unstable under either budgetary rule.

$\tau = 9.52\%$, so that the replacement rate is again 75%. In period 3, we assume $\beta = 0.09$, while $\beta = 0.05$ in all other periods.

7 Discussion

Broadly speaking, we believe there is little disagreement between economists on the merits and the risks associated with a policy of unbalanced government budgets. In particular, unbalanced budgets which operate symmetrically over the business cycle tend to act as automatic stabilizers, inasmuch as demand is reduced in booms and stimulated in recessions. If used in this way, unbalanced budgets will be offsetting over the cycle and they offer a convenient 'rule' which tends to be more effective than the discretionary fine-tuning of tax and expenditure adjustments in the political decision process. Moreover, facing a lower risk premium, the government should be in a better position than private households to facilitate intertemporal consumption smoothing. Further stressing the advantages of the use of automatic stabilizers, Schmitt-Grohé and Uribe (1997) have recently shown within a neoclassical growth model that expectations of tax adjustments aimed at balancing the budget may well be self–fulfilling, leading to indeterminate rational expectations equilibria even in the absence of fundamental shocks.[20]

However, as recently summarized by the OECD (1999), relying on a policy of unbalanced budgets invariably involves the risk that automatic stabilizers will react to (potentially long lasting) structural shocks as well. Thus, unbalanced budgets may well mask a deterioration of the underlying structural deficit, and required adjustments may therefore be postponed. Evidently, such a policy, though rationalizable in a political economy context, may be costly in the long run, particularly when deficits go hand in hand with adverse bond dynamics.[21]

Addressing various sources of unemployment persistence in OECD countries, the study of Elmeskov and MacFarlan (1993) reaches a conclusion which describes very well the tensions which are implicit in a policy that relies strongly on automatic stabilizers, i.e. allows for unbalanced budgets: "Both hysteresis and slow adjustment may be seen as justifying efforts to avoid large shocks to economies. This could be an argument for having strong automatic stabilizers, particularly if the starting point was one of low unemployment...However, automatic stabilizers are also likely to react to changes in unemployment caused by a rising natural rate, which may have

[20] Using a similar argument, Rocheteau (1999) shows how balanced budgets can render the equilibrium rate of unemployment indeterminate in a matching model of the labour market. The set–up is such that expectations of higher taxes induce employers to reduce recruitment. Since the tax base increases with the number of jobs, government budget balancing requires a higher tax level, in accordance with employers' beliefs.

[21] In its overview, the OECD broadly concludes that "...adverse debt dynamics have been very prominent in most OECD countries during the 1990s, especially in countries that had high debt levels from the outset...Such poor starting positions stemmed from the earlier failure to use fiscal automatic stabilizers symmetrically during previous business cycles...Most countries have succeeded in offsetting the resulting adverse debt dynamics in the 1990s by strong fiscal consolidation." OECD (1999), p. 144.

a destabilizing influence on the economy."[22] We think that this statement is well taken and, in a sense, our paper may be seen as an attempt to develop a framework which accounts for the tensions addressed in the statement in a rigorous way.

In order to keep the comparison *between* the regimes of balanced and unbalanced budget policies analytically tractable, our treatment of tax instruments is deliberately simple. Various studies consider alternative, more elaborate tax schemes *within* balanced budgets. Abstracting from unemployment, Uhlig and Yanagawa (1996) argue that under the special life–cycle assumptions of overlapping generations economies, revenue–neutral shifts from labour to capital taxation are likely to raise output since any such shift implies a redistribution of disposable income towards agents with a higher savings propensity. Yet, this bias of overlapping generations models towards capital taxation is less clear–cut in multiperiod settings.[23] Pissarides (1998) considers a non–linear wage tax, made up of a fixed and a proportional component, and concludes that changes in the tax structure can have significant employment effects.

Closely related to our analysis, Daveri and Tabellini (2000) study the impact of proportional wage taxes on unemployment in an overlapping generations economy with collective wage bargaining, assuming balanced budgets throughout their analysis. They argue that a lasting increase of the wage tax (and thus labour costs) increases unemployment, slows down investment and reduces growth and conclude that taxation should be shifted more strongly on consumption or capital. In our analysis wage taxes are increased, if at all, temporarily to balance the budget. However, our model is perfectly compatible with the view that *permanently* higher wage taxes raise unemployment which is supported by the empirical findings of Daveri and Tabellini. Our results are thus complementary to their analysis by pointing at the importance of the stance of the budgetary balance.

