IMF Working Paper

WP/97/137

INTERNATIONAL MONETARY FUND

European II Department

Labor Market Institutions and Unemployment Dynamics in Transition Economies

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Authorized for distribution by Julian Berengaut and Leif Hansen

October 1997

Abstract

This paper studies interactions between labor market institutions and unemployment dynamics in transition economies. It presents a dynamic matching model in which state sector firms endogenously shed labor and private job creation takes time. Two main conclusions arises. First, higher unemployment benefits increase steady-state unemployment, and, during the transition, they reduce the fall in real wages and speed up closure of state enterprises. Second, higher minimum wages can theoretically speed up the elimination of state sector jobs without affecting steady-state unemployment. These results are broadly consistent with existing evidence on the dynamics of unemployment and real wages in transition economies.

JEL Classification Numbers: E24, J63

Keywords: Unemployment, Transition Economies, Matching Models

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[1]We wish to thank Jorge Márquez-Ruarte, Tom Wolf, Mark Schankerman, and other participants at seminars held at the IMF and the EBRD. We also thank Alex Keenan for providing us with the wage data for CIS countries, and Mark DeBroek and Julian Berengaut for useful conversations. Elaine Buckberg and Atish Rex Ghosh helped us in collecting information on Russia and Ukraine. The views expressed in the paper are those of the authors and do not necessarily represent those of the *International Monetary Fund.* Correspondence to: Pietro Garibaldi, European II Department, 20431 Washington D.C.

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SUMMARY

This paper examines the interactions between labor market institutions and the dynamics of unemployment and real wages in transition economies. In a dynamic matching model in which the state sector endogenously sheds labor and private job creation takes time, the paper shows that labor market institutions, such as the unemployment insurance system and the minimum wage, are important determinants of labor market dynamics.

Three results arise from the analysis. First, higher unemployment benefits increase unemployment in the steady state and, during the transition, they reduce the fall in real wages and they increase the speed of transition. Second, higher minimum wages can theoretically speed up the transition process without affecting steady state unemployment. Third, firing costs in the public sector slow down the increase in unemployment in the early stage of the transition and slow down the fall in real wages.

The paper briefly reviews the labor market experience of several Central and Eastern European economies and two CIS economies, Russia and Ukraine, and argues that difference in labor market institutions across countries can cast some light on the difference in labor market dynamics. The Central and Eastern European economies, with the exception of the Czech republic, have experienced a dramatic rise in unemployment and substantial fall in real wages. Conversely, CIS countries have experienced a moderate increase in unemployment and a substantial decline in real wages. Consistently with the predictions of the model, the minimum wage appears to be much higher in Central and Eastern European economies than in Russia and Ukraine, while the unemployment insurance system appears much more generous.

I. Introduction

The transition from a centrally planned to a market-oriented economy involves dramatic changes in the labor market, and this fact has recently received increased attention among policy makers and academic scholars.[2] One implication of the transition process is the reallocation of jobs and workers between a declining public sector and an emerging private sector. Surprisingly, in most of the existing literature, the decision to close down state-owned firms is assumed to be exogenous and independent of business conditions in the state sector. While this assumption might be valid for analyzing the interaction between private sector development and unemployment, it does not allow for examining the interactions between job destruction in the state sector and labor market institutions.

This paper argues that traditional labor market institutions, such as the unemployment insurance system, the minimum wage, and job security provisions, are important determinants of the dynamics of unemployment and real wages during the transition. Our aim is to show that labor market institutions interact with the reallocation of jobs between the state and the private sector in a way that traditional steady state analysis can not fully account for. Thus, we propose and solve a dynamic general equilibrium model with endogenous job destruction in the state sector. The model is flexible enough to study the impact of different labor market institutions on labor market dynamics at the early stage of transition. Furthermore, the model allows us to keep track of the dynamics of unemployment and real wages throughout the transition process.

We build on two different streams of literature. First, we borrow from the recent literature on labor market transition, pioneered by Aghion and Blanchard (1994), Atkenson and Kehoe (1996), Commander and Tolstopiatenko (1995), and recently extended to account for private firm creation by Brixiova and Kiyotaki (1997). Second, we use the most recent matching framework developed by Mortensen and Pissarides (1994), and recently extended by Mortensen and Millard (1997) and Garibaldi (1997) to account for the impact of labor market institutions on job creation and destruction. Borrowing from the transition literature, we consider a world in which state sector firms shed labor and private job creation takes time to arise. Borrowing from the most recent matching literature, we focus on the determinants and the dynamics of job destruction. In an economy in which state sector firms are subject to adverse business conditions, we show how firms endogenously select a value of the labor product at which the continuation of production is no longer profitable. As the reallocation of jobs between state and private sector jobs is completed, the economy converges to a traditional matching model, in the spirit of Pissarides (1990).

We then use the model to examine how the generosity of the unemployment insurance system, the level of the minimum wage, and the degrees of job security provisions affect job

[2]See, for example, World Bank (1996), Aghion and Blanchard (1994), and Gavin (1993).

destruction in the state sector and the reallocation of jobs into the private sector. Three main findings arise from the analysis. First, higher unemployment benefits reduce the surplus from a job, increase steady state unemployment and, during the transition, reduce the fall in real wages and speed up the closure of state sector jobs. Second, higher minimum wages can theoretically speed up the closure of the state sector without affecting steady state unemployment. Third, higher firing costs increase labor hoarding in state sector jobs and increase the fall in real wages.

Finally, we examine the empirical evidence to check whether the implications of the model are broadly consistent with stylized labor market dynamics in different transition economies. Several authors, and Commander and Tolstopiatenko (1996) in particular, have documented the differences in unemployment dynamics between countries in Central and Eastern Europe (CEE) and in the Commonwealth of Independent States (CIS). CEE economies, with the exception of the Czech Republic, have experienced dramatic increases in unemployment and substantial declines in real wages. Conversely, all CIS economies have experienced moderate increases in unemployment and dramatic declines in real wages. At the same time, information on the structure of unemployment benefits and the minimum wage recently collected by ILO (1996), suggests that the unemployment insurance system is much more generous in CEE economies than in CIS countries, such as Russia and Ukraine. Our findings are therefore broadly consistent with the existing evidence on labor market dynamics in transition economies.

The paper is organized as follows. Section II briefly reviews the existing literature on labor market transition. Section III firstly introduces concepts and notation and spells out the assumptions maintained throughout the paper. The rest of section III presents and solves the model, while section IV extends the model to account for labor market institutions, and presents the results of several simulations. Section V reviews the evidence and looks at labor market institutions in CEE and CIS countries. Section VI briefly summarizes and concludes the paper.

II. The Existing Literature

A comprehensive survey of the growing literature on labor market in transition is beyond the scope of the paper.[3] Nevertheless, there are at least three studies that examine the reallocation of jobs between the state and the public sector, and focus on the interactions between labor market institutions and unemployment. This section briefly review these three papers, highlighting their main results, and their differences from the approach of this paper.

[3]World Bank (1996) provides a comprehensive introduction.

Aghion and Blanchard (1994) solve a model of transition from a low productivity to a high productivity sector, and they study the interaction between unemployment, state sector restructuring and private sector development. They find that the unemployment level has an ambiguous impact on the speed of transition. On the one hand, higher unemployment decreases wages in the private sector, and therefore speeds up the rate of private sector formation through an increase in private sector profits. On the other hand, higher unemployment increase benefits expenditures and taxes on the private firms, thus lowering profits and job creation in the private sector. Furthermore, higher unemployment can adversely effect restructuring in the state sector and slow down the speed of transition. The paper mentions the negative impact of unemployment benefit on private sector growth, but it does not address explicitly the relationship between the level of unemployment benefits and the behavior of state firms. Throughout the analysis, Aghion and Blanchard assume that the decision to close state sector jobs is independent of institutional developments and labor market dynamics. However, their model explicitly considers the option to restructure state owned jobs as a way to increase productivity in the state sector.

Burda (1993) offers the first paper that explicitly applies the flow approach to labor markets, in the spirit of Pissarides (1990), to the analysis of transition. Burda estimates a matching function for the Czech Republic and Slovakia, and uses the Pissarides model to examine the optimal speed of state-sector closure in a two sector model. He discusses the impact of unemployment benefits, severance payments, collective bargaining, and active labor market policies on transition, but he does not solve the model for different policy experiments. Similarly to Aghion and Blanchard, he mentions the negative impact of high unemployment benefits (financed by taxation of the private sector) on private sector growth. Throughout the analysis, Burda focuses only on steady-state analysis and does not consider the full impact of institutions on the dynamics of the transition. Once again, the decision to close down state-sector firms is exogenously determined.

Commander and Tolstopiatenko (1996) study differences in labor market dynamics between CEE economies and the Russian Federation, and they show that unemployment protection schemes are much more generous in the former than in the latter. They simulate a dynamic matching model for a transition economy, and they show how different levels of unemployment compensation and tax pressure imply differences in unemployment dynamics. Similar to our paper, they find that higher unemployment benefits increase unemployment. However, they also find that higher unemployment benefits reduce the closure of the state sector. Furthermore, their model does not try to explain differences in the behavior of real wages. Finally, Atkenson and Kehoe (1996) examine the impact of social insurance on the speed of transition in a two-sector model. They find that social insurance can slow down the transition if agents have a large precautionary demand for saving.

III. The Model

In an economy with two sectors and a productivity differential, the transition is akin to a reallocation process from the low productivity to the high productivity sector. The model that we propose focuses on the decision *to close down* state sector jobs and on the implications of this decision on the dynamics of unemployment and real wages. Section 3.1 introduces concepts and notation, section 3.2 describes the process of job creation in the private sector, section 3.3 focuses on job destruction in the state sector, while section 3.4 looks at aggregate dynamics and closes the model.

A. Concepts and Notation

In the rest of the paper, we focus on the behavior of the system at the beginning of the transition, when central planning has collapsed, but state sector firms are still producing. We assume that throughout the transition process, state sector jobs decline over time while, simultaneously, new job opportunities arise in the private sectors. As the share of state sector jobs converges to a predetermined proportion, assumed to be zero for simplicity, the transition process is completed and the system converges to a steady-state position.

