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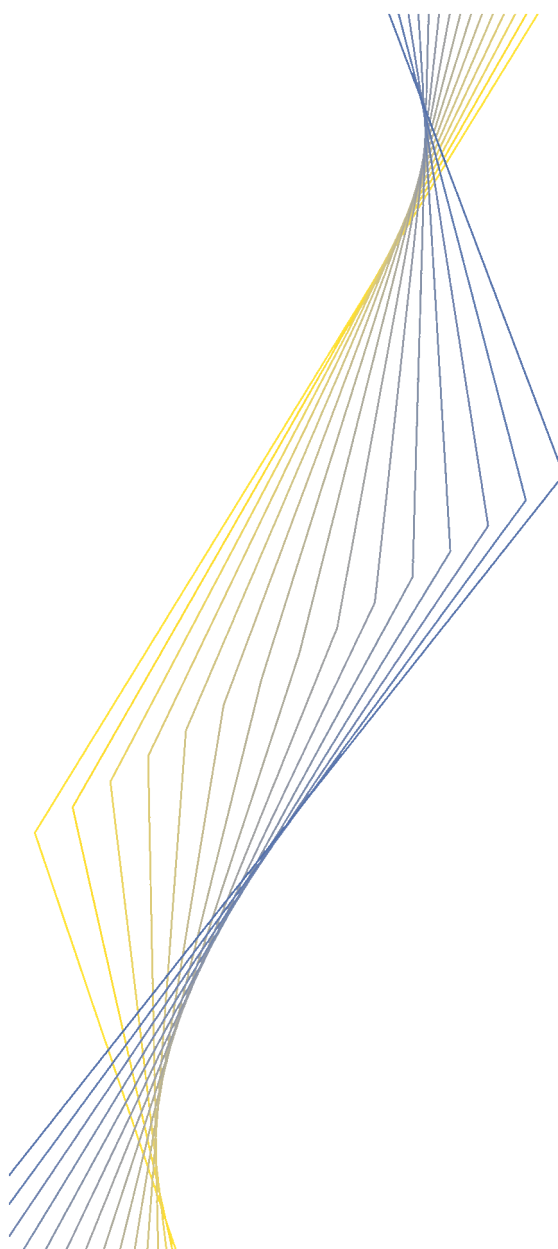
BY WOUTER J. DENHAAN

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TEMPORARY SHOCKS AND UNAVOIDABLE TRANSITIONS TO A HIGH-UNEMPLOYMENT REGIME[1]

BY WOUTER J. DENHAAN[2]

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2 London Business School, UC San Diego, CEPR, and NBER, Correspondence address: Department of Economics, London Business School, Regent's Park, London NW1 4SA, UK. E-mail: wdenhaan@london.edu.

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Abstract

This paper develops a model with multiple steady states (low tax and unemployment rate versus high tax and unemployment rate) in which equilibrium selection is not conditioned on a sunspot variable. Instead, large enough shocks initiate unavoidable transitions from one regime to the other. The predictions of this paper are consistent with the persistent increase of European unemployment rates observed during the seventies. The explanation given is that even if the unemployment rate would decrease it can only do so gradually because of matching frictions which in turn implies that the tax burden remains high and job creation remains low making the return to a low unemployment rate impossible. The paper shows that in some cases transition to the low-unemployment regime is not possible when tax rates are adjusted each period to balance the budget even though this would be possible under an alternative policy with lower tax rates and (temporary) budget deficits.

Key Words: Multiple Equilibria, Matching Model, Unemployment Benefits, Tax Burden, Fiscal Policy.

JEL Classification: D50, C62, E24, E62, J64.

Non-Technical Summary

In this paper we develop a labor-market matching model with two possible regimes or long-run outcomes. In one regime, unemployment rates are low and consequently the government's obligations to pay unemployment benefits are low. This implies a low tax burden. Low tax rates correspond to low breakup margins of existing jobs, low rejection margins of new jobs, and indeed a low unemployment rate. In the other regime, high tax rates imply high breakup and rejection margins and, thus, high unemployment rates. We will show that it is possible that both regimes are persistent in which case the economy will not automatically move from one regime to the other. The model, thus, can explain why high unemployment rates can be so persistent. It is important to understand that the environment in both regimes is assumed to be identical. Nevertheless the two outcomes differ substantially. Models with both a high-activity and a low-activity equilibrium are not uncommon in the modern business-cycle literature. An important question is why some economies end up in the undesirable high-unemployment equilibrium while other economies do not or why the same country goes through sustained periods with low unemployment rates followed by long periods of high unemployment rates. The literature has not provided convincing mechanisms that can explain this. Instead of providing an explanation within the model, the outcome is typically simply assumed to be random. Another important question is whether the government can influence in which equilibrium the economy is going to end up. Both questions are addressed in this paper.[1]

In contrast to the papers in the literature, this paper carefully models the dynamic aspects of the labour market and in particular incorporates a matching friction to model the fact that searching for an appropriate new job is costly and takes time. This innovation makes it possible to understand why some economies end up in a high-unemployment equilibrium and why it is so difficult to get out of this situation.

Suppose that an economy is in the low-unemployment regime when some temporary adverse shocks increase the unemployment rate. The paper shows that if the shocks are large enough, the transition to the high-unemployment regime is unavoidable. The idea is the following. Because of the matching friction unemployment will necessarily remain high in some of the ensuing time periods. This increase in the number of unemployed will increase the liability of the government to pay benefits *even* if future job creation and job destruction rates immediately return to their pre-shock levels, that is, even if the economy would converge back to the low-

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[1]The description at the beginning of this paragraph makes clear that a harsh way to eliminate the high-unemployment regime is to abolish unemployment benefits but such a drastic change in policy will not be considered. Instead we will focus on alternative policies to finance unemployment benefits.

unemployment regime. If the temporary increase in the number of unemployed and the magnitude of unemployment benefits leads to a big enough increase in tax rates, however, then it wouldn't be advantageous to start or continue marginal jobs and destruction and creation rates would have to change. Consequently, the economy cannot convergence back towards the low-unemployment regime and instead has to converge towards the high-unemployment regime.

In the last paragraph we described a situation in which a burst of destruction leads to an increase in the total amount of unemployment benefits the government has to finance and, thus, to an increase in the tax burden. If the increase in the tax rate is minor then job destruction and job creation rates will quickly return to their pre-shock levels and the economy will converge back towards the low-unemployment regime. How large the increase in the tax rate is depends on the type of tax policy used to finance the increase in unemployment benefits. One possibility would be to finance unemployment benefits out of current taxes and, thus, keep the budget deficit balanced period by period. In this case a sudden increase in the unemployment rate necessarily leads to a sharp increase in tax rates. Alternatively, the increase in unemployment benefits can be financed by a combination of both debt financing (future taxes) and current taxes. This policy leads to (temporary) budget deficits but limits the increase in the tax rate, which can have substantial benefits. For example, it is possible that when the budget has to be balanced period by period and current tax rates are increased to finance the increase in total transfers, the increase (decrease) in the job destruction (creation) rate leads to a further increase in the unemployment rate and, thus, a further increase in the tax rate. If on the other hand the initial increase in total transfers is financed out of both an increase in current taxes and by issuing bonds, it is possible that job destruction and creation rates are not affected and the unemployment rate quickly recovers.

1 Introduction

Models with both a high-activity and a low-activity steady-state equilibrium that are sustained by macroeconomic complementarities have played an important role in the modern business-cycle literature. Exemplary papers that model this idea are Bryant (1983) and Cooper and John (1988). In a dynamic framework the switching between the two regimes is typically conditioned on a sunspot variable. Although the idea of external stochastic shocks is appealing, relying on sunspot variables has disadvantages because they are hard to identify and the sign of the effect of the sunspot variable is indeterminate.[2] This paper contributes to this literature by providing a framework in which temporary changes in productivity, through its effect on the stock of unemployed, control the dynamics of the system. In particular, temporary shocks can induce an inevitable transition from one steady state to the other.[3]

In this paper we develop a labor-market matching model with a low and a high-unemployment steady state. In one steady-state, unemployment rates are low and consequently the government's obligations to pay unemployment benefits are low. This implies a low tax burden. Low tax rates correspond to low breakup margins of existing jobs, low rejection margins of new jobs, and indeed a low unemployment rate. In the other steady state, high tax rates imply high breakup and rejection margins and, thus, high unemployment rates.[4] We will show that it is possible that both steady states are unique continuation equilibria in the sense that the belief to move to the other steady state is not self-fulfilling.

If steady states are unique continuation equilibria, then the economy will converge back to the original steady state after a small shock. If the shock is large enough, however, this is not the case. The idea is the following. Suppose the economy is in the low-unemployment steady state and in response to a *one-time* negative shock there is a sudden increase in the rate of job destructions and the unemployment rate. Because of the matching friction unemployment will remain high in some

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[2]For example, in a model in which nominal money surprises have no effect, they still could have a positive effect on output if they serve as a sunspot variable. See Farmer (1997). In general, however, an equally valid solution is one where a positive monetary surprise has a *negative* effect on output.

[3]In Den Haan, Ramey, and Watson (2002), the number of relationships between borrowers and lenders serves a similar role, that is, a large enough decline in the number of relationships necessarily leads to a total collapse.

[4]Blanchard and Summers (1987) also develop a model with two such steady states. In contrast to Blanchard and Summers (1987), the focus here is on dynamics and the contribution of this paper is to document that in a matching framework the value of the unemployment rate, which is a state variable in this framework, may uniquely determine the equilibrium time path.

of the ensuing time periods as well. This increase in the number of unemployed will increase the liability of the government to pay benefits *even* if future job creation and job destruction rates immediately return to their pre-shock levels, that is, even if the economy would converge back to the good steady state. If the temporary increase in the number of unemployed and the magnitude of unemployment benefits leads to a big enough increase in tax rates, however, then it wouldn't be advantageous to start or continue marginal jobs and destruction and creation rates would have to change. Consequently, the economy doesn't convergence back towards the low-unemployment steady state and has to converge towards the high-unemployment steady state. For intermediate shocks multiple equilibrium time paths are possible and the economy could either converge back to the low-unemployment steady state or converge to the high-unemployment steady state.

We will compare the fiscal policy under which budget deficits are always equal to zero and unemployment benefits are financed out of current-period taxes with fiscal policies that allow the government to have temporary budget deficits.[5] Under the latter policy, the present value of revenues is assumed to equal the present value of expenditures. If the economy is pushed out of the low-unemployment steady state because of a large negative shock, then it is more likely that the economy will move to the high-unemployment regime under the balanced-budget fiscal policy. Recall from the discussion above that because of the matching friction unemployment rates cannot immediately return to their pre-shock levels even when productivity would do so. Now consider the favorable outcome where destruction rates and creation rates immediately return to their pre-shock levels and the unemployment rate, thus, steadily declines towards its value in the low-unemployment steady state. Under the balanced-budget fiscal policy tax rates would follow the pattern followed by the unemployment rate, that is, they would sharply increase in the period of the shock and then steadily decline. The tax rate at which the present values of the government's revenues and expenses are equal is initially lower then the tax rate under the balanced-budget fiscal policy, since this policy takes into account that future unemployment rates are declining. This means that the net benefits of creating a new job are initially lower under the balanced-budget fiscal policy. It is, thus, possible that these net benefits under the balanced-budget fiscal policy are negative in which case moving back towards the low-unemployment steady state would not be an equilibrium outcome while under the alternative fiscal policy these net benefits are still positive and the economy could converge back towards the low-unemployment steady state. A policy that insists on a balanced budget (or low deficits) may, thus, prevent the economy from moving back to the low-unemployment steady state.