Finally, studying optimal tax schedules in a small open economy, Koskela and Schöb (2000) point out that the conventional wisdom to tax labour (as the less mobile factor) more strongly than capital may well be modified if reconsidered in a bargaining framework. In particular, under unemployment the supply of labour tends to be rather elastic, and according to the inverse elasticity rule this suggests that labour should not necessarily be taxed at a higher rate than capital.

Drawing on these studies, one may well argue that our treatment of a proportional wage tax as the only tax instrument makes the short–run employment effects of a balanced–budget policy particularly strong. However, a comprehensive analysis of optimal taxation in our dynamic framework, in particular with respect to the effects of capital taxation, is beyond the scope of this paper and left for future research.

[22] Elmeskov and MacFarlan (1993), p. 84.

[23] For a related discussion in a continuous–time overlapping generations economy see Bertola (1996).

8 Conclusions

We argue in this paper that the disappointing employment record of many OECD countries beginning in the 1970s may have been affected by significant changes in the fiscal stance. In particular, we present some evidence that a lasting weakening of the governments structural balance leads to higher unemployment persistence. To account for this evidence, we present a dynamic general equilibrium model which explores the dynamic interaction between capital formation, fiscal policies, and unemployment resulting from collective wage bargaining.
We consider the effects of two distinct budgetary rules of balanced and unbalanced budgets. Under a strict balanced–budget rule, we show that steady states and their stability features correspond naturally to the perfectly competitive benchmark case, whereas the dynamics tend to be unstable under unbalanced budgets. We analyze how the economy reacts to adverse structural shocks (such as excessive wage setting) under either policy. Under balanced budgets, the government needs to raise taxes which leads on impact to higher unemployment. However, when the shock is over, the recovery of employment is relatively fast due to a more productive asset structure. By contrast, under unbalanced budgets the government leaves taxes unchanged and thereby mitigates adverse employment effects on impact. However, unemployment dynamics are now likely to exhibit more persistence, depending on the strength of crowding out effects. Moreover, when bond dynamics are unstable, low unemployment today will be bought at the expense of higher unemployment at some point in the future. In short, by stressing the effects on the labour market, our paper gives a rigorous account of the merits of unbalanced budgets (when used symmetrically over the cycle) as well as of the dangers (when used inappropriately to postpone adjustments to structural shocks).

Appendix

Proof of the Lemma:
Let $\underline{k}$ be such that $0 < \mu(k, 0) < 1$ (and thus $0 < u(k, 0) < 1$) for all $k \geq \underline{k}$ (such a $\underline{k}$ exists by assumption (A1)). Thus for each $k \geq \underline{k}$ and at a zero tax rate, the public deficit is well defined and positive: $d(k, 0) > 0$. Note that $\mu_\tau > 0$. Since μ tends to infinity as τ tends to $1 - a/w(k)$, the unemployment rate equals unity (and so employment is zero) at some sufficiently high tax rate $\overline{\tau} \in (0, 1 - a/w(k))$ which solves $\mu(k, \overline{\tau}) = 1$. Solving for this value yields $\overline{\tau} = 1 - a/(w(k)(1 - \mu_1(k)))$, with $0 < \mu_1(k) < 1$ and $w(k)(1 - \mu_1(k)) > a$ being satisfied because of $\mu(k, 0) < 1$. Clearly, at $\overline{\tau}$ the deficit $d(k, \overline{\tau})$ is also positive. Using the definition of u, the deficit is positive iff

$$a\pi\mu(k, \tau) > \tau w(k)(1 - \mu(k, \tau)) \ .$$

Using the definition of μ and after some manipulation, this becomes

$$\tau^2 w(k)(1 - \mu_1(k)) + \tau \left(a(1 - \pi\mu_1(k)) - w(k)(1 - \mu_1(k))\right) + a\pi\mu_1(k) > 0 \ . \quad (16)$$