In the economy there are two types of jobs, low productivity jobs in the state sector and high productivity jobs in the private sector. Throughout the transition, state sector jobs are in only one state, filled and producing. Conversely, private sector jobs can be in two different states, filled and producing or vacant. For simplicity, we assume that there is no job creation from state-owned jobs. Workers are homogenous in quality, have identical risk-neutral preferences in consumption, and are endowed with one flow unit of time. The labor force is constant, and it is normalized to one for simplicity. Workers can spend their unit of time working and producing, or being unemployed and searching for jobs. For simplicity, we assume that there is no on-the-job search and worker movements from the state sector to the private sector require workers to experience an unemployment spell. This assumption is analytically convenient but not irrelevant, and we discuss it in more detail at the end of this section. Finally, since our focus is on jobs, rather than on firms, we assume that each firm is made up of only one worker.

Heterogeneity in the state sector has been recognized by several authors (e.g. Blanchard and Aghion, 1995), and this model tries explicitly to account for it. We assume that labor productivity in the state sector can take different values, and stochastically jumps across these values. The existing risk for state sector jobs is modeled as a jump process and a drawing from a specific probability structure. Once an adverse productivity shock hits a state sector job, the value of its labor product will be permanently lower, but the residual value of future streams of production may still be positive. Conversely, when the present value of the job turns negative, the job is immediately destroyed, the match is dissolved and the worker switches to unemployment. The idea that the transition is associated with output falls and with the collapse of the state sector is a well known empirical fact, and it has recently been rationalized by Blanchard and Kremer (1997) in a formal model of disorganization.[4] In this paper, the permanently adverse shocks to the state sector are meant to capture the disorganization that follows the breakdown of the central planning.

For analytical convenience, we abstract from heterogeneity in the private sector and we assume that the high productivity in the private sector is time invariant. Nevertheless, private sector jobs are subject to catastrophic events which lead to immediate job destruction.

Job creation in transition economies is a complex process, and it is very difficult to describe it in a simple analytical model[5]. In what follows we try to capture the time consuming process of private sector development by assuming that job formation is costly and time consuming. Job creation comes from the posting of costly vacancies, and unemployed workers and vacant jobs in the private sector meet according to a homogenous of degree one matching function $m(u,v)$, where u is the unemployment rate, v is the vacancy rate[6], and $m(u,v)$ keeps track of the number of matches formed in a given period. Imperfect information in the labor market implies that $m(.)<\min[u,v]$. Thus in the labor market there is stochastic rationing. If we indicate with $\theta = v/u$, a measure of market tightness from the firms' standpoint, the probability of filling a vacancy is

$$q(\theta)=\frac{m(u,v)}{v}; \quad where \quad \frac{\partial q(\theta)}{\partial \theta} < 0$$

Similarly, the probability that an unemployed job seeker meets a vacant job is

$$\theta q(\theta)=\frac{m(u,v)}{u}; \quad where \quad \frac{\partial \theta q(\theta)}{\partial \theta} >0$$

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[4]Blanchard and Kremer (1997) claim that under central planning economic relationships were based on specific, one-to-one relationships that opened room for bargaining. However, the coercive power of the central planner warranted an outcome to the bargaining process. During the transition the coercive power of the central planner disappear and the relationships became have to be solved by decentralized bargaining between suppliers and buyers. The paper show that when the bargaining inefficiently breaks down (due to the incomplete contracts or asymmetric information), output will immediately fall.

[5]Brixiova and Kiyotaki (1997) propose a model entirely focused on private sector development in a transition economy.

[6]The matching function exhibits constant returns to scale in unemployment and vacancies. For transition economies, Burda (1993) and Burda and Boeri (1996) offer empirical estimates of the matching function.

The presence of the matching function and the fact that posting a vacancy is costly give rise to a pure economic rent to be split between job-worker pairs. In this paper, and similarly to Mortensen and Pissarides (1994), we assume that firms and workers split the surplus from the job in fixed proportion at all times and workers enjoy a fraction β of the total surplus. From now on, the time subscript is omitted. We start the process with most of the workers in the state sector, and we keep track of the reallocation of jobs as long as state sector jobs reach the predetermined value, which we set to zero for analytical convenience. Once the state sector reaches this lower bound level, the model behaves like a traditional matching model, in the spirit of the analysis of Pissarides (1990).

Our view on the transition process is entirely focused on the process of job reallocation between the private sector and the state sector. Even though we think that our approach can shed some light on labor market dynamics and on the speed of job destruction in the state sector, we are aware that our approach neglects important elements of the process. First, we neglect the role of privatization. While, in reality, state sector jobs can become private without being destroyed, in our model state sector jobs face only job destruction, and the remaining choice variable is the exact timing of the event.[7] Second, we neglect restructuring in the state sector. In reality, state sector jobs have often the option of being restructured and of seeing their job turning productive through a costly restructuring. In a way similar to Aghion and Blanchard (1995), it would be possible to extend the model and explicitly considering the option of restructuring. Third, we neglect the role of the government. In what follows we do not model the government budget constraints and how the latter affects productivity in the state sector. However, the adverse productivity shocks in the state sector are akin to subsidy cuts in government budget, a common element in the transition. Finally, as we mentioned earlier on, we rule out on-the-job search. In reality, there is substantial evidence of job to job movements in many transition economies (e.g. Boeri 1995). To actually keep track of these movements would change the analysis along two dimensions. First, the relevant pool of workers actively engaged in searching activity would increase, and, as a result, vacancy posting and private sector job creation would increase. Second, a non zero probability of workers from the state sector finding private sector jobs would speed up state sector closure. Both effects work in the same direction and would increase the speed of transition. However, keeping track of these movements would not change the qualitative results of section 4 and would simply make the model analytically tedious.

[7] Empirically, there is evidence of substantial growth in private sector employment in transition economies, but it is very difficult to assess to what extent the process is driven by job formation in the emergent private sector or by privatization of the state sector.

B. Job Creation and Job Destruction in the Private Sector

Let J^p be the present value of a private sector job that is filled and producing. The asset valuation of a private job is

$$rJ^p = y^p - w^p + \lambda(V - J^p) + \dot{J}^p, \tag{3}$$

where y^p is the value of the labor product in a private sector job, w^p is the wage in the private sector, λ is the arrival rate of catastrophic events that lead to immediate job destruction, and V is the value of a vacant job. Equation (3) is a standard asset valuation and features a dividend and two capital gain terms. At each point in time, a private firm enjoys a dividend equal to its operating surplus, expressed as the difference between the value of the labor product and *the negotiated wage*, $y^p - w^p$. Simultaneously, with instantaneous arrival rate equal to λ, the firm loses the job and starts searching for a new worker. Thus in equation (3), $V - J^p$ is the capital gain (loss) conditional on the arrival of a shock λ. Finally, the last term reflects the change in the value of the job over time when there is no change in state.

Job creation comes from the posting of a costly vacancy. If posting a vacancy costs γ per period and yields a probability $q(\theta)$ of being filled, the asset valuation of a vacant job is

$$rV = -\gamma + q(\theta)(J^p - V) + \dot{V}. \tag{4}$$

If there is free entry in the job market and full exhaustion of rents, as in Pissarides (1990), the asset value of a vacant job has zero value and the value of a job in the private sector is equal to the expected search costs. Substituting for $V = \dot{V} = 0$ in (4), and rearranging, yields,

$$J^p = \frac{\gamma}{q(\theta)}. \tag{5}$$

Similarly, the value of a worker employed in the private sector, E^p, becomes

$$rE^p = w^p + \lambda(U - E^p) + \dot{E}^p, \tag{6}$$

where U is the present discounted value of being unemployed. An employed worker enjoys a dividend equal to a wage rate and a probability that the job is destroyed and becoming unemployed at rate λ. Finally, if we indicate with b the income when unemployed, or the level of unemployment benefits, the asset value of being unemployed, U, is

$$rU = b + \theta q(\theta)(E^p - U) + \dot{U}, \tag{7}$$

where $\theta q(\theta)$ is the probability of finding a job for an unemployed worker, as defined in the previous section. From (6) and (7) it follows that an unemployed worker is willing to take on a job as long as $E^P \geq U$.

At each point in time a job-worker pair enjoys a surplus from a match, W^p, given by the sum of the respective value functions of a filled jobs, net of the respective outside option. Making use of the free-entry condition on V, the surplus from a private sector job becomes

$$W^p = J^p + E^p - U \tag{8}$$

In what follows, as in Mortensen and Pissarides (1994), we assume that the worker and the firm continuously split the surplus from the job in fixed proportion. If the worker gets a fraction β of the total surplus, it must be true that

$$E^p - U = \beta W^p; \quad J^p = (1-\beta) W^p. \tag{9}$$

From (9) it is obvious that for each side of the match, a private sector job is viable as long as the total surplus from the job is positive. Making use of (8) and (9), adding (6) to (3) and subtracting to the result (7), the surplus in a private jobs becomes

$$(r+\lambda) W^p = \left[y^p - b - \theta q(\theta) \beta W^p\right] + \dot{W}^p. \tag{10}$$

Equation (10) shows that the gross return of the surplus from a private sector job is the sum of two elements. The first element is simply the term in bracket square in the r.h.s of (10), and reflects the difference between the productivity of the job and the opportunity cost to the worker, which is the sum of the unemployment benefit plus the expected value of finding a new job. The last term in the r.h.s of (10) is the capital gain associated with the change in aggregate labor market conditions. Substituting equation (5) into equation (10), and making use of (9), yields

$$\frac{(r+\lambda)\gamma}{(1-\beta) q(\theta)} = y^p - b - \frac{\gamma q'(\theta)}{q(\theta)^2} \dot{\theta} - \frac{\beta \gamma \theta}{1-\beta} \tag{11}$$

Equation (11) is one of the key equation of the model and describes an equilibrium transition path of θ towards its unique steady state value.[8] Given a path for θ, all the remaining asset equations for the state sector can be fully derived.

C. Job Destruction in the Public Sector.

As a way to capture the disorganization that follows the beginning of the transition, we assume that public sector jobs are subject to adverse productivity shocks, and the value of their labor product is heterogenous and it changes over time..