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[5]Productive income, unemployment benefits, and leisure are taxed at different rates. Consequently, the model does not satisfy the Ricardian-equivalence property and tax policy matters.

We show that the predictions of the model are consistent with the high European unemployment rates in the postwar period. During the 1950's and 1960's, the unemployment rate in both Europe and the U.S. was on average below five percent and was in the U.S. somewhat higher than in Europe. In response to steep increases in oil prices unemployment increased sharply during the 1970's on both continents. In Europe unemployment rates remained high in the two following decades, while in the U.S. they returned to their earlier low levels. The divergent behavior has been termed the "European unemployment puzzle". Obviously, a variety of institutional factors distinguishes Europe from the U.S., including strong unions, minimum wages, generous unemployment benefits, and strong employment protection. The presence of these institutional differences is by itself not a convincing explanation for the differences in unemployment rates observed during the last two decades since they have been present throughout the postwar era. Several recent papers explain the European unemployment puzzle with models in which unemployment rates remain low in the presence of "employment-unfriendly" institutions as long as economic conditions are good but in which they increase if conditions deteriorate. In contrast, in countries with "employment-friendly" institutions the unemployment rate remains low if economic conditions deteriorate.[6] Several candidates for the exogenous change in the economic environment are given in the literature.[7]

In this paper the wedge between taxes on productive income and unemployment benefits increases when the economy moves from the low-unemployment steady state to the high-unemployment steady state. This is exactly the deterioration in economic conditions used in Daveri and Tabellini (2000) to explain the European unemployment puzzle using both an empirical analysis and a theoretical model. Although similar in spirit, this paper distinguishes itself from Daveri and Tabellini (2000) and the recent literature in two important aspects. First, the long-term changes predicted by the model proposed here are not in response to a change in an *exogenous* variable,[8] but are the endogenous response to a temporary shock. Second, in this

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[6]Similarly, in this paper the high-unemployment steady state does not exist if the replacement rate (i.e., the level of unemployment benefits to the predisplacement wage level) is low.

[7]Ljungqvist and Sargent (1998) consider a long-term rise in economic turbulence, manifested in greater skill loss for displaced workers; Marimon and Zilibotti (1999) consider skill-biased technology improvements; Mortensen and Pissarides (1999) consider an increase in the variability of idiosyncratic productivity shocks; Daveri and Tabellini (2000) consider an increase in the tax wedge between labor income and unemployment benefits; Hornstein, Krusell, and Violante (2000) consider a long-term increase in embodied productivity; and Den Haan, Haefke, and Ramey (2001) consider a long-term rise in real interest rates, an increase in tax rates, and a decrease in the growth rate of disembodied total-factor-productivity.

[8]This is not supposed to mean that (exogenous) changes in, for example, TFP growth rates did not occur and are not part of the explanation to the European unemployment puzzle. To simplify the discussion, however, these effects are not included in the model.

paper the 1970's play a key role in the explanation of the behavior of European unemployment rates in the 1980's and 1990's. In recently developed models the high European unemployment rates are caused by an exogenous change in the economic environment that is not related–at least not directly–to the experience of the 1970's. In contrast, in the proposed model a large enough increase in the number of unemployed, such as the increase observed during the 1970's, necessarily leads to a new steady-state with high unemployment. This paper formalizes the view in Lindbeck (1996) that "... *once high unemployment has emerged, basic structures and mechanisms in West European societies tend to perpetuate it.*"

This paper focuses on the externality generated by unemployment benefits and tax rates. There may very well be other negative externalities associated with a decrease in unemployment levels. For example, one can imagine that at lower aggregate employment levels research and development is lower which is likely to have spill-over effects. The predictions of the framework developed in this paper would apply to such an externality as well.

This paper is organized as follows. In Section 2 we develop the benchmark model. Section 3 discusses the steady states and Section 4 considers the response of the economy to small and large temporary shocks. In Section 5 we show that the proposed framework can be used to understand the behavior of European unemployment rates.

2   Model

The model used in this paper is a job-market matching model similar to the one developed in Mortensen and Pissarides (1994). In Section 2.1 we describe the productive relationship between a worker and an entrepreneur, in Section 2.2 we describe the matching market, in Section 2.3 we define the surplus, in Section 2.4 we describe fiscal policy, and in Section 2.5 we give the equilibrium conditions. In Section 2.6, we discuss an extension of the model with creation and destruction costs and in Section 2.7 we discuss the related literature.

2.1   Employment Relationships

Production takes place within employment relationships consisting of one worker and one firm, who interact through discrete time until the relationship is severed. In this economy there are low-productivity relationships with low-skilled workers and high-productivity jobs with high-skilled workers. To simplify the model the skill level of a worker is given at birth and fixed throughout the worker's life. A relationship produces output z per period, where z is a stochastic variable and the three possible

realizations for z satisfy $z_{l,1} < z_{l,2} < z_h$. Low-productivity relationships can only attain values of $z_{l,1}$ and $z_{l,2}$ and when such a relationship is first formed, an initial value equal to z is drawn with probability $p^n(z)$. For ongoing low-productivity relationships the probability that next period's value of z is equal to $z_{l,j}$ when the current value of z is given by $z_{l,i}$ is given by the transition function $p(z_{l,j}|z_{l,i})$ with $i, j \in \{1, 2\}$. New and continuing relationships with a high-skilled worker always produce z_h.[9]

Both types of relationships may experience an *exogenous breakup* that occurs with probability ρ_l^x for low-skilled workers and with probability ρ_h^x for high-skilled workers. Exogenous breakups reflect events that permanently destroy the productivity of the relationship, e.g., market conditions may shift adversely. Alternatively, exogenous breakups can capture changes in workers' personal circumstances that lead them to change jobs. Assume that exogenous separations cannot occur in the period that a relationship is newly formed. After the current-period productivity parameter is determined, the worker and firm decide whether to continue or sever their relationship. If the worker and firm agree to sever their relationship following a switch, or if exogenous separation occurs, then they each enter a matching market in which new employment relationships are formed. In addition, workers and entrepreneurs are subject to shocks that induce retirement, occurring at the end of a period. Let ρ^r denote the probability of retirement. For simplicity we assume that a retirement shock hits both partners in the relationship simultaneously. A retiring agent leaves the labor market and obtains a future value of zero.

2.2 Matching Market

New employment relationships are formed on a matching market. In our model there are low and high-productivity workers and entrepreneurs with projects for either low-productivity or high-productivity workers.[10] There is a unit mass of workers and a unit mass of entrepreneurs. The fraction of low-productivity workers in the labor force ϕ, is equal to the fraction of low-productivity projects. Whether a worker has low or high productivity is determined at birth and cannot be changed. We assume that low-productivity and high-productivity workers find jobs on separate matching markets. These assumptions imply that in both matching markets the ratio of the mass of unemployed to the mass of vacancies is constant. This together with the assumption of a homogeneous of degree one matching function implies fixed match-

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[9] What matters for the numerical results considered here is that all high-productivity jobs are immune to the changes in the tax rates not that z_h is not stochastic.

[10] For simplicity we assume that low-productivity workers are not productive in a high-productivity project and vice versa.

ing probabilities. For low-productivity workers the matching probability is denoted by λ_l and for the high-productivity workers by λ_h. Each period, a proportion ρ^r of the workers leaves the labor force through retirement, replaced by an identical number of new entrants that flow into the unemployment pool.[11] Further, established workers enter the unemployment pool when their employment relationships are severed. While they are unemployed, workers receive unemployment benefits equal to r_k and a not-taxable benefit representing the disutility of working equal to b_k, with $k \in \{l, h\}$.

2.3   Surplus Level

A worker and entrepreneur in an ongoing relationship choose to continue their relationship if the value of z is sufficiently high. We assume that the value of z_h is sufficiently high so that high-productivity jobs are never severed. The worker and firm bargain efficiently over the terms of their relationship, and thus they make acceptance and continuation decisions that maximize their *joint surplus.* The joint surplus for a low-productivity job can be written as

$$s_{l,t}(z) = (1 - \tau_{e,t}(z))\, z + g_{l,t}(z) - b_l + (1 - \tau_{u,t}(r_l))r_l - w^w_{l,t} - w^f_{l,t} \qquad (1)$$

for z equal to $z_{l,1}$ and $z_{l,2}$. Here $\tau_{e,t}(x)$ is the tax rate on productive income equal to x in period t and $\tau_{u,t}(x)$ is the tax rate on unemployment benefits equal to x, $g_{l,t}(z)$ denotes the future joint value from continuing the relationship when the current productivity level is equal to z, $w^w_{l,t}$ denotes the (low-productivity) worker's discounted future benefits from entering the unemployment pool in the current period, and $w^f_{l,t}$ denotes the (low-productivity) entrepreneur's discounted future benefits from entering the matching market in the current period. The functions $s_{l,t}(z)$, $\tau_{e,t}(z)$, $\tau_{u,t}(b)$, $w^f_{l,t}$, $w^f_{h,t}$, $w^w_{l,t}$, and $w^w_{h,t}$ are indexed by t to indicate their dependence on the current and expected future distribution of agents over the different employment and unemployment categories.[12]

In equilibrium, $s_{l,t}(z)$ is an increasing function of z,[13] and there exists a cutoff level, $\underline{z}_{l,t}$, such that relationships with a value of z bigger than or equal to $\underline{z}_{l,t}$ have a non-negative surplus and, thus, continue the relationship, while relationships with a value of z less than $\underline{z}_{l,t}$ have a negative surplus and break up. The cutoff level is

---

[11] A fraction ϕ of all new borns have low-productivity skills.

[12] To be precise, the variables $s_{l,t}(z)$, $w^f_{l,t}$, $w^f_{h,t}$, $w^w_{l,t}$, and $w^w_{h,t}$ only depend on current and future tax rates but indirectly depend on characteristics of the cross-sectional distribution because tax rates do.

[13] At least when the tax policy is such that $(1 - \tau_e(z))z$ is increasing in z.

the level of z at which the surplus, $s_{l,t}(z)$, is equal to zero. Thus,

$$s_{l,t}(\underline{z}_{l,t}) = 0. \tag{2}$$

If there are no costs to destroy or create a match, the cutoff level for newly matched relationships is equal to the cutoff level for continuing relationships. Analogous equations can be written down for the cutoff level for high-productivity relationships, $\underline{z}_{h,t}$, but these are not that interesting since we assume that z_h is always bigger than $\underline{z}_{h,t}$.