The LHS of (16) has a minimum

$$\tau^*(k) = \frac{w(k)(1 - \mu_1(k)) - a(1 - \pi\mu_1(k))}{2w(k)(1 - \mu_1(k))},$$

with $\tau^*(k) > 0$. The deficit at $\tau^*(k)$ is negative if (16) is satisfied with "$<$"at $\tau^*(k)$. After some manipulations, this amounts to show that

$$4a^2\pi\mu_1(k) < \left(w(k)(1 - \mu_1(k)) - a(1 + \pi\mu_1(k))\right)^2 \ . \quad (17)$$

It is obvious that (17) is fulfilled if a is sufficiently small. We choose some $\overline{a}$ so that (17) is satisfied at $k = \underline{k}$ for all $a \leq \overline{a}$ (this is feasible because of $\mu_1(\underline{k}) < 1$). Since w is increasing and μ_1 is non–increasing in k, (17) is also satisfied at any $k \geq \underline{k}$. Hence, the budget is balanced by two tax rates $0 < \tau_1(k) < \tau_2(k) < \overline{\tau}(k)$ whenever $a \leq \overline{a}$ and $k \geq \underline{k}$. Moreover, since $d_k < 0$ and since $d_\tau < 0$ at $\tau = \tau_1(k)$, we have $\tau_1'(k) < 0$. □

Preliminaries to the proofs of Propositions 2 and 3:
The Jacobian matrix J of (8) and (9) or of (14) and (15) evaluated at a steady state $(\overline{k}, \overline{b})$ with $\overline{b} \geq 0$ and $d = 0$ is given by:

$$J = \begin{bmatrix} \frac{1}{x}\left(s(w_k(1-u) - wu_k) - (1-s)d_k - R_k\overline{b}\right) & -\frac{R}{x} \\ R_k\overline{b} + d_k & R \end{bmatrix}$$

where $x = 1 - u - ku_k - s_R R_k w(1-u) > 0$ and where all functions are evaluated at the steady state. Under (BB), we have $d_k = 0$, whereas $d_k < 0$ under (UB). Moreover,

u_k is replaced by $u_{Bk} = du_B/(dk)$ in case of (BB). Calculating the determinant and trace of J yields

$$\begin{aligned}
\det J &= \frac{sR}{x}(w_k(1-u) - wu_k + d_k) \ , \\
\mathrm{Tr}\, J &= R + \frac{1}{x}\left(s(w_k(1-u) - wu_k + d_k) - d_k - R_k\overline{b}\right) \\
&= R + \frac{\det J}{R} - \frac{d_k + R_k\overline{b}}{x} \ . \qquad (18)
\end{aligned}$$

Clearly, under (BB) $\det J > 0$ and $\mathrm{Tr}\, J > 0$ because of $d_k = 0$, $w_k > 0$, $u_{Bk} < 0$, $R_k < 0$ and $\overline{b} \geq 0$. Under (UB), substituting $d_k = (a + \overline{\tau}w)u_k - \overline{\tau}w_k(1-u)$ reveals that $\det J = (sR/x)(w_k(1-u)(1-\overline{\tau}) - u_k w(1 - \overline{\tau} - a/w)) > 0$ since $1 - \overline{\tau} - a/w > 0$ from the Lemma. Moreover, $\mathrm{Tr}\, J > 0$.

Proof of Proposition 2:
Consider $\overline{b} = 0$. The steady state is a saddle iff $\det J < -1 + \mathrm{Tr}\, J$ which means that

$$\det J < -1 + R + \frac{\det J}{R} - \frac{d_k}{x} \ .$$

Substituting $\det J$ and x and rearranging yields

$$\begin{aligned}
d_k &< (R-1)\left((1-u)(1 - s_R R_k w - s w_k) + u_k(sw - k) - s d_k\right) \\
&= (R-1)((1-u)(1 - \eta_s \eta_R - \eta_w) - s d_k) \ ,
\end{aligned}$$