In what follows y_i^s denotes the productivity of a public sector job of productivity *i*, where *i* is an index of productivity in the public sector that can take *n* different values. In general, $y_i^s > y_j^s$ as long as $i>j$, so that the index i is a measure of productivity in a state sector job. Furthermore $y^p > y^n$, so that private sector jobs are always more productive than state sector jobs. In what follows, productivity shocks hit state sector jobs according to a Poisson process with arrival rate equal to δ. Conditional on being hit by a shock δ, the productivity of a state sector job, y_i^s , changes according to a transition matrix *P*, whose general row *i* reads

$$p_{ij}=0 \quad for \;\; j > i$$
$$p_{ij}=\frac{1}{i} \quad for \;\; j \le i. \tag{12}$$

The transition matrix (12) captures the idea that during the transition public sector jobs experience a worsening in the value of their labor product. The first row of (12) implies that a job of productivity *i* has no chance of moving to a job of quality *j*, j>*i*, i.e. it implies that things can only get worse over time. Conversely, the second row in equation (12) implies that a firm in state *i* faces an equal probability of moving to a job with productivity *j*, where *j* can not be higher than the current one, i.e. $j \le i$. From the transition probability matrix (12), it follows that the lowest productivity state is an absorbing state and there is a probability one that sector jobs end up in state 1 in finite time.

Let J_i^s be the value of a state firm with productivity *i*. Given the probability matrix described in (12), the value function of state sector job is

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[8]It can be immediately seen from (11) that the only path of θ that satisfies (11) and converges to the steady involves a constant θ along the transition path. The proof of the existence and the uniqueness of the steady state equilibrium as well as the solution of the transition paths of θ and W^p are derived in the appendix.

$$rJ_i^s = y_i^s - w_i^s + \delta\sum_{k=1}^{i} \frac{1}{i} \left(\max[J_k^s,0] - J_i^s \right) - \lambda J_i^s + \dot{J}_i^s \tag{13}$$

With respect to the asset valuation of a private sector job (13), the value function in (13) features an extra capital gain term. Adverse productivity shocks hit state sector jobs at rate δ, and the term in parenthesis reflects the choice faced by state-sector jobs. For each productivity value j<i that the firm may reach, the max operator in equation (13) reflects the fact that state sector jobs can not be forced to operate, and will be kept open as long as their value is still positive. Similarly, when adverse productivity shocks hit state sector jobs, public sector employees have the option to leave the job and switch to unemployment. Denoting with E_i^s the asset function of a worker employed in a state sector job with productivity *i*, the corresponding value function becomes

$$rE_i^s = w_i^s + \delta\sum_{k=1}^{i} \frac{1}{i} \left(\max[E_k^s,U] - E_i^s]\right) + \lambda \left(U - E_i^s\right) + \dot{E}_i^s, \tag{14}$$

where the max operator in (14) reflects the option of state sector workers of leaving the job, switching into unemployment and look for a job in the private sector.

We assume state sector employees share the surplus from the job with public sector insiders and get a fraction β of the total surplus. From equations (8) and (9) of the previous section, it is clear that there is agreement over which jobs should be kept open, and it is possible to define the asset valuation for the total surplus of a state job of quality i. Making use of (12), (13), and (14), the total surplus from a state sector job with productivity *i* is

$$(r+\lambda)W_i^s = y_i^s - b + \delta\sum_{k=1}^{i} \frac{1}{i}\left(\max[W_k^s,0] - W_i^s\right) - \theta q(\theta)\beta W^p + \dot{W}_i^s. \tag{15}$$

Since the surplus from the job is an increasing function of the productivity y_i, the problem facing state sector jobs can be summarized by the choice of a reservation productivity index i^*, such that a job is kept running as long as the productivity of the job is at least as high as i^*. When the productivity falls below i^*, the job is destroyed. Formally, the reservation productivity i^* is the last productivity index with a positive total surplus and satisfies the following condition:

$$i^*: W_{i^*}^s > 0, \quad W_{i^*-1}^s \leq 0. \tag{16}$$

The definition of the reservation productivity completes the description of job destruction in the state-sector. Making use of the definition of $W_{i^*}^s$, and setting $\dot{W}_{i^*}=0$, as it is true in equilibrium, the value of the marginal state sector job is

$$W^s_{i^*} = \frac{y^s_{i^*} - (b + \theta\, q(\theta) W^p)}{r + \lambda + \delta \frac{i^* - 1}{i^*}} \geq 0 \tag{17}$$

Equation (17) indicates that for a marginal job in the state sector, the value of the labor product is just sufficient to cover the opportunity cost of employment. Intuitively, as the numerator in equation (17) changes sign, a state sector job is destroyed and the worker switches to unemployment.

D. Aggregate Dynamics

To close the model, we need to specify the dynamics of unemployment. Since the distribution of state sector jobs continuously changes, we also need to keep track of the distribution of state sector jobs at different productivity values.

Unemployment dynamics is given by the difference between aggregate job creation and aggregate job destruction. Since we rule out on-the-job search, job creation comes from the matching of unemployed worker and vacant jobs. Conversely, job destruction comes from those jobs that are hit by the shock λ, plus the state-owned jobs whose productivity falls below the reservation productivity i^*. For given reservation productivity $i*$, the unemployment transition path evolves according to

$$\dot{u} = \lambda(1-u) + \delta\left(\sum_{k=i^*}^{n} \frac{i^*-1}{k} n^s_k\right) - \theta q(\theta) u, \tag{18}$$

where the first term refers to the fraction of jobs that get a shock λ, and the summation refers to the fraction of state sector jobs with productivity index higher than i^* that draw a productivity index lower than i^* . To solve for unemployment in (18), we need to specify the dynamics of state sector jobs at different productivity indices. From the definition of productivity index i^* in equation (16), it follows that

$$\begin{gathered} \dot{n}^s_i = -\lambda n^s_i - \delta\left(\frac{i-1}{i}\right) n^s_i + \delta\left(\sum_{k=i}^{n} \frac{1}{k}\, n^s_k\right) \quad if\ i \geq i^* \\ n^s_i = 0 \quad if\ i < i^*, \end{gathered} \tag{19}$$

where the first term in the first equation refers to immediate job destruction from state i, the second term keeps track of outflows to other states, and the last term keeps track of inflows into state i from other public sector jobs with productivity state above i^*. Finally, private sector employment is the difference between the fixed labor force, unemployment and state sector employment and reads

$$n^p = 1 - u - \sum_{i=1}^{n} n_i^s \tag{20}$$

Before presenting the numerical solutions it is helpful to illustrate the transition for *a simple special case* when n = 1; i.e. when all jobs in the public sector are identical and the only source of job destruction in the state sector come from the catastrophic event λ. The law of motion for unemployment becomes

$$\dot{u} = \lambda(1-u) - \theta q(\theta) u, \tag{21}$$

with initial conditions $u(0)=0$. The transition path of θ is still determined by (11) and the steady state condition. Figure 1 plots phase diagram equations (11) and (20), when market tightness θ is the control variable and u is the state variable. The equilibrium transition path is illustrated by the unique saddle path which starts at point $u(0) = 0$ and $\theta(0)=\theta^*$. In the model, the behavior of vacancies is such that the control variable, θ, immediately jumps to its steady state value and unemployment monotonically converges to the steady state point E.[9]

The transition path of wages can be derived from the transition paths of market tightness, θ, from the surplus in the private sector, W^p, and from the surplus in state sector job with productivity i, W_i^s. From (11), and from the analysis in the appendix, we know that θ, and thus W^p and W_i^s , are constant along the transition. It thus follows that the wage associated with each type of job is constant and the dynamics of the average wage is completely driven by changes in employment across sector and across productivity states in the public sector. At every point in time, the average wage equals

$$w_a = \frac{\sum_{i=1}^{n} w_i^s n_i^s + w^p n^p}{1-u} \tag{22}$$

where $\sum_{i=1}^{n} w_i^s n_i^s + w^p n^p$ is the total wage bill and $1-u$ is total employment.

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[9]For simplicity we assume that conditions on parameters are such that unemployment monotonically increases to its steady state value.

IV. Labor Market Institutions and Transition

The dynamics of aggregate labor market variables (unemployment, employment, and real wages) are driven by the productivity level at which jobs in the state sector are destroyed. Thus, different values of productivity shocks and productivity values would affect job destruction in the state sector, and the speed of convergence to the steady state. In what follows, rather than trying to calibrate the model for unobservable productivity parameters and for different productivity shocks, we focus on the aggregate impact of different labor market institutions, such as unemployment benefits, the minimum wage, and firing costs.

A. Unemployed Income

In the stylized model proposed in section III, the flow of income when unemployed, b, is intended to measure the income of workers when unemployed, and it is certainly correlated with the level of unemployment benefits, an exogenous parameter. The first policy exercise we carry out is to examine how changes in the unemployment benefits affect the equilibrium and the dynamics of the model.

In general, the level of unemployment benefit affects both job creation in the private sector and job destruction in the state sector, and the appendix reports several comparative static exercises. First $(\partial W^{p}/\partial b)\leq 0$: a higher unemployment benefit, increasing the value of the outside option to the unemployed, reduces the surplus of a private sector job. Second $\partial\theta/\partial b\leq 0$, higher unemployment benefits, through their effect on private surplus, reduce job creation in the private sector and increase steady state unemployment, thus $\partial u/\partial b\geq 0$. With respect to the public sector, it is possible to show that higher benefits reduce the surplus from a job and increase the reservation productivity in the state sector, i.e. $(\partial W^{s}_{i^*})/(\partial b)\geq 0$. Thus, if the increase in unemployment benefits is sufficiently large (so that the surplus from the reservation productivity becomes negative), the productivity level at which state sector jobs are destroyed increases. This, in turn, speeds up the transition.

Table 1 presents the baseline parameter values used for the simulations, which are meant to be suggestive, rather than fully realistic. The values of the parameters resemble the baseline values chosen in the matching literature (e.g Millard and Mortensen), and the steady state equilibrium roughly matches the statistics of a representative OECD economy. Table 2 reports the most important simulation statistics that result from the numerical solution, while figures 1 and 2 keep track of the dynamics of unemployment and real wages for different level of unemployment benefit. Table 2 shows that when the replacement ratio, defined as a ratio of unemployment benefit to the average wage, falls from .3 to .1, steady state unemployment falls by approximately one percentage point. However, as Figure 1 shows, this marginal change in unemployment benefits produces remarkable differences in the dynamics of unemployment. When the benefit ratio is relatively high, unemployment immediately jumps to double digit level and converges to the steady state level with a hump shaped dynamics. Conversely, when the replacement ratio is relatively low, unemployment does not jump, but tends to rise smoothly and converges monotonically to its steady state value. Figures 3 and 4 show that differences in the dynamics of unemployment are driven by different speeds of job destruction in the state sector and different speed of job creation in the private sector. When benefits are relatively high, the incentive to hold on to low productivity jobs in the state sector is relatively low, the reservation productivity rises and state sector jobs decline faster (Figure 3). At the same time, high job destruction in the state sector results in initially high unemployment and, from the behavior of vacancies, in relatively high job creation. Figure 3 keeps also track of the behavior of real wages over the transition, and shows that the higher the level of benefits, the lower is the fall in real wages associated with the adverse productivity shocks that hit state sector jobs. With high benefit, jobs with very low productivity are destroyed and the average wage remains relatively high.