2.4 Fiscal Policy

Throughout the paper we assume that tax rates on productive income are equal for all agents (that is, $\tau_{e,t}(z) = \tau_t$), and that the tax rate on unemployment benefits is equal to $\psi \tau_t$, where ψ has a value less than one to capture the empirical fact that tax rates on benefits are lower than those on productive income.[14] We will consider two opposite extreme cases on how the government chooses debt and tax rates to finance unemployment benefits. Under the first policy the government only uses current tax revenues to finance unemployment benefits, which means that the government's budget is balanced period by period. In this case, tax rates are solved from

$$\tau_t \left[\sum_{j=1}^{2} z_{l,j} e_{l,j,t} + z_h e_{h,t} \right] = gov + (1 - \psi \tau_t) \left[r_l u_{l,t} + r_h u_{h,t} \right], \tag{3}$$

where gov is the level of per capita government expenditures which is assumed fixed, $e_{l,j,t}$ denotes the mass of employed workers with productivity level $z_{l,j}$, $j \in \{1, 2\}$ in period t, $e_{h,t}$ denotes the mass of employed high-productivity workers, $u_{l,t}$ denotes the mass of low-skilled unemployed workers, and $u_{h,t}$ denotes the mass of high-skilled unemployed workers. We will refer to this policy as the *balanced-budget* fiscal policy. We also consider the fiscal policy where the government sets a constant tax rate, $\tau_t = \tau$, such that the present value of current and future tax revenues is equal to the present value of current and future transfers to the unemployed plus the amount of outstanding government debt. That is,

$$\begin{aligned} \tau \left[\sum_{k=0}^{\infty} \sum_{j=1}^{2} \beta^{t+k-1} \left[z_{l,j} e_{l,j,t+k} + z_h e_{h,t+k} \right] \right] = \\ d_t + \sum_{k=0}^{\infty} \beta^{t+k-1} \left[gov + (1 - \psi \tau) \left(r_l u_{l,t+k} + r_h u_{h,t+k} \right) \right], \end{aligned} \tag{4}$$

where d_t is the amount of outstanding government debt at the beginning of period t. We will refer to this policy as the *balanced-NPV* policy. Under both the balanced-budget and the balanced-NPV policy, the government sets tax rates taking the level

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[14]See Section 5 below.

of unemployment benefits and government expenditures as well as the expectations of the agents as given and we will, therefore, refer to these as *passive* policies. We will compare those with a fiscal policy in which the government commits to a sequence of tax rates. Since decisions of the private sector affect the government's obligation to pay out unemployment benefits and its revenues, a credible commitment to a sequence of tax rates would require that–if necessary–the government would adjust government expenditures to satisfy 4. We will refer to this fiscal policy as the *active credible-commitment* fiscal policy.

2.5 Equilibrium

In this section we discuss equilibrium values for $g_{l,t}(z)$, $g_{h,t}$, $w_{l,t}^w$, $w_{h,t}^w$, $w_{l,t}^f$, $w_{h,t}^f$, and steady-state conditions for the distribution over the different employment and productivity categories. The joint value from continuing a low-productivity relationship is equal to

$$g_{l,t}(z) = \beta(1 - \rho^r) \left[\begin{array}{c} (1 - \rho^x) \left\{ \sum_{j=1}^2 s_{l,t+1}(z_{l,j}) I_{\underline{z}_{l,t+1}}(z_{l,j}) p(z_{l,j}|z) \right\} + \\ b_l + (1 - \psi\tau_{t+1})r_l + w_{l,t+1}^w + w_{l,t+1}^f \end{array} \right] \qquad (5)$$

for z equal to $z_{l,1}$ and $z_{l,2}$. Here $I_{\underline{z}_{l,t}}(z)$ is an indicator function with a value equal to 1 if $z \geq \underline{z}_{l,t}$ and a value equal to 0 otherwise. Similarly,

$$g_{h,t} = \beta(1 - \rho^r) \left[\begin{array}{c} (1 - \rho^x)s_{h,t+1}(z_h) + \\ b_h + (1 - \psi\tau_{t+1})r_h + w_{h,t+1}^w + w_{h,t+1}^f \end{array} \right]. \qquad (6)$$

The continuation values for low-productivity workers and entrepreneurs with low-productivity projects leaving the current period in the matching market satisfy

$$w_{l,t}^w = \beta(1 - \rho^r) \left[\begin{array}{c} \lambda_l \left\{ \sum_{j=1}^2 \pi s_{l,t+1}(z_{l,j}) I_{\underline{z}_{l,t+1}}(z_{l,j}) p^n(z_{l,j}) \right\} \\ + b_l + (1 - \psi\tau_{t+1})r_l + w_{l,t+1}^w \end{array} \right] \text{ and} \qquad (7)$$

$$w_{l,t}^f = \beta(1 - \rho^r) \left[\lambda_l \left\{ \sum_{j=1}^2 (1 - \pi)s_{l,t+1}(z_{l,j}) I_{\underline{z}_{t+1}}(z_{l,j}) p^n(z_{l,j}) \right\} + w_{l,t+1}^f \right]. \qquad (8)$$

Similarly, the continuation values for the high-productivity workers and entrepreneurs are equal to

$$w_{h,t}^w = \beta(1 - \rho^r) \left[\lambda_h \pi s_{h,t+1}(z_h) + b_h + (1 - \psi\tau_{t+1})r_h + w_{h,t+1}^w \right], \qquad (9)$$

$$w_{h,t}^f = \beta(1 - \rho^r) \left[\left\{ \lambda_h \left\{ (1 - \pi)s_{h,t+1}(z_h) \right\} + w_{h,t+1}^f \right\} \right]. \qquad (10)$$

Here π is the bargaining weight of the worker and λ_l and λ_h are the matching probabilities for the low-productivity and the high-productivity workers (and entrepreneurs) respectively.

The equations determining the law of motion of the unemployment rate and distribution over the different productivity levels are straightforward but somewhat tedious. We, therefore, only give the equations to determine steady-state levels. The following five equations can be used to solve for the steady-state values of u_l, u_h, $e_{l,1}$, $e_{l,2}$, and e_h. An equal flow of workers into and out of the matching markets for low-productivity workers requires

$$
\begin{aligned}
\phi \rho^r + (1 - \rho^r)\rho^x(e_{l,1} + e_{l,2}) + \\
(1 - \rho^r)(1 - \rho^x)\sum_{i=1}^{2}\sum_{j=1}^{2}(1 - I_{\underline{z}_l}(z_{l,j}))p(z_{l,j}|z_{l,i})e_{l,i} = \\
\left[\rho^r + (1 - \rho^r)\lambda_l \sum_{j=1}^{2} I_{\underline{z}_l}(z_{l,j})p^n(z_{l,j})\right]u_l.
\end{aligned} \tag{11}
$$

An equal flow into and out of the matching market for high-productivity workers requires

$$
(1 - \phi)\rho^r + (1 - \rho^r)\rho^x e_h = \left[\rho^r + (1 - \rho^r)\lambda_h\right]u_h. \tag{12}
$$

An equal flow of workers into and out of relationships with productivity level $z_{l,1}$ requires

$$
\begin{aligned}
(1 - \rho^r)\lambda_l I_{\underline{z}_l}(z_{l,1})p^n(z_{l,1})u_l + (1 - \rho^r)(1 - \rho^x)I_{\underline{z}_l}(z_{l,1})p(z_{l,1}|z_{l,2})e_{l,2} = \\
\left[\rho^r + (1 - \rho^r)\rho^x + (1 - \rho^r)(1 - \rho^x)p(z_{l,2}|z_{l,1})\right]e_{l,1}.
\end{aligned} \tag{13}
$$

An equal flow of workers into and out of relationships with productivity level $z_{l,2}$ requires

$$
\begin{aligned}
(1 - \rho^r)\lambda_l I_{\underline{z}_l}(z_{l,2})p^n(z_{l,2})u_l + (1 - \rho^r)(1 - \rho^x)I_{\underline{z}_l}(z_{l,2})p(z_{l,2}|z_{l,1})e_{l,1} = \\
\left[\rho^r + (1 - \rho^r)\rho^x + (1 - \rho^r)(1 - \rho^x)p(z_{l,1}|z_{l,2})\right]e_{l,2}.
\end{aligned} \tag{14}
$$

Finally an equal flow of workers into and out of relationships with productivity level z_h requires

$$
(1 - \rho^r)\lambda_h u_h = \left[\rho^r + (1 - \rho^r)\rho^x\right]e_h. \tag{15}
$$

2.6   Destruction and creation costs

In this section we introduce destruction and creation costs. Of course there is an empirical motivation to include these costs; creation of a new job obviously requires some setup costs and in Europe there are nontrivial costs associated with the elimination of positions. If these costs are substantial then it seems like a bad idea to ignore them in a paper that focuses on transitions between steady

states. For example, in a steady state destruction costs are not important but during the transition from the low-unemployment steady state to the high-unemployment steady state they obviously are important. Similarly, during the transition out of the high-unemployment equilibrium creation costs play a crucial role. In the presence of these types of costs the surplus of a continuing match, $s^o(z)$, differs from the surplus of a newly created match, $s^n(z)$. In particular,

$$s^o_{l,t}(z) = (1 - \tau_t)\, z + g_{l,t}(z) - b_l + (1 - \psi \tau_t)r_l - w^w_{l,t} - w^f_{l,t} + \zeta^{des},$$

where ζ^{des} stands for the destruction costs. Similarly,

$$s^n_{l,t}(z) = (1 - \tau_t)\, z + g_{l,t}(z) - b_l + (1 - \psi \tau_t)r_l - w^w_{l,t} - w^f_{l,t} - \zeta^{cre},$$

where ζ^{cre} stands for the creation costs.

2.7 Related literature

The paper by Morris and Shin (2000) also takes on the task to derive determinate predictions from a model with externalities without relying on sun spots. In this paper the authors focus on a fairly standard model of bank runs with a low-withdrawal and a high-withdrawal steady state but propose a modification such that the equilibrium is uniquely determined by the value of the fundamental variable. There is still a sense of having two regimes because the fraction of withdrawals is a discontinuous function of the fundamental state variable. In contrast, in this paper all fundamental exogenous variables have the same values in both steady states. The time paths, however, are typically (but not always) unique. Whether the economy is on a time path towards the low-unemployment or the high-unemployment steady state is determined by the magnitude of the unemployment rate and, thus, by current *and past* realizations of the fundamental variables.

The idea of this paper that a state variable will determine to which of the steady states the economy will converge resembles those developed in the growth literature.[15] Because of the matching friction, the number of employed becomes a state variable and plays a role similar to capital in the growth literature. There are, however, differences between the number of employed and the capital stock as state variable. Burst of destructions can easily lead to sharp reductions in the number of unemployed. Except in response to drastic events such as wars, it is hard to think of similar destructions in capital. The frameworks developed in the growth literature with multiple steady states are, therefore, unlikely to be used for business cycle analysis.

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[15]See, for example, Zilibotti (1995).

The idea that the increase in European unemployment rates observed during the seventies was key in understanding the high unemployment rates in the following decades is, of course, not new.[16] The seventies are also key in those papers that are based on the assumption that the skills of unemployed workers deteriorate to such an extent that they cannot find attractive employment when aggregate productivity levels have recovered (hysteresis). The hysteresis explanation, however, cannot explain why a large fraction of the unemployed in Europe are young and formerly unskilled workers.[17]

3 Steady states

In Section 3.1, we document the values of some key variables in the two steady states. In Section 3.2, we address whether a change in agents' expectations without an accompanying change in a fundamental variable can drive the economy out of a steady state. The type of fiscal policy implemented is important for the answer to this question. If a change in expectations by itself cannot drive the economy out of the steady state then we say that staying in the steady state is the unique continuation equilibrium. In the first two subsections fiscal policy is passive and the government takes the expectations of the private sector as given when it sets tax rates. In Section 3.3 we consider a tax policy where the government moves first and commits to a particular tax rate.

