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Modelling labour reallocation during the Polish transition: a search-and-matching approach

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Abstract

An important feature of the reallocation process that took place in Eastern European and former Soviet Union countries was the decline in public sector employment due to the collapse of state-owned enterprises combined with an increase in private sector employment as new private firms emerged and old public companies were privatized. We propose a theoretical, parsimonious model which combines this feature with the standard search and matching model introduced by Diamond, Mortensen and Pissarides. Using numerical simulation we show that faster transition (associated with faster restructuring of state-owned enterprises into more productive private firms) leads to a quicker convergence to the post-transitional equilibrium characterized by high GDP and high employment in the private sector. However, this comes at the cost of negative output growth and higher unemployment in the short run.

Keywords: labour reallocation, transition, search-and-matching

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1 Introduction

Starting from the early 1990s, Central and Eastern European (CEECs) and former Soviet Union (FSU) economies were expected to experience a massive labour force reallocation related to their move from centrally planned to market regimes. Economists pointed to a distinct process behind this reallocation which was the closure of inefficient state-owned enterprises and the associated decline of employment in the public sector, combined with the emergence of an allegedly efficient private sector. The theoretical foundation for this process was laid by Aghion and Blanchard (1994). However, they abstract themselves from the mechanism captured by the search and matching model introduced by Diamond, Mortensen and Pissarides (Mortensen, Pissarides 1992), which is the workhorse of modern labour market economics and the starting point of a vast number of analyses focusing on labour market flows (i.e. Elsby, Michaels, Solon 2007; Davis, Faberman, Haltiwanger 2011; Davis, Haltiwanger 2014). Similarly, empirical literature analysing job and worker flows during the transition in CEECs and FSU countries uses the framework described by Aghion and Blanchard (1994) as theoretical background but does not pay too much attention to the search and matching model (i.e. Konings, Lehmann, Schaffer 1996; Haltiwanger, Vodopivec 2002; Earle 2012; Mitra, Muraveyv, Schaffer 2014; Svejnar, Tyrowicz, van der Velde 2017).

We therefore try to address these shortcomings by proposing a theoretical, parsimonious model which combines the standard search and matching model introduced by Diamond, Mortensen and Pissarides (1992) with the model of Aghion and Blanchard (1994). In this way, the proposed model accounts for flows from the public to the private sector. Using a numerical simulation for Poland, the biggest transition economy among CEECs, we show that faster transition (associated with faster restructuring of state-owned enterprises) leads to a quicker convergence to the post-transitional equilibrium characterized by high GDP and high employment in the private sector. Nonetheless, this comes at the cost of negative output growth and higher unemployment in the short run.

The paper is structured as follows. Section 2 reviews the relevant literature. In Section 3 we present the model and describe the forces at play. A numerical example is discussed in Section 4. Section 5 concludes the paper.

2 Literature review

The labour economics literature points to a distinct process to describe labour reallocation in CEECs and former Soviet Union countries. It is the closure of inefficient state-owned enterprises and a decline of employment in the public sector combined with the emergence of an allegedly efficient private sector. This process leads to massive job flows in two forms. The first one is privatization: workers stay in the firm but the ownership of the firm becomes private. The second form are worker flows between different jobs in different companies with a possible spell of unemployment. Another important process mentioned in the literature is the reallocation from manufacturing to services (Caballero, Hammour 1996a, 1996b, 1998, 2000). However, in this paper we only focus on the process of labour reallocation from the public to the private sector.

The theoretical background for this transformation is provided by the model of Aghion and Blanchard (1994; henceforth AB). In this model restructured/privatized state-owned companies reduce

employment while the new private sector emerges.[1] A period of high unemployment occurs during which unemployment benefits are provided to jobless workers. There are two equilibriums in the model by AB. In the first, the abrupt collapse of the public sector results in higher unemployment and leads to higher taxes levied on workers and on firms as the state has to obtain funds to finance unemployment benefits. This in turn pushes up the non-wage cost of labour. As a result, job creation in the private sector is limited as creating a job turns out to be costly. In consequence, job destruction in the state-owned sector exceeds job creation in the private sector, which leads to an increase in unemployment. This in turn pushes wage claims down. However, the tax wedge limits job creation and deepens the social costs of public-to-private sector reallocation. As a result, an unstable high unemployment equilibrium is reached.[2] The second equilibrium is a stable one – in this case the speed of job destruction does not exceed the speed of job creation of the emerging private sector: the unemployment pool is low, which in turn leads to small fiscal needs and as a result levied taxes are less distortionary.