The analysis has so far ignored the issue of benefit finances. Let us first consider the case in which payroll taxes are levied on jobs in the private sector, and let us assume that both employer and employees contribute to the payroll tax at rate π (See Appendix for formal results). The payroll tax affects the surplus from the job in the private sector and it is possible to show that higher payroll taxes reduce market tightness, thus $(\partial\theta/\partial\pi)\leq 0$. As a consequence, equilibrium unemployment raises. With respect to job destruction in the state sector, the appendix shows that higher payroll tax in the private sector increases the surplus from the job in the state sector, i.e. $(\partial W^s_{i*})/(\partial\pi)\geq 0$. Higher taxes in the private sector reduce the opportunity cost in the state sector and increase the incentive to hold on to low productivity jobs in the state sector. The overall effect of payroll taxes on the model can be summarized as follows. On the one hand, higher taxes in the private sector increases steady state unemployment, exactly as high benefits. On the other hand, they increase the surplus in state sector jobs and reduce the impact of higher unemployment benefits on job destruction in the state sector. Conversely, if taxes are levied entirely on state sector jobs, steady state variables are unaffected and the surplus in the state sector falls. Thus, payroll taxes on the state sector work in the same qualitative direction as higher unemployment benefits.

B. Minimum Wage

As in most equilibrium models, the effect of the minimum wage depends entirely on its level. In the model, a viable minimum wage must be lower than the unique wage in the private sector and it does not affect the steady state properties of the model. In what follows we consider the case of minimum wage binding for (some) state sector jobs. In general, a binding minimum wage does not influence the total surplus associated with each job, but it changes how the surplus is divided between a worker and a firm. In the absence of the minimum wage constraint, the surplus W_j^s associated with a job of productivity j is continuously split in fixed proportion. The share that goes to workers is $E_j^s-U=\beta W_j^s$ and the share that goes to the firm is $J_j^s=(1-\beta)W_j^s$. This simple rules allows to solve for the negotiated wage w_j^s.

Let us suppose that a minimum wage, $w_{\min}=\bar{w}$ is introduced, and let us assume that $w_j^s<\bar{w}$. The minimum wage can produce two effects. The first effect of a binding minimum wage is a *distributional effect.* More specifically, denoting the return to the worker from being employed in a state sector job with productivity j, $(E^s_{j(\min)})$, the share that goes to the worker must necessarily be greater than the share obtained with the splitting rule, thus $E^s_{j(\min)}-U>\beta W_j^s$.[10] Conversely, the share that goes to the firm must necessarily be lower than $(1-\beta)$. Since the outside option for a firm is zero, a firm is willing to form a match as long as its share of the total surplus is positive, i.e. $J^s_{j(\min)}>0$, where $J^s_{j(\min)}$ denotes the value to the firm with productivity j to employ a worker and pay him the minimum wage. While, at least in principle, a worker is always willing to form a match with a binding minimum wage, the problem faced by a state sector firm reads

$$
\begin{aligned}
rJ^s_{j(\min)}=y_j^s-\bar{w}-\lambda J^s_{j(\min)}+\delta\textstyle\sum_{k=1}^{j-1}\max_{\phi_k=0,1}\left((1-\phi_k)(0-J^s_{j(\min)})\right)+\dot{J}^s_{j(\min)}\\
\phi_k=1 \;\; if \; J^s_{k(\min)}>0\\
=0 \;\; otherwise
\end{aligned}
\tag{23}
$$

where the operator function ϕ keeps track of the decision to keep open a job paying a minimum wage as long as the residual fraction of the surplus that goes to the firm is positive. Equation (23) highlights second effect of the minimum wage, i.e. the *destruction effect.* In principle, a minimum wage can increase the value of reservation productivity index and cause faster destruction of low productivity jobs. Since firms are obliged to pay workers the minimum wage $\bar{w}$, the fall in the present future profits may be so high that the value of the job turns negative, and it becomes optimal to immediately shut down the job .

Similarly to equation (23), the return to the worker employed in a firm that pays a binding is

$$
\begin{aligned}
rE^s_{j(\min)}=\bar{w}+\lambda(U-E^s_{j(\min)})+\delta\textstyle\sum_{k=1}^{j-1}\frac{1}{j}\max_{\phi_k=0,1}\left((1-\phi_k)(U-E^s_{j(\min)})\right)+\dot{E}^s_{j(\min)}\\
\phi_k=1 \;\; if \; J^s_{k(\min)}>0\\
=0 \;\; otherwise
\end{aligned}
\tag{24}
$$

where $\bar{w}$ is the minimum wage, $\lambda(U-E^s_{j(\min)})$ is depreciation due to the destructive shock,

---

[10]Since, by assumption, the minimum wage is not binding in the private sector, the value of being unemployed, U, does not change and is described by (7).

the term in bracket is the capital loss associated with changes in the productivity index and the last term is the capital gain.

To summarize, equations (23) and (24) show that for a given reservation productivity i^*, the introduction of the minimum wage implies the selection of a new reservation index, $i_{\bar{w}}$, determined in the following way:

$$
\begin{aligned}
&i_{\bar{w}} = i^* \qquad \textit{if} \;\; w_{i^*}^{s} \geq \bar{w} \\
&i_{\bar{w}} = j;\;\; j \geq i^* \;\; \textit{if} \;\; w_{i^*}^{s} < \bar{w} \\
&(\textit{where } j \textit{ is s.t. } y_j^{s} > \bar{w} \geq y_{j-1}^{s})
\end{aligned}
\tag{25}
$$

The first row in equation (25) says that the reservation productivity does not change if the minimum wage is not binding and is below the negotiated wage. The second row says that when the minimum wage is binding the reservation productivity may increase. The last row says that the new reservation productivity is the first productivity index higher than the minimum wage. The derivation of (25) is provided in the appendix.

Figures 6 to 9 show the dynamics of the transition with a binding minimum wage in the state sector. From figure 6 and 7 is clear that the higher the minimum wage, the higher is the increase in unemployment at earlier stage of the transition and the lower is the fall in real wages. Figure 8 and 9 show that the relatively high minimum wage increases job destruction in the state sector and speeds up the convergence to the steady state. With respect the parameter chosen, the minimum wage in figure 4 and Table 2 is extremely high, especially if compared with the wage in the private sector. However, if wage in the private sector were allowed to grow, as they should be in reality, the minimum wage would turn out to be high at early stage of the transition, and in steady state would be much lower than the one used in Table 2 and in the simulations.

C. Firing Tax

The last institution we consider is a firing tax to be paid before a match can be dissolved. Since we do not explicitly model job destruction in the private sector, our analysis is limited to the case of firing costs in the state sector. Burda (1992) considers the effect of firing costs on the bargained wage and we refer the reader to that paper for the effect of firing costs on the steady state wage. Garibaldi (1997) considers various forms of job security provisions in a model of job creation and destruction, and our analysis follows that paper, even though we only focus on job destruction in the public sector. Both parties know that dissolving the match involves a lump sum tax and, with respect to the job destruction decision, the formal decision who is actually paying the tax is irrelevant, and there is always agreement on the decision to shut down the job. In what follows, we assume that before dissolving a job the worker-firm pair must incur a lump sum fee equal to F, and the total surplus from the job reads

$$(r+\lambda)W_i^s = y_i^s - b + \delta\sum_{k=1}^{i}\frac{1}{i}\left(\max[W_k^s, -F] - W_i^s\right) - \theta q(\theta)\beta W^p + \dot{W}_i^s. \tag{26}$$

The difference between (13) and (26) is that a job continues to operate even if the value of operating is negative, as long as the loss from operating surplus is lower than cost of exiting.The presence of the firing costs changes the definition of the reservation productivity i^f, that now satisfies

$$W_{i^f}^s > -F, \quad W_{i^f-1}^s \le -F \tag{27}$$

Comparing (16) and (27) we see that for a given productivity distribution of the state sector, $i^f \le i^*$ if the state firm pays firing tax $F \ge 0$ when laying off a worker.

Figures 10 to 13 simulate the dynamics of the model for different level of firing taxes. Higher firing taxes, increase the incentive to hold on to low productivity jobs in the state sector and affect the reservation productivity. As a consequence, higher firing costs reduce job destruction in the state sector, reduce the increase in unemployment at early stage of the transition and increase the fall in real wages. Even though the mechanics is driven by very different channels, the qualitative effect of higher firing costs are similar to the effect of higher unemployment benefits. The main difference is that high firing costs in the public sector do not affect the steady state condition.

V. A Brief Look at the Empirical Evidence

The dynamics of output and unemployment in CEE and CIS economies have been extensively documented in the transition literature. While we refer to the extensive work of the OECD and the World Bank for the details and the cross-country variation, in what follows we just review the main characteristics and findings of the empirical literature. With the notable and extensively documented exception of the Czech Republic (Boeri and Burda, 1996), the transition in CEE economies is characterized by a dramatic rise in the unemployment rate. Average unemployment, almost non-existent at the beginning of the nineties, has reached the double digit level in most CEE economies (Table 3). Surprisingly, similar patterns do not hold in the CIS, where officially reported unemployment data show an average unemployment rate of only 4 percent, despite a cumulative output fall in GDP of approximately 50 percent. Table 3 reports unemployment and output dynamics for 6 CEE economies and two of the largest CIS countries, Russia and Ukraine[11].

One possible way to reconcile the difference in unemployment dynamics is to question the quality of the unemployment statistics in CIS. Several authors, and Standing (1997) in particular, have pointed out the problems with registered unemployment data in CIS countries, and in Russia in particular. Standing points out that official unemployment in Russia is likely to be underestimated because old workers tend to be counted as pensioners even if they are actively searching for jobs, and because the temporary laid off are still counted as employed.[12] A first way of dealing with the issue is to consider alternative unemployment statistics, such as the unemployment rate measured by Labor Force Survey (LFS) that applies international definitions of unemployment. ILO measures of unemployment in Russia show that the unemployment rate passed 9 percent in 1996. For Ukraine, a LFS was firstly conducted in 1994 and shows that unemployment, albeit much higher than the officially reported data, is still very low with respect to CEE standards.