3.1 Properties of the two steady states

Table 1 reports the three sets of parameter values used in the numerical examples. The first parameter set is characterized by a low discount factor, $\beta = 0.8$, and there are no destruction or creation costs. In the second column the discount factor has a more realistic value, $\beta = 0.98$, and again there are no destruction or creation costs. In the third column the discount factor also has a value equal to 0.98 but there are positive destruction and creation costs. Motivation for the choice of parameter values will be given later in this section and in Section 5. Also, for all three sets of parameter values, the steady-state values of the tax rates and unemployment rates are the same. In particular, the two steady states always have the following properties. In both the low-unemployment and the high-unemployment steady state there is some unemployment due to the entrance of new workers and exogenous job destruction. In

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[16]See, for example, Lindbeck (1996).

[17]See Table 22 in Nickell and Layard (1999) documents for information on male unemployment rates by education and see Table 3 in Machin and Manning (1999) for information on the composition of longterm unemployment by age.

the low-unemployment regime this is the only source of unemployment. For this to be an equilibrium it is necessary that the surplus of all relationships be positive. In the high-unemployment regime no low-productivity workers are employed. For the high-unemployment steady state to be an equilibrium it is sufficient that either the surplus of low-productivity relationships operating at both $z_{l,1}$ and $z_{l,2}$ is negative or alternatively the surplus of only those low-productivity relationships operating at $z_{l,1}$ is negative and no new relationships start at $z_{l,2}$.[18] It is easy to find parameter values such that the model has these two steady-state equilibria.[19]

Table 2 documents the unemployment rates and tax rates for the examples used in this paper. The unemployment rates are equal to 4.7% and 13.5% in the low-unemployment and high-unemployment steady state, respectively. This substantial increase in the unemployment rate corresponds to an increase in the tax rate from 29.9% to 35.5%. An increase in the tax rate of 5.6 percentage points, while not humongous, is high enough to drive the marginal jobs out of existence. There are two reasons for this increase in the tax rate. The first is an increase in total transfers to the unemployed, which is responsible for 3.8 percentage points. But even if total transfers would have remained the same there would have been an increase in the tax rate since total productive income has been reduced, so a higher tax rate is needed for the same amount of per capita government expenditures.

3.2 Unique continuation equilibrium

In this section we address the question of whether the steady-state equilibria described above are unique continuation equilibria.[20] We start in section 3.2.1 by discussing the properties of the economic environment that affect the answer to this question. Particularly important is fiscal policy, and in section 3.2.2 we discuss in more detail whether staying in the steady state is the unique continuation equilibrium under passive fiscal policies.

3.2.1 Properties that affect uniqueness of equilibrium

This section focuses on the question whether staying in the steady state is a unique continuation equilibrium under at least one type of passive fiscal policy. It might, therefore, be worthwhile to start with an example in which staying in the steady

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[18]The reader never has to worry about the high-productivity relationships, because for the parameter values considered here, the surplus of high-productivity relationships always remains positive.

[19]Basically, for a high-unemployment equilibrium to exist b_l and/or r_l have to be high enough.

[20]In the appendix we describe in more detail the procedures used to check whether staying in the steady state is a unique continuation equilibrium.

states is *not* a unique continuation equilibrium under either fiscal policy. This is easier to do for the low than for the high-unemployment steady state, since a large number of jobs can be destroyed instantaneously but the creation of jobs takes time even under favorable economic conditions. Suppose both creation and destruction costs are equal to zero and that the other parameter values are such that the surplus values at both low-productivity levels are negative in the high-unemployment steady state and positive in the low-unemployment steady state. In this case the low-unemployment steady state is not an unique continuation equilibrium. To see why, suppose the system is in the low-unemployment steady state, but all agents expect to move instantaneously to the high-unemployment steady state. That is, agents expect the unemployment and tax rate to increase instantaneously to the values they take on in the high-unemployment steady state. The values for the surplus of low-productivity relationships are then negative and low-productivity relationships would indeed immediately break up.

Above the assumption was made that destruction costs are zero. But note that destruction costs make it less likely for existing low-productivity relationships to break up and, thus, make it less likely for the economy to move from the low-unemployment to the high-unemployment steady state). But although destruction costs may prevent the economy from moving to the high-unemployment steady state it doesn't make the existence of a high-unemployment steady state less likely since no destruction costs have to be paid by jobs that are not operating.[21] Similarly, the assumption that creation costs are positive would make it more likely that the high-unemployment steady state is a unique continuation equilibrium.

Creation and destruction costs are not necessary for steady states to be unique continuation equilibria. In particular, the matching friction makes it more likely that staying in the high-unemployment steady state is the unique continuation equilibrium. Because of the matching friction the unemployment rate will decline only slowly towards the low-unemployment steady state even if all newly matched pairs form a productive relationship. The tax burden corresponding with this gradual decrease in the unemployment rate is less than the decrease corresponding with an immediate decrease in the unemployment rate to its low-unemployment steady-state value. Consequently, the surplus values don't immediately increase to the values they take on in the low-unemployment steady state and may, at least initially, remain negative which means a transition to the low-employment steady state is not an equilibrium time path.

It is also possible for the low-unemployment steady state to be an unique continuation equilibrium without relying on destruction and creation costs. In particular,

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[21]In fact, by reducing the benefits of being in a relationship destruction costs reduce the creation margin and, thus, make the high-unemployment steady state more likely.

suppose that the assumption made in the beginning of this section that $s_l(z_{l,1}) < 0$ and $s_l(z_{l,2}) < 0$ in the high-unemployment steady state is replaced with the assumption that $s_l(z_{l,1}) < 0$ and $s_l(z_{l,2}) > 0$ and in addition assume that $p^n(z_{l,2}) = 0$, that is, all newly matched low-productivity relationships start at the lowest productivity level, $z_{l,1}$.[22] Although $s_l(z_{l,2}) > 0$, no jobs will operate at $z = z_{l,2}$ in the high-unemployment steady state since all low-productivity pairs have to start at $z_{l,1}$ and these jobs are not created. Now suppose that the economy is in the low-unemployment steady state and agents expect to be moving towards the high-unemployment steady state. Even when the high-unemployment steady-state has been reached, the surplus for jobs operating at $z_{l,2}$ is positive, so the expectation the economy will move to the high-unemployment steady state will not make $s_l(z_{l,2})$ negative and relationships with a productivity level equal to $z_{l,2}$ will, thus, not choose to break up. This means that the convergence towards the high-unemployment steady state will be slow. The slow convergence implies a slow increase in the unemployment rate and if the corresponding increase in the tax burden is not severe enough then $s_{l,t}(z_1)$ will—at least initially—remain positive, which is inconsistent with the agents' expectations that the economy is moving towards a high-unemployment steady state.

This example hopefully also makes clear that fiscal policy and the discount rate are also important for considering whether staying in the steady state is the unique continuation equilibrium. For example, if the discount factor is relatively high, then the belief that the economy will deteriorate will lead to a larger decrease in the continuation value of staying in a relationship and, thus, to a larger drop in the surplus. In the next subsection we discuss fiscal policy in more detail.

3.2.2 Uniqueness under alternative passive fiscal policies

A steady state is more likely to be a unique continuation equilibrium under the balanced-fiscal policy than under the balanced-NPV fiscal policy. That is, under the balanced-NPV fiscal policy the economy is more likely to move out of the high-unemployment steady state but also more likely to move out of the low-unemployment steady state. The reason is that if the government implements a balanced-NPV fiscal policy then it sets tax rates according to the expectations of the private sector, thereby reinforcing these expectations. The difference between the two fiscal policies becomes clear if we look at the implied tax rates if agents believe the economy will move out of the high-unemployment steady state towards

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[22]The productivity levels, thus, display an upward drift. Den Haan, Ramey, and Watson (2000b) show that models with an upward drift in productivity can replicate observed data on wages of displaced workers while models with a downward drift or no drift cannot.

the low-unemployment steady state. Figure 1 plots the time paths for tax rates under the two policies.[23] Because of the matching friction, unemployment rates decline slowly, which under a balanced-budget fiscal policy translates into tax rates that decrease slowly. In fact, just after the transition the tax rates are still so high that the surplus of newly created matches is still negative. Consequently, staying in the steady state is the unique continuation equilibrium under the balanced-budget fiscal policy for all three parameter sets. Under the balanced-NPV fiscal policy, the government sets the tax rate such that the present value of tax revenues equals the present value of government expenditures where both are calculated using the beliefs of the private sector. For the second parameter set, this implies an immediate and substantial reduction in the tax rate from 29.1% to 24.5% which increases the surplus value of forming a new relationship. Since the unemployment rate hasn't gone down yet this also implies an increase in the government's budget deficit. But it could be worth it to allow for temporary budget deficits and reduce the tax rate immediately, because for the second parameter set the increase in surplus values is high enough so that moving from the high-unemployment steady state towards the low-unemployment steady state is also an equilibrium. For the other two parameter sets, however, staying in the high-unemployment steady state is also the unique continuation equilibrium under the balanced-NPV fiscal policy.[24]

The fiscal policy implemented affects whether the low-unemployment steady state is a unique continuation equilibrium in a similar manner if the assumption is made that $s_l(z_{l,1}) < 0$ and $s_l(z_{l,2}) > 0$ in the high-unemployment steady state. Since $s_l(z_{l,2}) > 0$ in the high-unemployment steady state, low-productivity jobs would remain productive when the economy would converge from the low-unemployment towards the high-unemployment steady state. Consequently, convergence will be slow and the analysis is similar to the one for convergence from the high-state towards the low-unemployment steady state. In fact, the low-unemployment steady-state is also a unique continuation equilibrium when the balanced-budget is implemented for all three parameter sets. When the balanced-NPV fiscal policy is implemented it is not a unique continuation equilibrium for the second parameter set but it is for the other two.

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[23]The transition from the high-employment regime to the low-employment regime results in time paths for unemployment and tax rates during the transition that are identical for the three parameter sets considered. Under the balanced-budget fiscal policy tax rates also would be the same. Under the NPV-balanced fiscal policy tax rates would the same for the last two parameter sets that share the same discount factor but different for the first parameter set. In the figure, the tax rate for the NPV-balanced fiscal policy corresponds to the last two parameter sets.

[24]It is important to point out that even under the balanced-budget fiscal policy, future tax decreases are taken into account in the agents' decisions through their impact on the continuation values $g_{l,t}$, $g_{h,t}$, $w_{l,t}^f$, $w_{h,t}^f$, $w_{l,t}^w$, and $w_{h,t}^w$.