where the last line uses $s = k/w$ at a steady state with $\overline{b} = 0$. Under the stability assumption (13), this condition is the same as the condition $R > \overline{R}$ stated in Proposition 2. Hence, if this condition is satisfied, the steady state is a saddle and adjustment dynamics are monotone. On the other hand, if $R < \overline{R}$, the steady state is a sink: $\det J > -1 - \mathrm{Tr}\, J$ is clearly satisfied since $\det J$ and $\mathrm{Tr}\, J$ are positive. Moreover, $\det J > -1 + \mathrm{Tr}\, J = -1 + R + \det J/R - d_k/x$ yields

$$\frac{R d_k}{x} > (R-1)(R - \det J) \ ,$$

which implies $\det J < 1$ since $d_k < 0$ and $R < \overline{R} < 1$. Furthermore, it is easy to check that adjustment dynamics to a sink is monotone, i.e. that $4 \det J < (\mathrm{Tr}\, J)^2$ is satisfied.
It remains to be shown that the stable manifold is upward–sloping in (k, b) space whenever the steady state is a saddle. Denote by α the upper left entry of the Jacobian. Then the stable manifold is upward–sloping iff $\lambda_1 < \alpha$. Using the inequality $(\mathrm{Tr}\, J)^2 - 4\det J \geq (R - \det J/R)^2$, we have

$$\lambda_1 = \frac{1}{2}\left(\mathrm{Tr}\, J - \sqrt{(\mathrm{Tr}\, J)^2 - 4\det J}\right) \leq (\alpha + R - R + \det J/R)/2 = (\alpha + \det J/R)/2 \ .$$

Hence, $\lambda_1 < \alpha$ is satisfied if $\det J < \alpha R$. But this is clearly fulfilled since $\det J = \alpha R + R d_k / x < \alpha R$. □

Proof of Proposition 3:
Consider a steady state with $R = 1$ and $\bar{b} > 0$. Using (18), the saddle condition $\det J < -1 + \operatorname{Tr} J$ is equivalent to $(d_k + R_k \bar{b})/x < 0$ which is clearly satisfied under both the (BB) and the (UB) dynamics since $d_k \leq 0$ and $\bar{b} > 0$. Since $\det J$ and $\operatorname{Tr} J$ are positive, both eigenvalues are positive.
Denote by λ_U (λ_B resp.) the stable eigenvalue under (UB) ((BB) resp.) dynamics, and by D_U (D_B) the determinants of the Jacobians. Note first that $D_U < D_B$ iff

$$\frac{w_k(1-u) - w u_k + d_k}{1 - u - k u_k - s_R R_k w(1-u)} < \frac{w_k(1-u) - w u_{Bk}}{1 - u - k u_{Bk} - s_R R_k w(1-u)} .$$

Because of $d_k < 0$ and $u_k > u_{Bk}$, this is satisfied whenever the function $h(v) = (w_k(1-u) - wv)/(1 - u - kv - s_R R_k w(1-u))$ is decreasing. But this is the case since the stability condition (13) is satisfied, and thus $D_U < D_B$. We also have $\lambda_U < \lambda_B$ if

$$T_U - \sqrt{(T_U)^2 - 4D_U} < T_B - \sqrt{(T_B)^2 - 4D_B} \tag{19}$$

holds, where $T_U = 1 + D_U - (d_k + R_k \bar{b})/x_U$ and $T_B = 1 + D_B - R_k \bar{b}/x_B$ denote the trace under (UB) and (BB). Since $x_B > x_U > 0$, $0 > R_k \bar{b}/x_B > (d_k + R_k \bar{b})/x_U$, and since the LHS in (19) is decreasing in T_U, (19) is satisfied if $\varphi(D_U) < \varphi(D_B)$ where

$$\varphi(D) = 1 + D - \frac{R_k \bar{b}}{x_B} - \sqrt{\left(1 + D - \frac{R_k \bar{b}}{x_B}\right)^2 - 4D} .$$

The function φ is increasing in D whenever $\varphi(D) < 2$ which is clearly satisfied at $D = D_B$ because of $\lambda_B < 1$. Hence, φ is increasing also at all $D \leq D_B$. In particular, since $D_U < D_B$, $\varphi(D_U) < \varphi(D_B)$ is satisfied. Hence, $\lambda_U < \lambda_B$. □

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