Furthermore, once the larger output fall in CIS economies is correctly taken into account, Commander and Tolstopiatenko (1995) show that unemployment responded more to the output fall in CEE than in Russia. In CEE economies, output fell by some 20-30 percent and unemployment sharply rose to the double digit level. Considering an average output fall

---

[11]The selection of countries in Table 3 was driven by the availability of comparable information on labor market institution in ILO (1996). Official unemployment in other CIS countries show similar results, but is difficult to find consistent time series on ILO unemployment estimates.

[12]Standing refers also to the fact that the fall in employment has been higher than the increase in unemployment. Since he reports also of a dramatic fall in the labor force, we do not believe that the fall in employment is, by itself, evidence of the rise in hidden unemployment.

in the CIS of more than 50 percent, *it is clear that the response in the unemployment level in CIS* countries was much smaller than in CEE. Another possible explanation of the smaller response of unemployment to the output fall would be a dramatic change in labor force participation in CIS countries. However labor force participation marginally fell marginally across the entire region, and there not seem to be substantial difference between the CIS and CEE.

The dynamics of real wages, measured as the difference between increases in average wages and increase in average consumer price index, complete the picture of the dramatic difference in the dynamics of unemployment between CEE and CIS countries. Table 5 reports real wage indices for the same countries reported in Table 3. Overall, there is a substantial fall in real wages across the entire region. However, the magnitude of the fall varies between CEE and CIS countries. If real wages in CEE were equal to 100 in 1989, in Czech Republic Hungary, Poland and Slovakia they fell by some 30 percent, while they fell by some 50 percent in Bulgaria and Romania. Similar data constructed for Russia and Ukraine show that the cumulative fall in real wages was higher than 60 percent in Ukraine, reaching almost 70 percent in Russia. The problem with official wage data in CIS is that they disregard wage arrears, and it is quite likely that the actual fall in real wages was much higher than what is reported in official data. As the recent work by Standing shows, in the Russian Federation around 70 percent of workers report that their firms owe them wage arrears. Besides the non-payment of wages, workers report that they were put on minimal salary, well below the contractual wage rate and in some cases below the minimum subsistence income. Conversely, the problem with *wage* arrears in CEE countries has been fairly limited *so far*.

A. Labor Market Institutions

The theoretical analysis of the previous sections has argued that the minimum wage, the level of unemployment benefit and the firing costs can be important determinant of the dynamics of unemployment in transition economies. Table 6 reports time series data on the minimum wages for the same CEE countries reported in Table 3, plus data for Russia and Ukraine. Two facts are worth noting. First, as Standing and Vaughan-Whitehead of the ILO (1995) recognize, there is an overall tendency for the minimum wage to fall as a percentage of the average wage. Second, since 1993, the level of the minimum wage as a percentage of the average wage in Russia and Ukraine is exceptionally low. In Russia and Ukraine, the minimum wage is less than 10 percent of the average wage, whereas it averages around 35 percent in other CEE economies. By all international standards, it is reasonable to assume that there is no minimum wage in Russia and Ukraine.

The theoretical analysis of the previous section suggests that the higher the minimum wage, the higher is the increase in unemployment at early stage of the transition, and the lower is the fall in real wages. As a results, higher minimum wage increases the reshuffle of jobs between the state and the private sector. The differences in minimum wages between

CEE and CIS countries is remarkable, and the difference in the dynamics of unemployment between the two regions goes in the direction suggested by the model. Furthermore, the dynamics of real wages go in the direction predicted by the model, even though the magnitude of the actual fall in real wages is over and beyond the explanatory power of the simple model.

As was also pointed out by Commander and Tolstopiatenko (1996) , a way to look at the differences in unemployment dynamics is to look at the generosity of the unemployment system. In CEE there has been some fall in the level of the unemployment benefit but the replacement ratio has remained in the order of 40 50 percent. Table 6 reports 1994 data on average unemployment benefits and on the unemployment insurance system for the same countries for which we have data on the minimum wage. If we take the Russian Federation and Ukraine as representative countries for the CIS, differences highlighted in Table 6 are remarkable. In the Russian Federation, unemployment benefits, as a percentage of the average wage fell below 20 percent, while in CEE economies they remain well above 40 percent.[13] Data on the average benefit duration suggests that there is no remarkable differences between CEE and CIS economies. The last column of the Table 7 proposes a simple measure of the generosity index and suggests that Ukraine and Russia fell at the very bottom of the proposed scale. In CEE, as Commander and Tolstopiatenko report, unemployed workers are entitled to social assistance after the expiration of the unemployment insurance. In Russia, by contrast, when the unemployment insurance expires, workers have no further assistance.

The theoretical analysis of the previous section suggests that higher unemployment benefits should raise the unemployment rate over the transition, reduce the fall in real wages and speed up the closure of the state sector. Again, looking at the generosity index compiled in Table 7, it is suggestive to note that the difference in labor market dynamics and the difference in unemployment benefit among the selected countries go in the direction implied by the model. CEE economies experienced a relatively rapid increase in unemployment and a relatively lower decline in real wages. The evidence on private sector developments goes also in the direction predicted by the model, but data on private sector developments are very difficult to interpret, owing to the simultaneous presence of the privatization process (Table 4).

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[13]The level of the average benefit in Table 7 is calculated on the basis of the existing legislation, as is described in ILO (1996) and in Table 7. While CEE economies tend to link benefits to the average wage in the country or to the minimum wage, Russia and Ukraine calculate the benefits in a different way. Russia links the benefit to the wage in the previous year and this practice, in periods of high inflation, substantially reduces the replacement ratio with respect to the existing average wage. Ukraine links the benefit to the salary of the previous job, providing no automatic indexation for periods of high inflation. Thus the very low coverage with respect to the average wage in 1994.

Finally, Table 8 looks at the structure of firing costs in our sample of countries. Information on severance payments and prior notice indicates that measured firing costs are not very high by western European standards (OECD 1994). Furthermore, from Table 8, there is no significant difference between the structure of firing costs in CEE countries and Russia and Ukraine. Even though our theoretical analysis predicts that high firing costs affect unemployment and wage dynamics, from the information reported in Table 8 it is impossible to connect differences in labor market dynamics to differences in firing costs.

VI. Conclusions

This paper has examined the interactions between labor market institutions and the dynamics of unemployment and real wages in transition economies. In a dynamic matching model in which the state sector endogenously sheds labor and private job creation takes time, the paper has shown that labor market institutions, such as the unemployment insurance system and the minimum wage, are important determinants of labor market dynamics.

Three results arise from the analysis. First, higher unemployment benefits increase unemployment in the steady state and, during the transition, they reduce the fall in real wages and they increase the speed of transition. Second, higher minimum wages can theoretically speed up the transition process without affecting steady state unemployment. Third, firing costs in the public sector slow down the increase in unemployment in the early stage of the transition and slow down the fall in real wages. These results show that the effects of labor market institutions during the transition can be very different than the steady state effects. Thus, without a fully dynamic analysis, it is very difficult to infer the full impact of different labor market institutions. The paper has offered a first attempt to distinguish between these temporary and permanent effects.

From an economic policy stand-point, the paper has shown that during the transition, institutions that increase the return to unemployment can speed-up the process of job reallocation between low productivity jobs in the public sector and high productivity jobs in the emerging private sector. Other traditional policy instruments, like cuts in subsidies to low productivity jobs in the public sector have not been formally analyzed, and an extension of the model would predict that a cut in subsidy speed up the reallocation process. Furthermore, such policies would not affect the steady-state equilibrium of the model.

The paper has briefly reviewed the labor market experience of several CEE economies and two CIS economies, Russia and Ukraine, and has argued that the difference in labor market institutions across countries can cast some lights on differences in labor market dynamics. CEE economies, with the exception of the Czech republic, have experienced a dramatic rise in unemployment and substantial fall in real wages. Conversely, CIS countries have experienced a moderate increase in unemployment and a substantial decline in real wages. Differences in minimum wages and in the unemployment insurance system across countries are consistent with the implications of our model. The minimum wage appears to be much higher in CEE economies than in Russia and Ukraine, and the unemployment insurance system is much more generous. Finally, there is no evidence of substantial differences in severance payments and firing costs.

Much remains to be done. A natural extension of the model would be to look at how different institutions affect the optimal speed of transition. With respect to the unemployment insurance system, the paper has pointed out a potential trade-off between the effect of benefits on the speed of transition and on the steady state unemployment rate. Solving an efficiency problem for the optimal level of benefits, would probably result in a relatively high benefits at early stage of the transition, followed by relatively low benefits as the system approaches the steady state. Similar reasoning would apply for the minimum wage. We intend to carry over such tasks in future research.

Table 1: Baseline Parameter Values

Variables	Notation	Value
Matching Elasticity	α	0.50
friction parameter	γ	1.00
bargaining share	β	0.40
turnover rate (private)	λ_p	0.09
turnover rate (public)	λ_s	0.00
interest rate	r	0.04
productivity (private)	y^p	1.00
productivity (public)	y_1^s	0.98
productivity (public)	y_n^s	0.78
productivity states	$i...n$	20.00
state sector shock rate	δ	0.25
unemployment benefit	b_{high}	0.30
unemployment benefit	b_{low}	0.10
firing costs (high)	f_h	0.30
firing costs (low)	f_l	0.00
minimum wage (high)	w_{min}	0.81
minimum wage (low)	w_{min}	0.00

Source: authors' calculations.