3.3 Using fiscal policy to eliminate high unemployment

In this subsection we discuss three alternative types of fiscal policy that the government can use to reduce unemployment in the current framework. First, we consider the case where the government doesn't passively set tax rates based on the expectations of the private sector but can commit to tax rates and analyze whether by setting tax rates appropriately the government can select the desirable equilibrium time path when staying in the high-unemployment steady state is not the unique time path. Second, we discuss how the government could use huge but temporary *increases* in the tax rate to push the economy out of the high-unemployment steady state. Third, we discuss how changing the tax rates for different income groups could eliminate the high-unemployment steady state. Although all three proposals provide a road map out of the high-unemployment steady state each of them has severe practical complications.

3.3.1 Fiscal policy with commitment

In the last subsection, where we assumed that the government takes the expectations of the private sector as given and sets tax rates accordingly, we showed that there are cases for which staying in the high-unemployment steady state is not the unique continuation time path if the government implements a balanced-NPV fiscal policy. In this section we assume we are in such a situation and address the question whether the government by actively setting tax rates could select the equilibrium time path that converges to the low-unemployment equilibrium. In particular, suppose that the government announces that from now on the tax rate will be equal to the (constant) level corresponding to the time path along which the economy moves out of the high-unemployment steady state. At this tax rate the surplus values for all productivity levels are positive, and the government balances the present value of its revenues and expenditures. One might be tempted to conclude that by committing to this tax rate the government eliminates staying in the high-unemployment steady state as an equilibrium. Consequently, the only remaining equilibrium is to move towards the low-unemployment steady state. Bassetto (2002) points out this establishes the uniqueness of an equilibrium but under the assumption that the private sector believes that the government will act in a way that is simply impossible under some alternative scenarios. In particular, suppose that the private sector does not believe that the economy will converge towards the low-unemployment steady state. Under the assumption that the government commits to a low tax rate, the present value of government expenditures and revenues are no longer equal. It is unclear what would happen under this scenario. It is possible that the government would break its commitment. Since one cannot evaluate the alternatives, one also cannot conclude

there is not an equilibrium among the alternatives. Theoretically, an easy way out of this problem is to assume that the government commits to a low tax rate *and* that government expenditures, gov_t, will adjust to ensure that the net-present-value of the government's budget deficits equal to zero. With this modification the time path along which the economy moves to the low-unemployment steady state is the unique equilibrium. In equilibrium the government wouldn't have to adjust the level of government expenditures, but to have proper uniqueness we have to assume that the government will do so along off-equilibrium time paths.[25] Although the assumption that the private sector believes the government will adjust government expenditures is convenient from a theoretical point of view, it has to be pointed out that it isn't a very realistic one.

3.3.2   Build up a surplus to finance the transition towards prosperity

Suppose that the economy is in the high-unemployment steady state and also suppose that this steady state is a unique continuation equilibrium under both the balanced-budget and the balanced-NPV fiscal policy. This means that the unemployment benefits to be paid out during the transition out of the high-unemployment steady state are still so high that the implied reduction in the tax rate is not enough to make the surplus positive even under the balanced-NPV fiscal policy. Recall from Figure 1 that under the balanced-NPV fiscal policy the tax rate immediately drops to a new lower level. Clearly, one could make the surplus of relationships at the beginning of the transition positive by lowering the tax rate even further. But if the government satisfies its intertemporal budget constraint it will have to raise taxes at some later point during the transition making the surplus then even more negative. And as long as surplus levels are negative at some point during the transition, it is not an equilibrium time path.

But now suppose that when the economy is in the high-unemployment steady state the government *raises* taxes. Since high-productivity jobs have a substantial surplus and low-productivity jobs are not operating anyway, the tax rate would have no affect on the job destruction and job creation decision but the government would accumulate funds. At some point it will have accumulated enough funds so that it can set tax rates to a level low enough to make transition to the low-unemployment steady state an equilibrium and still satisfy the intertemporal budget constraint. In this model this policy works because the surplus of the high-productivity jobs is quite high even in the high-unemployment steady state. If there are marginal jobs operating in the high-unemployment regime then the increase in tax rates might

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[25]Note that we also could make unemployment benefits the residual in the government's fiscal policy.

destroy those and actually increase the unemployment rate.

3.3.3 Alternative tax rates for different groups

In this paper we assume that all productive relationships are taxed at the same rate $\tau_{e,t}$ and that unemployment benefits are taxed at a lower rate, that is, $\tau_{u,t} = \psi \tau_{e,t} < \tau_{e,t}$. The high-unemployment steady-state could be eliminated by a transfer of funds from the high-productivity relationships to the low-productivity relationships, for example in the form of letting the low-productivity relationships pay less taxes or give them a subsidy (negative tax rate). That is, instead of transferring funds from the productive relationships to the unemployed there would be transfers from the more productive to the less productive workers. A sufficient condition for this to be a Pareto improvement is that $b_l < z_{l,1}$, which means that the output of low-productivity jobs is higher than the combined value of home production and leisure.

However, a policy like this one that subsidizes marginal jobs might not be politically feasible or desirable. First, it may be difficult to implement such a policy since what matters here is not the value of the output produced or profits but the value of the surplus. This may be hard for the government to observe, that is, one may be taxing firms with a high level of revenues or profits but low surplus. Moreover, keeping marginal jobs alive may distort incentrives.

4 Small and large temporary shocks

Above we asked the question whether self-fullfilling expectations could drive the economy out of a steady state. Although this is a possibility for some parameter values, we assume from now on that steady states are unique continuation equilibria. The motivation for doing so is that economies don't seem to move that easily between high and low-unemployment regimes. In this section we discuss how the economy can move out of a steady state in response to temporary productivity shocks. In the first subsection we discuss shocks when the economy is in the low-unemployment steady state to begin with and in the second subsection we document that transitions between steady states can by asymmetric in the sense that the size and persistency of the shocks required to move the economy out of a steady state differ for the two steady states.

4.1 Transitions out of the low-unemployment steady state

The aggregate fundamental shock considered here is a one-time change in the rate of exogenous break ups. Although we think of this burst of destructions as being caused

by a one-time drop in aggregate productivity we don't actually change productivity levels which simplifies the exposition.[26]

4.1.1 Small shocks

Suppose the economy is in the low-unemployment steady state and a fraction of low-productivity jobs is destroyed. This shock will lead to an increased obligation of the government to pay unemployment benefits and necessarily leads to an increase in tax rates at some point. If staying in the low-unemployment steady state is a unique continuation equilibrium then the economy will converge back to the low-unemployment steady state for a small enough shock.[27]

4.1.2 Large shocks

Clearly there are shocks large enough such that the economy will leave the low-unemployment steady state. In particular, suppose that there is a one-time sharp reduction in the productivity level of the low-productivity relationships that is so large that the surplus values of the relationships operating at $z_{1,t}$ as well as $z_{2,t}$ become negative. This means that these relationships break up and in response to this (temporary) change in a fundamental the economy moves to the high-unemployment steady state instantaneously. Since the high-unemployment steady state is a unique continuation equilibrium, the belief that the economy will converge back to the low-unemployment steady state cannot push the economy out of the high-unemployment steady state after productivity levels have recovered. Similarly, shocks that lead to unemployment rates close to the level of the high-unemployment regime cause an inevitable transition to the high-unemployment steady state.[28]

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[26]Note that by not changing aggregate productivity we also do not lower output levels of the continuing relationships and, thus, underestimate the reduction in the tax base. This means that we actually make it somewhat easier to return to the low-unemployment steady state after a shock.

[27]Suppose the government implements a balanced-budget fiscal policy. If staying in the low-unemployment steady state is a unique continuation equilibrium, then the belief, formed at the beginning of period one that the economy will move out of the steady state—without a change in any of the fundamentals—leads to a time path with $s_{l,t}(z_{l,1}) > 0$ for some $t \geq 1$. Continuity of $s_{l,t}(z_{l,1})$ then guarantees that $s_{l,t}(z_{l,1})$ remains positive in response to small changes in the fundamentals, which is inconsistent with the assumption that relationships are breaking up and the economy is moving to the high-unemployment equilibrium.

[28]Again because of continuity and because the high-unemployment steady state is a unique continuation equilibrium.

4.1.3 Intermediate shocks

Above we showed that if the shock is small enough the unique equilibrium is to move back to the low-unemployment steady state, while if the shock is large enough the economy has to move to the high-unemployment steady state. Not surprisingly, there are intermediate shocks for which the time path is not uniquely determined and the economy could either move back towards the low-unemployment steady state or move towards the high-unemployment steady state. This range can be large or small. Figure 2 documents that for the parameter values considered in the third column of Table 1 the range is quite small. This figure graphs the possible time paths for the unemployment rate after a burst of destruction. The solid line represents the unemployment rate after the largest possible burst of destruction after which return to the low-unemployment steady state is still an equilibrium outcome under the balanced-budget fiscal policy. In particular, if the burst of destruction leads to an unemployment rate equal to 10.5% or less then the economy can still move back to the low-unemployment regime.[29] If the initial unemployment rate is larger than 10.5%, however, then the economy will have to move to the high-unemployment regime. The dashed line represents the unemployment rate after the smallest possible burst of destructions after which the economy could still move to the high-unemployment steady state, again assuming the government implements a balanced-budget fiscal policy. In particular, if the unemployment rate rises to 8.9% or more then the economy could move to the high-unemployment regime. If the unemployment rate does not increase above 8.9% pessimistic expectations could not push it towards the high-unemployment steady state and the economy has to move back to the low-unemployment steady state. Thus, only if the unemployment increases to a level above 8.9% but not above 10.5% is there more than one equilibrium time path. In this case, the economy could move to either steady state and the outcome would depend on whether expectations are optimistic or pessimistic.

When the government implements a balanced-NPV fiscal policy then the range for which the time path is indeterminate is between 8.6% and 11.7%. We see that the indeterminate region under this fiscal policy is slightly larger. This is not surprising since under this policy the government reinforces the agents' expectations.

One could deal with the indeterminacy by choosing the time path towards the low-unemployment steady state with probability α and the time path towards the high-unemployment steady state with probability $1 - \alpha$.[30] One might imagine that

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[29]The procedure to check whether a time path is an equilibrium is the same as the one used to check whether moving out of the steady state is an equilibrium.

[30]Note that in the indeterminate region, there are besides the two time paths that converge directly to a steady state also other equilibrium time paths.

expectations of the private sector depend on where in the region of indeterminacy the economy is. In particular, it seems plausible that expectations of the private sector are more likely to be pessimistic if the increase in the unemployment rate is close to the level where return to the low-unemployment steady state is impossible. This suggests making α a function of the unemployment rate.[31]

4.2 Asymmetries

Suppose the surplus of marginal jobs in the low-unemployment steady state, $s_l(z_{l,1})$, is such that the belief the economy will move towards the high-unemployment steady state is almost an equilibrium. Then a temporary negative shock leading to only a small number of destructions could push the economy on a path towards the high-unemployment steady state. Similarly, if the high-unemployment steady state just barely meets the conditions for being a unique continuation equilibrium then it is possible that the economy would move towards the low-unemployment steady state after a very small shock. In other words, the indeterminate region in Figure 2 could be close to the low-unemployment or the high-unemployment steady state (or both in case the indeterminate region is large).