Table 2: Simulation Statistics

Simulation	u^* [1]	w^p [2]	$\frac{b}{w^p}$ [3]	$\overline{w}$ [4]	F [5]
Benefits:					
$b = 0.30$	0.093	0.89	0.34	0.00	0.00
$b = 0.20$	0.087	0.88	0.23	0.00	0.00
$b = 0.10$	0.082	0.87	0.12	0.00	0.00
Minimum Wage:					
$b = 0.20$	0.087	0.88	0.23	0.00	0.00
$b = 0.20$	0.000	0.88	0.23	0.81	0.00
Firing Costs:					
$b = 0.20$	0.000	0.88	0.23	0.81	0.30
$b = 0.20$	0.000	0.88	0.23	0.81	0.00

[1] Steady State Unemployment
[2] Private Sector Wage
[3] Benefit Level, Replacement Ratio in Steady State
[4] Minimum Wage
[5] Firing Costs
Source: authors'calculation

Table 3: Output and Unemployment over the Transition: 1989-96

Country	1989	1990	1991	1992	1993	1994	1995	1996
Bulgaria								
Output	100	90.9	80.3	74.4	72.6	73.9	75.8	72.8
Unemployment Rate	-	1.5	6.7	13.2	15.7	14.1	11	-
Czech Republic								
Output	100	99.6	85.5	80	79	81	85	89.6
Unemployment Rate	-	0.3	2.6	3.1	3	3.3	2.9	-
Hungary								
Output	100	96.5	85.3	82.2	81.9	84.2	85.6	86.8
Unemployment Rate	0.4	0.8	4.1	10.3	12.9	11.3	10.6	11.1
Poland								
Output	100	88.4	82.2	84.4	87.6	92.1	98.6	103.5
Unemployment Rate	-	3.4	9.7	13.6	14.9	16.5	15.3	14.4
Romania								
Output	100	94.4	82.2	75	76	78.9	84.4	88.1
Unemployment Rate	-	-	3	8.4	10.4	10.9	10.4	9
Slovakia								
Output	100	97.5	83.2	77.8	74.7	78.2	84	88.7
Unemployment Rate	-	0.6	6.6	11.4	12.7	14.4	13.9	12.7
Russia								
Output	-	100	87	74.4	67.9	59.4	56.9	55.3
Unemployment Rate 1	-	-	0.1	0.8	1	1.7	2.8	3.6
Unemployment Rate 2	-	-	-	-	5.6	7.5	8.9	9.6
Ukraine								
Output	-	100	91	82	70.4	54.3	47.9	44.5
Unemployment Rate 1	-	-	0.1	0.3	0.4	0.4	0.6	
Unemployment Rate 3	-	-	-	-	2.4	4.7	-	-

[1] Official Unemployment
[2] Unemployment according to ILO defintion
[3] Unemployment according to ILO defintion from Labor Force Survey
Source: IMF, Euroepan Commission and Ministry of Ukraine

Table 4: Private Sector Share in Employment in Transition Economies: 1989-95

Country	1989	1990	1991	1992	1993	1994	1995
Bulgaria	5.5	5.9	10.1	17.7	28.3	34.7	-
Czech Republic 1	1.3	6.9	18.8	31.1	47.1	-	-
Hungary	-	-	-	-	-	59.4	-
Poland	45.7	45.8	51.1	57	57.6	59.8	-
Romania 1	5.9	9.2	33.6	41	43.8	51.4	-
Slovakia 1	1	5	12.8	18.4	22.2	31.9	-
Russia 3	-	-	-	-	28	33	34.4
Ukraine [1]	-	-	-	-	-	8	16

[1] Excluding cooperative
[2] Including cooperative
[3] From Goskomstat
Source: Ebrd (1995) and International Monetary Fund

Table 5: Real Wage Indices over the Transition: 1989-96

Country	1989	1990	1991	1992	1993	1994	1995	1996
Bulgaria	100	106.2	61.3	72.7	73.5	58.6	48.6	-
Czech Republic	100	94.5	69.7	76.8	79.6	84.7	90.7	-
Hungary	100	99.8	96.1	97.7	97.3	102.2	96.1	-
Poland	100	72.6	72.7	70.6	68.5	68.9	69.2	-
Romania	100	104.5	82.9	72.2	55.4	44.4	51.2	-
Slovakia	100	94.6	67.5	73.8	71	73.2	75.2	-
Russia	-	-	100	42	41.5	37.9	29.2	32.4
Ukraine	-	-	100	73	37.1	32.8	36.8	38.2

Source: IMF and Euroe̍pan Commission

Table 6: Minimum Wage over the Transition: 1989-95

Minimum wage as a percentage of average wage							
Country	1989	1990	1991	1992	1993	1994	1995
Bulgaria	-	43.7	53.3	35.0	38.3	36.8	34.7
Czech Republic	-	-	52.3	47.1	37.4	31.9	27.5
Hungary	34.6	37.3	37.4	35.9	32.8	31.2	-
Poland	18	21	34	43	41	43	43
Romania	66.4	57.2	55.5	42.3	39.2	31.4	26.2
Slovakia	-	-	52.3	48.5	41	38.9	37.1
Russia	27	24	14	9	9	7	10
Ukraine	-	32.3	53	20.3	7.6	3	0.8
Source: ILO (1996)							

Table 7: Generosity of the Unemployment Insurance System in 1994

Country	Minimum Wage over average wage [1]	Average Benefit level[2]	Average benfit duration[3]	Generosity index
Bulgaria	36.8	42.3	8	338.6
Czech Republic	31.2	55	6	330
Hungary	43	64.5	24	1548
Poland	31.4	36	18	648
Romania	31.4	55	9	495
Slovakia	38.9	55	6	330
Russia	7	13	18	234
Ukraine	3	14	8	112

[1] Minimum wage in 1994; See Table 6

[2] Average level of benefit in 1994;

Average level of benefit calculated as follows:

Bulgaria 115% the minimum wage; Czech Republic 55% of the average wage;

Hungary 150% of the minimum wage; Poland 36% of the minimum wage;

Romania 55% of the average wage; Slovakia 5% of average wage;

Russia 55% of wage in the previous year; Ukraine 60 wage in previous job;

[3] Average duration of benefit in months;

[4] Average level of benefit times average duration;

Source: ILO (1996) and authors' calculation

Table 8: Firing Cost in Selected Transition Economies.

Country	Severance Payments	Prior Notice
Bulgaria	2 months' gross pay;	1 month if bankrupt or mass layoffs
Czech Republic	2 months' gross pay	paid thorugh severance payments
Poland	$\leq$ 10 years: 1 month's pay; 10-20 years: 2 months	Works council must be consulted
Romania	None	Not enforced
Slovakia[1]	2 months' gross pay	paid through severance payments
Russia	2 months' wage; 3 months' wage if workers does not find a job	-
Ukraine	None	3 months

[1] Identical to Czech Republic for 1993

Source: Burda (1993) and International Monetary Fund, (1996)