Although, in principle either steady state could be the more stable one, there are important reasons why one would expect it to be typically more difficult to move out of the high-unemployment steady state than out of the low-unemployment steady state. The first reason is the obvious fact of life that destruction can be quick, but restoration unfortunately takes time. This asymmetry is amplified in this model by the effect of job destruction on tax rates. Since destruction is instantaneous and creation is not, the tax increase corresponding to a period of negative shocks is larger than the decrease corresponding to a period of positive shocks. Suppose the economy is in the low-unemployment steady state and that a large aggregate shock destroys all low-productivity relationships. Then the tax rate increases immediately from 29.9% to 35.5% for both fiscal policies.[32] Now suppose that the economy is in the high-unemployment steady state and consider the case where after a particular point in time the rejection and endogenous destruction rates become equal to zero so that the economy will converge to the low-unemployment steady state. Since the unemployment rate shrinks only gradually the tax rate does not decrease from 35.5% to 29.9% but only to 33.2% for the parameters in the first column of Table 1

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[31]When a balanced-budget fiscal policy is implemented, then $\alpha = 0$ when the unemployment rate, u, increases to a level higher than 10.5% and $\alpha = 1$ when u increases to a level less than 8.9%. The theory doesn't restrict α for intermediate values. For example, one could specify that $\alpha = (10.5 - u)/(10.5 - 8.9)$ for for $8.9 < u < 10.5$.

[32]Note that these are the steady-state values.

and to 30.7% for the parameters in the last two columns.

To illustrate this asymmetry we consider the case where the government implements a balanced-budget fiscal policy and we use the parameters given in the third column of Table 1. As mention above, during one disastrous period the economy could instantaneously move towards the high-unemployment steady state. Now suppose the economy is in the high-unemployment steady state and that for one time period productivity levels are so high that all newly matched pairs create a relationship. The unemployment rate would decrease and the economy would be in a better starting position. Unfortunately, at these parameter values the economy has not improved enough to move towards the low-unemployment steady state. In fact, it takes ten periods of positive shocks, during which all new matches become productive relationship, for the unemployment rate to be low enough so that the economy could move towards the low-unemployment steady state.

5   European unemployment puzzle

Standardized unemployment rates for Europe[33] and the U.S. are plotted in Figure 3. As documented by the figure, the unemployment rates in Europe and the U.S. were low and fairly similar in the beginning of the sample. During the 1970's, European unemployment rates experienced a steep increase from which they still haven't fully recovered. Unemployment rates in the U.S. in contrast, reached unemployment rates in the second half of the 1990's that were close to their all time lows. In this section we illustrate that the predictions of the model developed above fit the experience of European unemployment well. The idea is that Europe started in the low-unemployment steady-state in the 1950's and 1960's. Even though replacement rates were high, they did not result in high tax rates because the unemployment rate was low. The recession in the 1970's increased the government's obligation to pay unemployment benefits and lowered the tax base. Consequently, the corresponding increase in tax rates made it difficult for the economy to move back to the low-unemployment regime.

In the first subsection we provide justification for the parameters that were used in the earlier sections to generate the results that mimic the European experience. In the second subsection we discuss the quantitative importance of the mechanism analyzed in this paper and in the last subsection we discuss current European fiscal policy.

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[33]The countries included are the fifteen members of the European Union.

5.1 European tax rates and unemployment benefits

In this section we justify the values of the parameters used to generate the results above. We start by providing data for the net-replacement rate. Next, we provide data for the assumption that unemployment benefits are taxed at a rate lower than productive income. After this we discuss how much European countries spend on transfers to the unemployed and in particular how the magnitude of these transfers as a fraction of GDP has increased. Finally, we discuss the overall tax burden and the observed increase. The empirical findings discussed in this section are not enough to pin down all parameters. But as discussed above, values of other parameters (such as destruction and creation costs and matching probabilities) and chosen to obtain sensible unemployment rates an to ensure that the steady states are unique continuation equilibria.

5.1.1 Net-replacement rates

The model in this paper shows that a large negative temporary shock can have a permanent effect on unemployment rates if it interacts with an employment-unfriendly institution such as high net-replacement rates. In Table 3 we report average net-replacement rates for unemployed workers in several countries for the first five years after displacement. The table documents that in most European countries net replacement rates are substantial relative to U.S. replacement rates. This gap cannot by itself explain the high unemployment rates in Europe relative to the U.S., however, because European replacement rates were already high relative to U.S. levels at the beginning of the postwar period when unemployment rates were similar.[34] As documented by the table, our assumed level of 0.5 is below the observed average of the replacement rate for the five-year period after displacement for several European countries. But then it must be pointed out that we assume that benefits are paid out indefinitely.

5.1.2 Wedge between tax on productive and non-productive income

The wedge between tax rates on productive income and unemployment benefits plays an important role in this paper. To illustrate the magnitude of this wedge we report in Table 4 average effective tax rates on labor income and unemployment benefits from Daveri and Tabellini (2000). The table shows that in all countries there are substantial differences in the effective tax rates. The tax rate on labor income averaged across European countries is equal to 35.8% while the average tax rate on unemployment benefits is equal to only 16.2%. The findings in this table

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[34]See, for example, Den Haan, Haefke, and Ramey (2002).

correspond roughly to our assumption that the tax rate on unemployment benefits is equal to four tenths of the tax rate on productive income.

5.1.3   Transfers to the unemployed

In the first column of Table 5 we report the amount spent on unemployment benefits and in the second column total transfers to the working-age population, both as a percentage of GDP. The numbers on unemployment compensation in the first column of Table 5 should be considered as a lower bound on the total amount of transfers paid because of labor market conditions to working-age individuals. One reason is that some unemployed are misclassified as sick or disabled[35] and their compensation should be counted as part of the unemployment benefits paid out. The reported numbers on total transfers to the working-age population include government expenditures such as expenses on housing benefits, family benefits, and early retirement that benefit the unemployed and are also related to labor market conditions. Of course, they also include transfers to the truly sick and disabled that are not directly affected by market conditions.

Moreover, transfers are not the only government expenditures that are related to labor market conditions. Examples are expenditures on labor market training, subsidized employment, employment services, and administration. The amount spent on these type of government programs is not necessarily small.[36] For example, in 1995 Denmark spent 1.0 per cent of GDP on labor market training programs and 0.58 per cent of GDP on subsidized employment programs. Sweden spent in 1994-95 0.78 per cent of GDP on labor market training programmes and 0.90 per cent of GDP on subsidized employment.

These numbers suggest that it is not unreasonable to argue that the higher unemployment rates in Europe have led to transfers that, as a per cent of GDP, are at least several points higher than their U.S. equivalents.

Using only actual unemployment compensation transfers Saunders and Klau (1985) report how much the ratio of unemployment benefits to GDP has changed over the period from 1970 to 1981, which should be a good estimate of the change in total transfers from the low-unemployment period to the high-unemployment regime. The results are reproduced in Table 6. The average increase of this ratio across European countries is equal to 4.51 percentage points. As documented in Table 2, the model is conservative in that it predicts an increase of 3.76 percentage points. Note that part of the observed increase is due to an increase in benefit

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[35]See, for example, Nickell and van Ours (2000).

[36]See Table T in the statistical annex of OECD (1996).

levels[37] and this is not taken into account in the model.

5.1.4   Tax rates

In Table 7 we report the overall tax burden for the following three sub-periods: 1966-1970, 1971-1975, and 1976-1982. Note that the tax rate generated by the model in the low-unemployment steady state closely matches the average tax burden for the sample period from 1966 to 1970.[38] The increase in the tax burden predicted by the model of 5.6 percentage points covers a big part of the observed increase of 6.9 percentage points.

5.2   Quantitative assessment

Empirical evidence for the view in this paper that the increase in total unemployment benefits paid out had a negative effect on economic activity can be found in Alesina, Ardagna, Perotti, and Schiantarelli (2002). Using an econometric panel analysis on a OECD panel data set, they document a sizable negative effect of public spending on business investment. In particular, they find that a one percentage point increase in transfers as a fraction of GDP decreases investment - as a share of GDP- with 0.21% on impact and with a cumulative effect of 1.25% over ten years. As documented in Table 6, the transfers to the unemployed increased on average by 4.51 percentage points in Europe which would lead to a cumulative effect of 5.64%.

To assess the quantitative effects of tax rates on the economy, the following aspects are important to keep in mind. Creation of new jobs clearly plays an important role for the performance of an economy. That new jobs have a low surplus value seems very plausible. As demonstrated by the numerical examples above, relatively small changes in tax rates can have a big impact on the economy under these circumstances.The next subsections discuss features that are not present in the basic framework proposed here and are likely to aggravate the effect of tax rates.

5.2.1   Other externalities

In this paper an increase in unemployment rates affect the remaining productive relationships only because it leads to a reduction in the tax base and an increase in unemployment benefits and, thus, to an increase in tax rates. There may very well be other negative externalities associated with a decrease in unemployment levels. For example, one can imagine that at lower aggregate employment levels

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[37]See Table 35 in Saunders and Klau (1985).

[38]This is accomplished by setting *gov* equal to 0.32, which corresponds to a level of government expenditures equal to 28% of GDP.

research and development is lower which is likely to have spill-over effects. Also, as unemployment increases voters may be more likely to support firing costs. Moreover, some jobs may produce commodities or services that are essential or cost-saving for other production processes.[39] Finally, if jobs remain unfilled for long periods of time networks affecting the efficiency of the matching market may deteriorate, which in turn may make it more difficult for these jobs to become productive again. The predictions of the framework developed in this paper would apply to these types of externalities as well.

5.2.2   Effect of tax rates on growth

In spirit this paper this paper is similar to Daveri and Tabellini (2000) who also argue that an increase in tax rates play an important role in the increase in European unemployment rates.[40] An interesting aspect of Daveri and Tabellini (2000), that is missing in this paper, is the theoretical and empirical analysis that shows that the increase in tax rates not only affects unemployment rates but also growth rates. It would be interesting to extend the framework here and model the effect of tax rates on growth rates along the lines used in, for example, Daveri and Tabellini (2000) or Novales and Ruiz (2002). This would not only increase the range of predictions made by the model but can also magnify the effects of temporary shocks by including the effect of tax rates on real activity through economic growth.

5.2.3   Other frictions

Note that the matching process is the only friction in the model. For example, in this model there is always demand for the commodities supplied.[41] The fact that demand for a new product (or an increase in supply) might be uncertain is an extra reason why the surplus level of new projects may be very low. Also, because agents are assumed to be risk neutral there are no changes in the interest rate. Den Haan, Ramey, and Watson (2000a) show that fluctuations in the interest rate serve as an important magnification and propagation mechanism in a job matching model with capital. To see this, suppose a burst of destruction leads to a reduction in consumption. The desire to smooth consumption will increase interest rates.[42] The increase in interest rates increases the cost of capital which in turn will increase the

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[39]For example, the disappearance of service jobs like child care or the home delivery of groceries would increase the costs of working and, thus, decrease the surplus of other jobs.

[40]In Daveri and Tabellini (2000), however, the increase in tax rates is exogenous while here the increase is an endogenous response to temporary shocks.

[41]Basically because agents consume their own production.

[42]Relative to what interest rates would do without the consumption-smoothing motive.

number of relationships destroyed. The desire to smooth consumption will also lead to a reduction in the capital stock which in turn will put upward pressure on future interest rates and lead to more destruction in future periods.