Figure 1: Unemployment Dynamics with no heterogeneity in the public sector

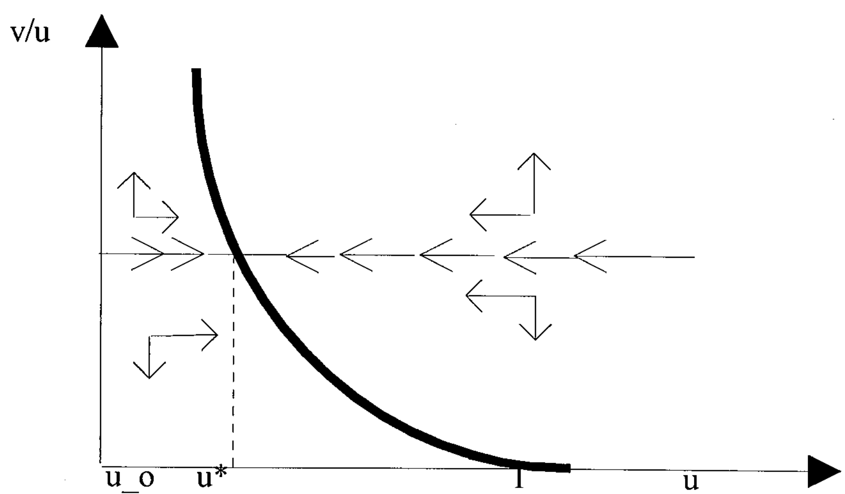


Figure 2: Transition of Unemployment for Different Benefit Level

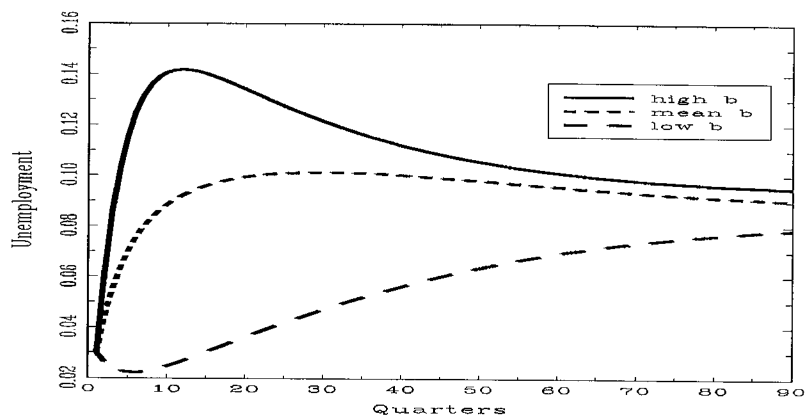


Figure 3: Transition of Real Wages for Different Benefit Level

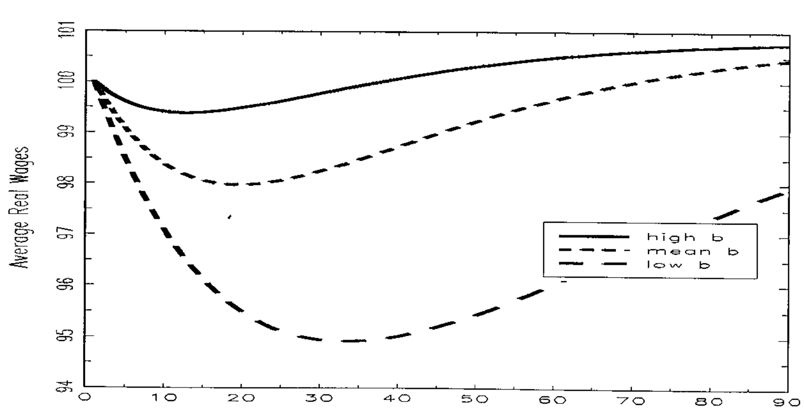


Figure 4: Private and State Sector Jobs with High benefits

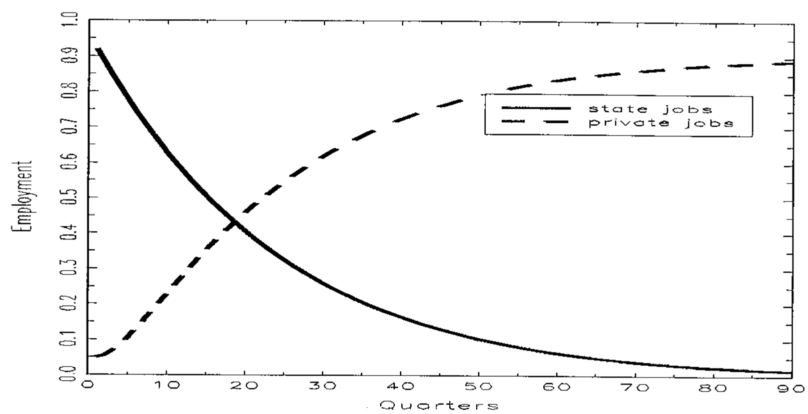


Figure 5: Private and State Sector Jobs with Low benefits

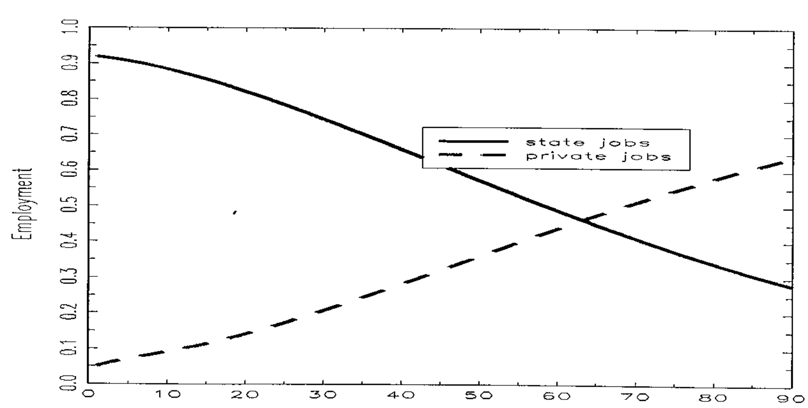


Figure 6: Transition of Unemployment for Different Minimum Wages

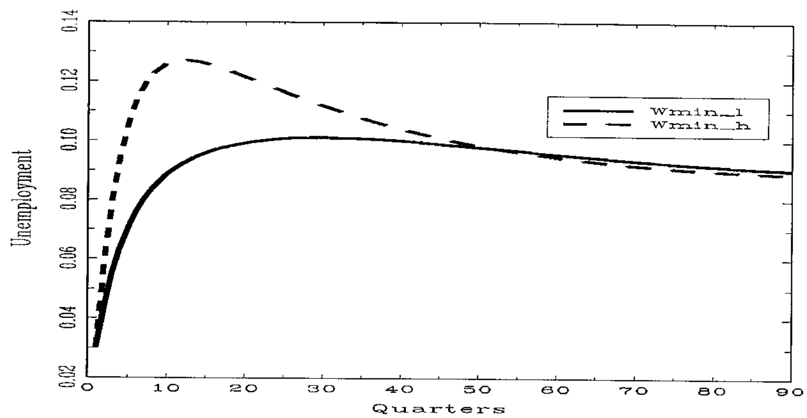


Figure 7: Transition of Real Wages for Different Minimum Wages

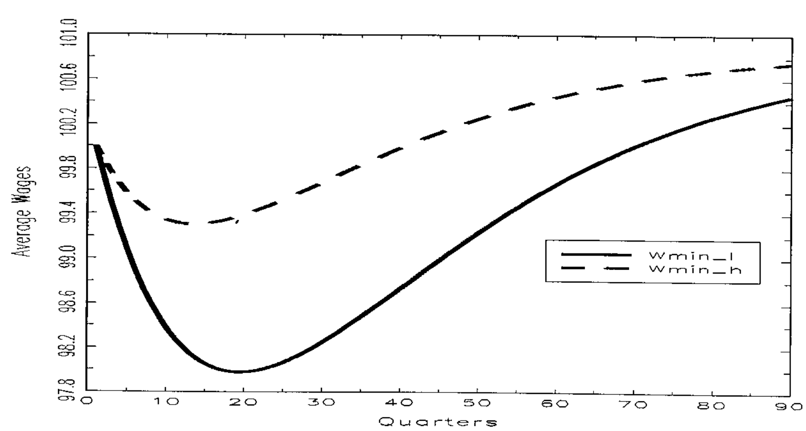


Figure 8: Private and State Sector's Jobs No Minimum Wage

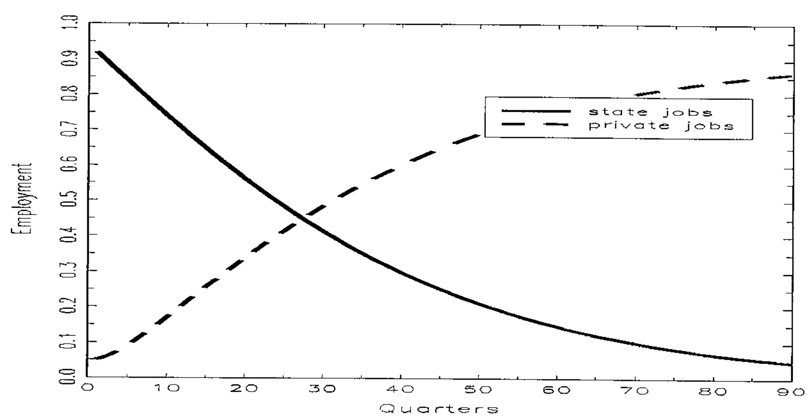


Figure 9: Private and State Sector's Jobs with High Minimum Wage

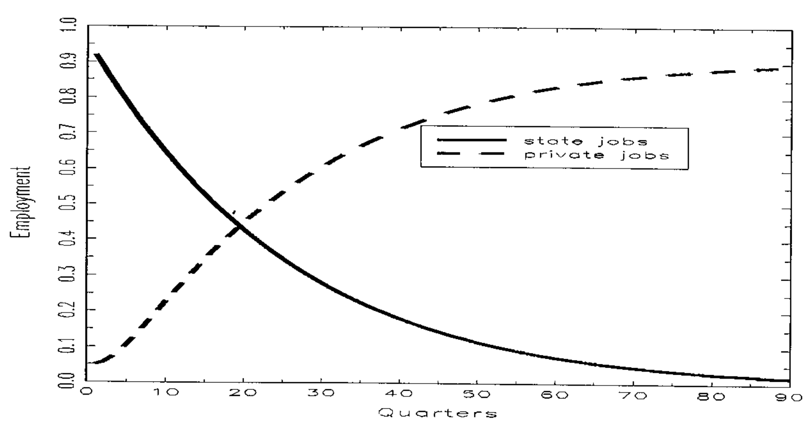


Figure 10: Transition of Unemployment for Different Firing Costs

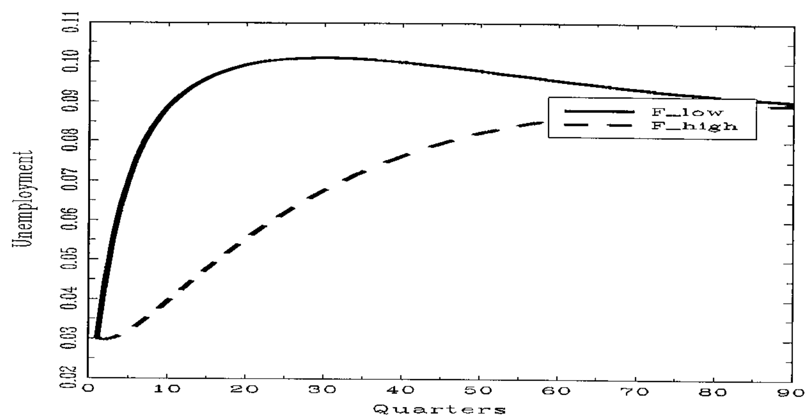


Figure 11: Transition of Real Wages for Different Firing Costs

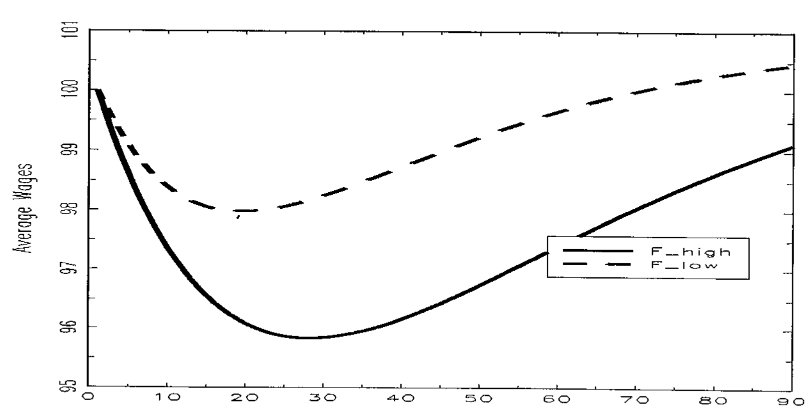


Figure 12: Private and State Sector's Jobs with High Firing Costs

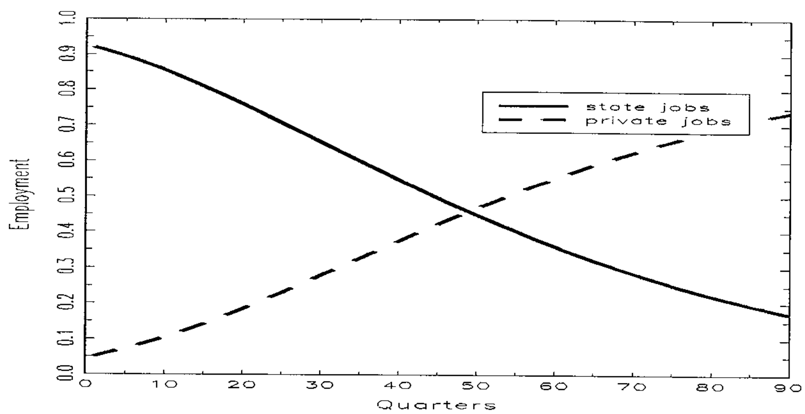
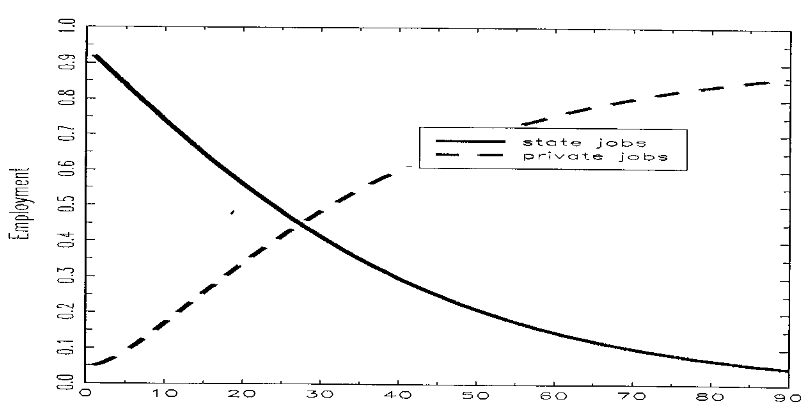


Figure 13: Private and State Sector's Jobs with No Firing Costs



I. Some Comparative Static Results

A. A. Steady State Equilibrium

In the steady state equilibrium, all state sector jobs are destroyed, i.e. $n_i^s = W_i^s = 0 \quad \forall i$. Furthermore, $\dot{u} = \dot{n}^p = \dot{W}^p = 0$ and market tightness θ is uniquely determined by

$$0 = \frac{(r+s)\gamma}{(1-\beta)q(\theta)} - p^p + b + \frac{\beta\gamma\theta}{(1-\beta)} \tag{28}$$

Given θ, all other steady state variables can be derived as follows:

$$u = \frac{\lambda}{\lambda + q(\theta)\theta}, \tag{29}$$

$$n^p = 1 - u. \tag{30}$$

and

$$W^p = \frac{y^p - b}{r + \lambda + \theta q(\theta)}, \tag{31}$$

where $(1-\beta)W^p$ is the firm's share of the total surplus.