5.3   Should Europe focus on low deficits?

After a burst of destruction there are several possibilities. One possible outcome is that the economy would converge to the high-unemployment regime even if the government implements the balanced-NPV fiscal policy.[43] A more favorable outcome would be the situation where a commitment to low tax rates would prevent the economy from moving to the high-unemployment regime and instead force the economy back to the low-unemployment regime. In some cases, this policy could even work after the economy has reached the high-unemployment regime.

After the Maastricht Treaty, European governments have put a lot of emphasis on deficit reduction. Note that this paper suggests that what matters are tax rates and not the deficit itself. If low deficits are accomplished by reducing government expenditures, low deficits may be beneficial because they would allow for employment-friendly tax policies if needed. If low deficits are accomplished by raising tax rates, however, they may in fact be harmful. In particular, it is possible that the economy would remain in the high-unemployment regime when tax rates are used to sustain low deficits in each period, while a commitment to lower tax rates would push the economy towards the low-unemployment steady state. Although the commitment to lower tax rates would lead to temporary increases in the budget deficit, the reduction in the unemployment rate would have to pay out would finance the reduction of tax rates.

Whether a persistent reduction in tax rates could actually push the economy to a low-unemployment equilibrium is of course a difficult question. The reason is that what really matters is the mass of jobs for whom the decrease in the tax rate would turn a negative surplus value into a positive one. Determining the mass of these jobs is difficult since under the current regime of high tax and unemployment rates they do not exist. The paper does provide, however, some insight into the best timing for such a persistent reduction in tax rates. The framework developed here would suggest that the best time to lower tax rates and push the economy out of the high-unemployment steady state would be during a business cycle expansion. Recall that for the transition to the low-unemployment steady state to be an equilibrium time path, the surplus values of the low-productivity jobs have to become positive after the reduction in tax rates. This is more likely to be the case during an expansion

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[43]Note that the government could still consider a complete overhaul of the transfer system including subsidies to marginal jobs instead of transfers to the unemployed.

in which case the reduction in taxes would reinforce increases in productivity and increase the likelihood that a time path towards the low-unemployment equilibrium becomes a possibility. A policy that proposes to decrease taxes during an expansion might seem surprising to some readers. One should keep in mind, however, when the proposal is to lower taxes when the economy is doing well relative to the high-unemployment steady-state values, so it is still doing poorly relative to the potential represented by the low-unemployment steady-state.

6   Concluding Comments

In this paper we developed a dynamic framework with multiple steady states in which equilibrium selection is not controlled by the realization of a sunspot variable but in which time paths are determined by current and past realizations of shock to a fundamental variable. Starting in the low-unemployment regime the following holds. After large temporary shocks the economy can only move to the high-unemployment equilibrium while after small shocks the economy can only move towards the low-unemployment equilibrium. Time paths are not always uniquely determined, however. For intermediate shocks, the economy could move either to the low or the high-unemployment equilibrium and expectations of the private sector would be self-fulfilling. The idea is that the unemployment rate, or more generally the implied tax burden, is a state variable that controls the solution to the model.

Fiscal policy plays a key role in this paper and we have shown that it is possible that a balanced-NPV fiscal policy would make the transition to the low-unemployment steady state an equilibrium outcome while this transition would not be an equilibrium outcome under the balanced-budget fiscal policy. When the government implements a balanced-NPV fiscal policy and passively adopts the expectations of the private sector, then staying in the high-unemployment steady state would remain an equilibrium. If the government follows an active policy, however, and commits to low tax rates the unique equilibrium would then be a transition to the low-unemployment steady state.

7   Appendix

This appendix discusses in more detail how to check whether a steady state is a unique continuation equilibrium. We focus on the high-employment steady state but the techniques are the same for the low-unemployment steady state.[44] For a

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[44]In fact, to check whether a time path converging to a steady state is unique similar procedure are used.

time path to be an equilibrium you need that the sign of the surplus is consistent with the creation and destruction decisions along the path. For example, the high-unemployment steady state requires that the surplus of newly created low-productivity matches, $s_l(z_{l,1})$, is negative so that indeed no low-productive matches are created.

Showing that a time path is an unique equilibrium might seem a daunting task because there are so many alternative time paths to consider. Typically, however, there is a candidate that serves as the most likely alternative time path. Suppose that the economy is in the high-unemployment steady state. Of all the time paths along which the economy moves out of the steady state, the one that is most likely to be an equilibrium as well is the time path for which at every point in time newly matched pairs create a productive relationship and no relationships choose to break up, that is, the time path that converges directly to the low-unemployment steady state and stays there. This is the time path that will lead to the largest possible reduction in unemployment benefits and tax burden and, thus, the largest increase in the surplus values.

To check whether staying in the high-unemployment steady state is an equilibrium, one would do the following. First consider the case where the government implements a balanced-budget fiscal policy. Suppose that at $t = 0$ the economy is in the high-unemployment steady state. If the transition to the low-unemployment steady state is also an equilibrium, then it must be the case that the surpluses of newly created low-productivity matches, $s_{l,t}(z_{l,1})$, is positive for all $t \geq 1$. The assumptions that all new matches lead to productive relationships and no relationships choose to break up imply a time path for the unemployment rate, output, and the government's obligations to pay unemployment benefits. These imply a time path for the tax rates. Since the economy moves to the low-unemployment steady state, the limiting continuation values under the alternative time path are equal to the low-unemployment steady-state values. We therefore solve for the time path of the continuation values by assuming they have attained the steady-state values for a large value of t and then iterate backwards using Equations 5 through 10. Next we calculate the time path for the surplus values and if $s_{l,t}(z_{l,1}) \geq 0$ for all $t \geq 1$ then the alternative time path considered is also an equilibrium and staying in the high-unemployment steady state is not a unique equilibrium.

The procedure under the balanced-NPV fiscal policy is similar. Given the time path of total unemployment benefits and output it is again easy to calculate the implied time path for tax rates, which under the balanced-NPV fiscal policy means solving for a tax rate that is assumed to be constant across time. Since tax rate are constant along the transition path, continuation values and surplus values are constant too and can easily be calculated. Again, if the surplus at the lowest pro-

ductivity level is non-negative then the alternative time path is an equilibrium under the balanced-NPV fiscal policy.

Note that we check whether the alternative time path is an equilibrium under the restrictions imposed. In particular, we always assume that all tax rates on productive income are equal to each other and that the tax rate on unemployment benefits is a fraction ψ of the tax rate on productive income.[45] Even under these restrictions, however, there are time paths for tax rates that also satisfy the government's intertemporal budget constraint but for which tax rates are not constant. But if moving out of a steady state is not an equilibrium for the constant tax rate discussed above, however, then there is no time path for tax rates for which moving out of this steady state is an equilibrium. That is, among all fiscal policies that satisfy the intertemporal budget constraint, the balanced-NPV fiscal policy with a constant tax rates makes it most likely that the economy could move out of the steady state.

To understand this claim assume that the economy is in the high-unemployment steady state and that, starting at $t = 1$, begins to move towards the low-unemployment steady state. Suppose that at the constant tax rate that equalizes the present value of government expenditures and revenues, the surplus values are all negative, that is, $0 > s_{l,1}(z_{l,1}) = s_{l,2}(z_{l,1}) = \cdots$. We will refer to this policy and the outcome as the benchmark. At the value of this constant tax rate, the assumed time path is, thus, not an equilibrium. The question is whether there is not an alternative time path along which taxes also satisfy the government's intertemporal budget constraint, but surpluses are positive in each period. Clearly, the government could make the surplus in the first period, $s_{l,1}(z_{l,1})$, positive by lowering the tax rate in period one.[46] Relative to the benchmark the situation would now be worse in period two, since the government has accumulated more debt in period one. The constant tax rate that would balance the present value of revenues and expenditures from period two on would be higher than the benchmark. Again, one could lower the tax rate in period two but that only makes it more difficult to get a positive surplus in period three. But since the government has to satisfy it's intertemporal budget constraint, it will have to raise tax rates at some point which will result in a surplus value even less than the benchmark value which was already negative.

In the framework considered in this paper, it is not trivial to construct examples

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[45]Section 3.3 discusses the predictions of the model when these restrictions are relaxed as well as the case when the government first builds up a large surplus.

[46]Note that this change does not affect the unemployment rate (or unemployment benefits paid out) since the exercise assumes that the time path for unemployment rates is the one that is implied by positive surpluses. The goal is to check whether at the implied tax rates the surplus values are indeed positive.

in which (i) the discount factor is high, (ii) there are no destruction or creation costs, (iii) the government implements the balanced-NPV fiscal policy, and (iv) staying in the steady states is a unique continuation equilibrium. One might, therefore, be tempted to conclude that steady states that are unique continuation equilibria are implausible unless there are destruction or creation costs or the government's budget deficits are consistently low. Note, however, that under the alternative time path the economy moves to the other steady state and *stays there forever*. Since the transition is permanent the change in the tax burden is huge, which makes it more likely that moving out of the steady state is an equilibrium time path. In reality, this alternative time path may not be that realistic and one may want to consider them as an alternative. This would make it more likely that the steady state is a unique continuation equilibrium.

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Figure 1: *Tax rates if the economy moves out of high-unemployment steady state*
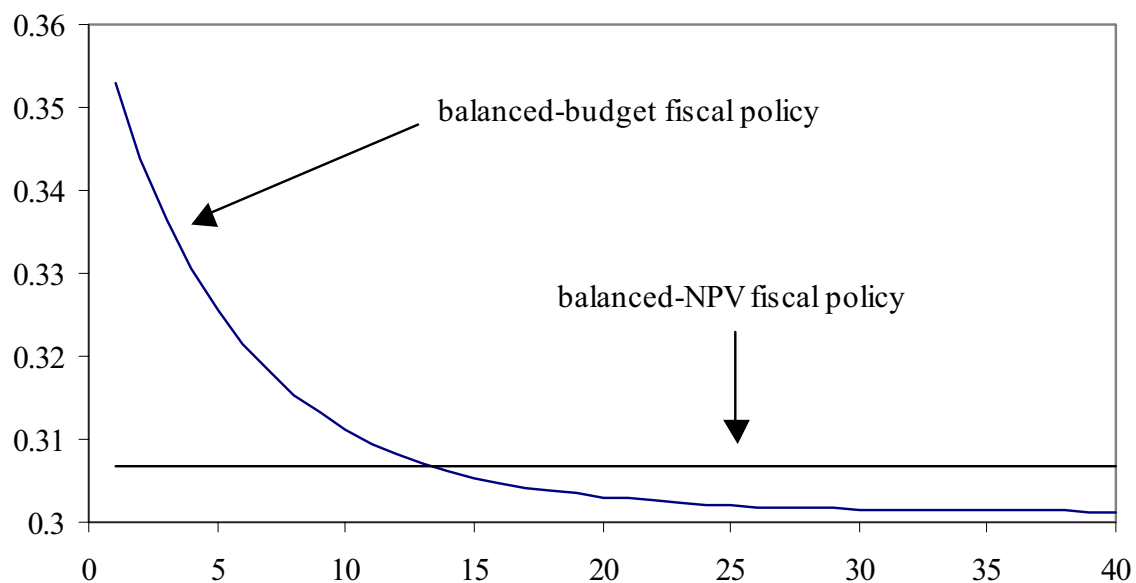
Note: The transition from the high-employment regime to the low-employment regime results in time paths for unemployment and tax rates during the transition that are identical for the three parameter sets considered. Under the balanced-budget fiscal policy tax rates also would be the same. Under the balanced – NPV fiscal policy tax rates would the same for the last two parameter sets that share the same discount factor but different for the first parameter set. The tax rate for the balanced-NPV fiscal policy in the figure corresponds to the last two parameter sets.

Figure 2: *Unemployment rate after a burst of destruction shock*
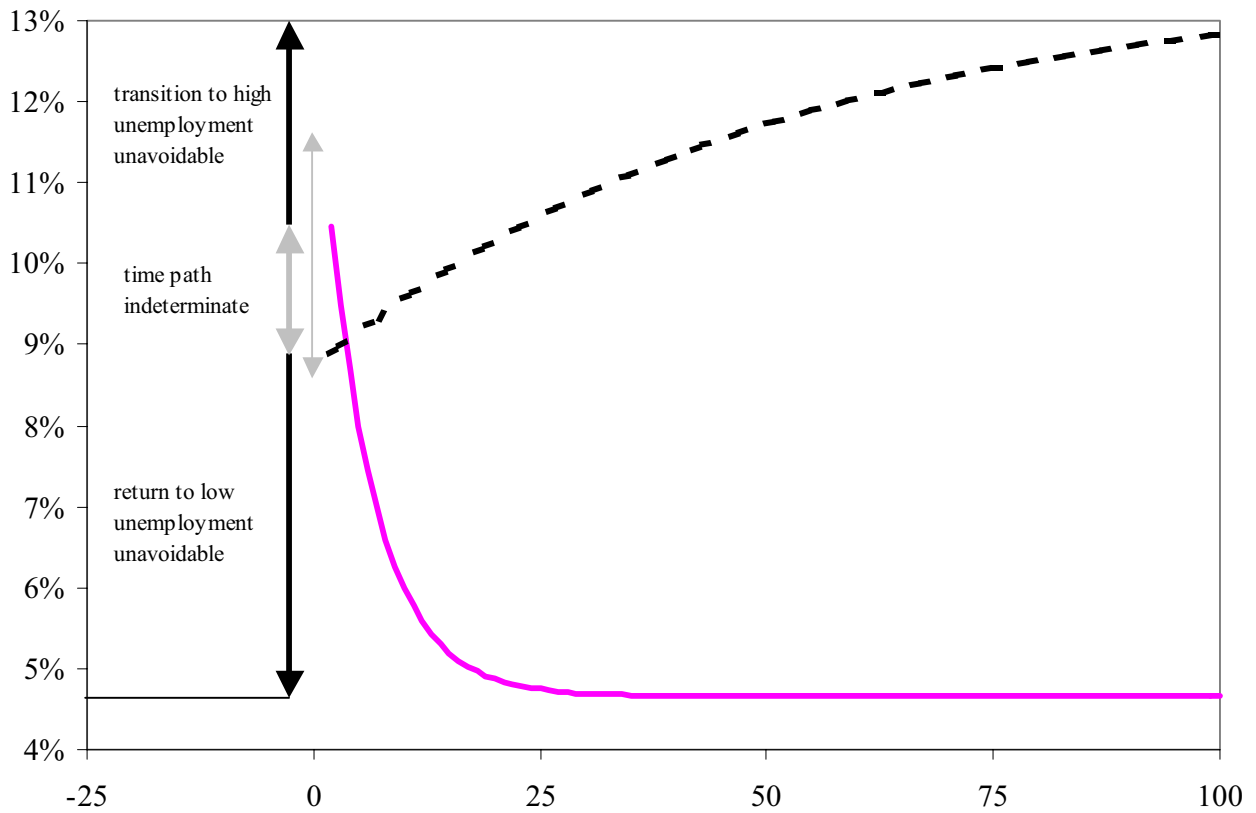
Note: The solid line gives the time path of the unemployment rate for the worst possible shock after which the economy could still move back to the low-unemployment steady state and the dashed line gives the time path of the unemployment rate after the smallest possible shock that is bad enough to make convergence to the high-unemployment steady state a possibility, both under the balanced-budget fiscal policy. The thin double arrow indicates the range of values of the initial unemployment rates for which the economy could move to either steady state under the NPV-balanced fiscal policy after a burst of destruction.

Figure 3: *Unemployment rates*
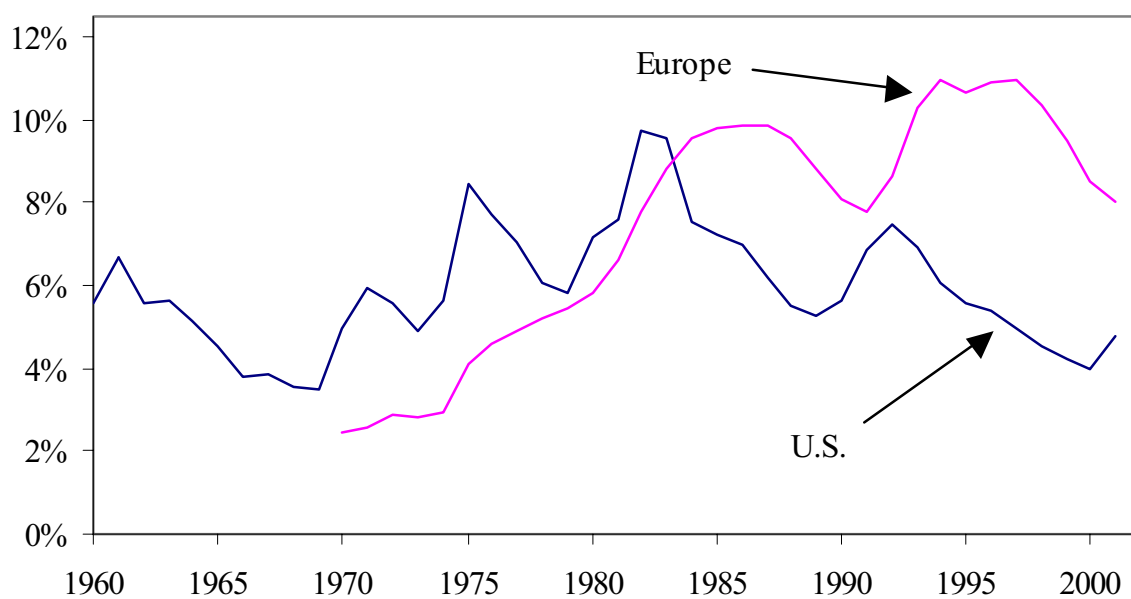
Note: The unemployment rate for Europe is an average of the 15 member countries of the European Union. The data were downloaded from Source-OECD on November 28 2002.

Table 1: Parameter Values

	low discount factor	high discount factor	
	$\zeta^{cre} = \zeta^{des} = 0$	$\zeta^{cre} = \zeta^{des} = 0$	$\zeta^{cre}, \zeta^{des} > 0$
β	0.8	0.98	0.98
ζ^{cre}	0	0	0.30
ζ^{des}	0	0	0.55
$b_l = b_h$	0.2425	0.2620	0.2550
$r_l = r_h$	.5	=	=
$z_{l,1}$	1.00	=	=
$z_{l,2}$	1.065	=	=
z_h	1.2	=	=
ρ^x	0.01	=	=
ρ^r	0.01	=	=
$p^n(z_{l,1})$	1	=	=
$p(z_{l,2}|z_{l,1})$	0.4	=	=
$p(z_{l,1}|z_{l,2})$	0	=	=
λ_l	0.1	=	=
λ_h	0.5	=	=
ϕ	0.9	=	=
ψ	0.4	=	=
gov	0.32	=	=

Note: An equality sign in this table indicates that the parameter has a value equal to the value reported in the first column.

Table 2: Steady-state properties

	low-unemployment steady state	high-unemployment steady state
unemployment rate	4.7%	13.5%
tax rate	29.9%	35.5%
total transfers / output	1.81%	5.57%

Table 3: 1994/1995 *Net replacement rates*

Country	Net Replacement Rate
Belgium	59
Denmark	81
Italy	19
Netherlands	69
Norway	62
Spain	49
Sweden	67
U.K.	51
U.S.	16

Note: The numbers are from Table 2 in Martin (1996) and represent an overall average across beneficiaries with different family circumstances for the first five years of unemployment. They are expressed as a percentage of the pre-displacement wage.

Table 4: *Effective tax rates on labor income and unemployment benefits* (1961-91 average)

Country	labor income	unemployment subsidies	difference
Belgium	39.2	27.3	11.9
France	39.8	31.0	8.8
Germany	36.3	8.0	28.3
Italy	34.0	-4.4	38.4
Netherlands	44.6	29.7	14.9
Norway	37.0	20.8	16.2
Spain	24.8	16.2	8.6
Sweden	42.2	15.8	26.4
U.K.	24.2	1.2	22.9
Europe (average)	35.8	16.2	18.0
U.S.	24.1	0.8	23.3

Note: These numbers are from Table 3 in Daveri and Tabellini (2000).

Table 5: *Transfers for the working-age population in 1992*

Country	Unemployment Compensation	Total Transfer
Belgium	2.2	8.7
Denmark	3.6	11.9
France	1.6	7.0
Germany	1.5	6.0
Ireland	3.2	7.9
Italy	0.7	3.7
Netherlands	2.8	12.7
Norway	1.4	9.9
Spain	3.2	6.7
Sweden	2.6	11.7
U.K.	1.2	8.1
U.S.	0.7	3.2

Note: Numbers are from Tables 1 and 2 in MacFarlan and Oxley (1996) and are expressed as percentage of GDP.

Table 6: *Change in ratio of unemployment compensation to GDP*, 1970-1981

Denmark	12.1
France	5.93
Germany	4.48
Ireland	1.91
Italy	3.62
Norway	3.2
Sweden	1.95
United Kingdom	2.92
Europe (average)	4.51
United States	1.26

Note: These numbers are from Table 35 in Saunders and Klau (1985). In addition to the U.S., only those European countries are included for which data are based on the complete sample.

Table 7: *Overall tax burden as percentage of GDP*

	1966-70	**1971-75**	**1976-82**
Austria	24.6	26.9	29.9
Belgium	34.6	38.6	44.8
Denmark	35.5	42.9	43.7
Finland	32.0	34.4	37.1
France	35.4	36.0	41.2
Germany	32.7	35.4	37.1
Greece	23.7	24.2	28.6
Ireland	29.4	31.6	35.7
Italy	28.0	28.2	33.6
Luxembourg	30.0	34.0	39.9
Netherlands	36.7	41.5	44.7
Norway	37.4	44.4	47.0
Portugal	20.5	22.9	28.3
Spain	16.3	18.5	23.1
Sweden	39.0	42.4	50.0
Switzerland	22.6	26.1	31.1
U.K.	34.6	34.3	35.7
Europe (average)	30.2	33.1	37.1
U.S.	28.3	29.2	30.1

Note: These numbers are from Table 56 in Saunders and Klau (1985).

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