Proof of the Existence and the Uniqueness of the Steady State Equilibrium

Claim: There exists a unique θ^* that satisfies (11). Proof: Define

$$H(\theta) = \frac{(r+s)\gamma}{(1-\beta)q(\theta)} - p^p + b + \frac{\beta\gamma\theta}{(1-\beta)} \tag{32}$$

(i) Suppose that $\theta \Rightarrow 0$. Then $H \Rightarrow b - p^p < 0$. (ii) Suppose that $\theta \Rightarrow \infty$. Since H is continuous, there exists θ^* s.t. $H(\theta^*) = 0$. Since $H'(\theta) < 0$, θ^* is unique.

B. B. Transition

It is clear from (32) that there exists a unique saddle path of θ which satisfies this condition and reaches the steady state derived above. Along this saddle path, θ is constant (it assumes that market tightness immediately jumps at date *0*). Consequently, the surplus associated with each job matches, the respective wages are constant, and the reservation productivity level, i^* , is the same throughout the transition.

The values of W^p and w^p were already derived in part I. To obtain the surpluses W_i^s , and wages w_i^s $(i = 1,....n)$ associated with state sector match , we start with the least productive job $(i = 1)$ and we proceed recursively. From (15), the surplus and wage in the least productive state sector job read

$$W_1^s = \frac{y_1^s - b - \theta q(\theta) W^p}{r+\lambda}, \tag{33}$$

and

$$w_1^s = y_1^s - (r+\lambda)(1-\beta) W_1^s \tag{34}$$

Similarly, the surplus and the wage in the second least productive job read

$$W_2^s = \frac{y_2^s - b + \delta \frac{1}{2} \max[W_1^s, 0]}{r+\lambda+\delta/2} \tag{35}$$

$$w_2^s = y_2^s - (r+\lambda+\frac{\delta}{2})(1-\beta) W_2^s + \frac{\delta}{2} \max[(1-\beta) W_1^s, 0] \tag{36}$$

The remaining surpluses and wages can be determined in a similar way. The reservation productivity level, i^*, is the index of the first positive surplus.

C. C. Labor Market Institutions and Transition

Unemployment Benefits

Proposition: $\partial W_i^s / \partial b \leq 0$. The Surplus associated with job of productivity i is decreasing in unemployment benefits.

Proof: We proceed in three steps. First we show that the ratio of vacancies to unemployed, θ, is decreasing gin unemployment benefits, b. Then we show that the surplus associated with a private sector job, W^p, is decreasing in b. Finally we show that surpluses in state sector jobs are decreasing in b.

Step (1). In order to show that $\frac{\partial\theta}{\partial b}<0$ we differentiate (28) w.r.t. b and obtain:

$$\frac{\partial\theta}{\partial b}\left(\frac{\beta\gamma}{1-\beta}-\frac{(r+\lambda)\gamma\frac{\partial q(\theta)}{\partial\theta}}{(1-\beta)q(\theta)^2}\right)=-1 \tag{37}$$

Since, by assumption $\frac{\partial q(\theta)}{\partial\theta}<0$, (37) implies $\frac{\partial\theta}{\partial b}<0$.

Step (2). From (5) and (10) we get that the surplus in the private sector job can be written as

$$(r+\lambda)W^p=\frac{(1-\beta)(y^p-b)-\theta\beta\gamma}{1-\beta} \tag{38}$$

Then

$$(r+\lambda)\frac{\partial W^p}{\partial b}=\frac{(r+\lambda)\gamma\frac{\partial q(\theta)}{\partial\theta}}{\beta\gamma q(\theta)^2-(r+\lambda)\gamma\frac{\partial q(\theta)}{\partial\theta}}<0 \tag{39}$$

Step (3) From (15) we derive the surplus in the least productive state job to be

$$(r+\lambda)W_1^s=y_1^s-b-\frac{\theta\beta\gamma}{1-\beta} \tag{40}$$

It is clear that $\frac{\delta W_1^s}{\delta b}$ is identical to $\frac{\delta W^p}{\delta b}$. Given these results, the surplus of second least

productive state sector job satisfies

$$(r+\lambda+\delta/2)W_2^s=y_2^s-b-\frac{\theta\beta\gamma}{1-\beta}+\delta\frac{1}{2}\max[W_1^s,0] \tag{41}$$

and must be also decreasing in b.

Payroll taxes

The case of taxes levied on the Private sector

If both the employer and the employee contribute to a payroll tax at rate π, the gross wage for the employer is $w(1+\pi)$ and the net wage for the employee is $w(1-\pi)$. The total surplus reads

$$(r+\lambda)W^{P} = y^{P} - 2\pi w^{P} - \beta\theta q(\theta)W^{P} \tag{42}$$

where w^{P} can be obtained from the firm's value function and reads

$$w^{P} = \frac{y-(r+\lambda)(1-\beta)W^{P}}{1+\pi} \tag{43}$$

Combining (42) and (43), and making use of the free entry condition (5), θ is uniquely determined by

$$\frac{(r+\lambda)\gamma}{(1-\beta)q(\theta)} = \frac{(1-\pi)y}{1+\pi} + \frac{2\pi(r+\lambda)}{1+\pi}\frac{\gamma}{q(\theta)} - \frac{\beta\theta\gamma}{1-\beta} \tag{44}$$

We derive two comparative static results: First $(\partial\theta)/(\partial\pi)<0$. Differentiating (18) with respect to θ, and rearranging, yields

$$\frac{-\gamma q'(\theta)(r+\lambda)[1-\pi+2\beta\pi(2-\beta)]+\beta\gamma(1-\beta)q(\theta^{2}(1+\pi)}{(1-\beta)^{2}q(\theta)^{2}(1+\pi)}\frac{\partial\theta}{\partial\pi} = -2(r+\lambda)\gamma q(\theta)(1+\pi)^{2} - \frac{2\pi y^{P}}{(1+\pi)^{2}}$$

Since the r..h.s is negative and the fraction on the l.h.s. is positive, the results immediately follows.

Second $(\partial W_{i^*}^{s})/(\partial\pi>0$. Differentiating $W_{i^*}^{s}$ with respect to π yields

$$(r+\lambda+\delta\frac{i^{*}-1}{i^{*}})\frac{\partial W_{i^*}^{s}}{\partial\pi} = -\beta\gamma\frac{\partial\theta}{\partial\pi}$$

Making use of the fact that $(\partial\theta)/(\partial\pi)<0$ The result follows immediately.

If only public sector employee and employer contribute at rate π at a payroll tax, steady state market tightness θ is not affected. Proceeding as in (43) and (44), the surplus form a state sector jobs with payroll taxes read

$$\frac{(r+\lambda+\delta(i^*-1)/i^*)(1-\pi+2\pi\beta)}{1+\pi}W^s_{i^*}=y^s_{i^*}-b-\beta\theta q(\theta)w^p-\frac{2\pi y^s_{i^*}}{1+\pi} \qquad \textbf{(47)}$$

$(\partial W^s_{i^*})/(\partial\pi)<0$. Differentiating (47) w.r.t. π and rearranging yields

$$\frac{\partial W^s_{i^*}}{\partial\pi}(r+\lambda+\delta(i^*-1)/i*)(1-\pi+2\pi\beta)=\frac{-2y\beta}{(1+\pi)^2}-\frac{(b+\theta q(\theta)W^p)2(1-\beta)(1+\pi)}{(1+\pi)^2}$$

the results follows immediately.

Minimum Wage

Claim: Suppose that the minimum wage $w_{\min}=\bar{w}$ is binding for jobs with productivity $j\geq i^*\geq 1$. Then the match j is terminated if and only if $y^s_j\leq\bar{w}$.

Proof: First suppose that the minimum wage is not used. We know from (17) that with $i^*\geq 1$ the reservation productivity, the surplus associated with this job is

$$(r+\lambda+\delta\frac{i^*-1}{i^*})W^s_{i^*}=y^s_{i^*}-b-\theta q(\theta)\beta W^p \qquad \textbf{(49)}$$

which can be decomposed into a surplus to a worker

$$(r+\lambda+\delta\frac{i^*-1}{i^*})(E^s_{i^*}-U)=w^s_{i^*}-b-\theta q(\theta)\beta W^p \qquad \textbf{(50)}$$

and surplus to a firm

$$(r+\lambda+\delta\frac{i^*-1}{i^*})J^s_{i^*}=y^s_{i^*}-w^s_{i^*} \qquad \textbf{(51)}$$

Now suppose that the minimum wage $\bar{w}\geq w^s_{i^*}$ is imposed. From (51) we see that $\bar{w}\geq y^s_{i^*}$ *iff* $J^s_{i^*}\leq 0$, i.e. we have proved our claim for i^*. Since if minimum wage is higher than labor output at job j, $j>i^*$, it is also higher than labor output at job k, $i^*\leq k<j$, the claim holds for any $j\geq i^*$.

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