However, the AB model focuses to a lesser extent on the search and matching model introduced by Diamond, Mortensen and Pissarides (Mortensen, Pissarides 1992), which is the workhorse of modern macroeconomics. In short, in this class of models, exits from unemployment and vacancy posting are determined by search and recruiting decisions of workers and firms. Matching technology combines vacancies with the unemployed and generates jobs. On the supply side of the labour market, workers choose between home production and searching for work. If a worker is matched with a firm, he/she earns a wage, otherwise he/she is jobless and receives unemployment benefits. On the demand side of the labour market, firms post costly vacancies. Vacancies are filled with certain probability, depending on labour market tightness (the ratio between the aggregate number of vacancies and the total number of the unemployed). The number of successful matches between vacancies and workers searching for a job is governed by the matching function and the surplus resulting from a successful match between a worker and a firm is split according to the standard Nash bargaining protocol.

The abundant empirical literature analysing job and worker flows during transition in CEECs and FSU countries uses the framework described by AB as a theoretical background but does not pay too much attention to the search and matching model (i.e. Konings, Lehmann, Schaffer 1996; Haltiwanger, Vodopivec 2002; Earle 2012; Mitra, Muraveyv, Schaffer 2014; Svejnar, Tyrowicz, van der Velde 2017). As a result, it does not try to combine the search and matching model with the previously mentioned concept.

We try to address these shortcomings by proposing a theoretical model which combines the standard search and matching model introduced by Diamond, Mortensen and Pissarides (Mortensen, Pissarides 1992) with the model of AB. We then use numerical methods to simulate this model using the data for Poland. To the best our knowledge, such a model has not been proposed before.

3 Model

Our simple, stylized model illustrates basic mechanisms present in the economy that changes its employment structure from the situation in which most workers are hired in unproductive, state-owned enterprises (SOEs) to one in which the majority of them are employed by firms operating

[1] Aghion and Blanchard (1994) make no distinction between privatization and restructuring.

[2] One should bear in mind that 'unemployment' and 'taxes' should not be taken literately and should be viewed in a broad sense. For example, unemployment can include various forms of non-employment.

in a more productive private sector and restructured SOEs. Our framework blends the theoretical approaches of the Diamond-Mortensen-Pissarides model of frictional labour market (henceforth DMP; see e.g. Andolfatto 1996) with the concepts included in the work of Aghion and Blanchard (1994).

Time is infinite and divided into discrete periods. We include five types of agents in the model: there is a continuum of identical households/workers of measure one, there is a representative private firm composed of infinitely many jobs, obsolete SOEs (those before restructuring), restructured SOEs and the government. Following the standard DMP model, it is assumed that households are risk neutral, derive utility from consumption and discount future streams of consumed goods with a discount factor $\beta \in (0, 1)$. We assume that there is no aggregate uncertainty in the model. We omit this element since the analysis concentrates on the deterministic transition between two regimes: from one in which there is a majority of unproductive state-owned companies to one in which most of firms are private. This means that the economy follows a deterministic transition path and that rational agents have perfect foresight about it.

There is one type of good in the economy. It can be either consumed or used for posting vacancies in the frictional labour market. It is produced by firms (both private and state-owned) by means of linear technology which uses labour as the only input. It is assumed that private and restructured state-owned enterprises are more productive than those that were not restructured. More precisely, productivity of the latter is standardized and equals 1 and productivity of the former satisfies inequality $\phi_A > 1$. Employment in an obsolete state-owned firm is standardized to unity at the beginning of transformation and it drops after restructuring (this process is discussed later).

The labour market is frictional: a private firm has to pay fixed cost $\kappa > 0$ to open a vacancy. However, it is not necessarily filled: a worker is matched with the opened vacancy with probability $q(x) \in (0, 1)$ subject to labour market tightness x, which is the ratio between the aggregate number of vacancies V posted by private firms and the total number of the unemployed U:

$$x \equiv \frac{V}{U}$$

The number of successful matches between vacancies and workers searching for a job is governed by a constant-returns-to-scale function $M(U, V)$. Next we use the specification of M that was introduced by den Haan, Ramey and Watson (2000).

To simplify the analysis, we make three assumptions. First, it is assumed that the pace at which unproductive state-owned companies are restructured (i.e. transformed into more productive state--owned firms) is exogenous and given by rate $\rho_E \in (0, 1)$. Second, if a public sector company is restructured, then its employment drops to $\phi_E \in (0, 1)$ and the remaining proportion $1 - \phi_E$ of workers become unemployed. Restructuring is associated with some cost in terms of output:

$$\phi_A \cdot \phi_E < 1$$

In words, output generated by a restructured unit is lower than the one produced by an obsolete SOE. Third, existing state-owned companies cannot hire new workers. This assumption simplifies the wage-setting process since wages in the public sector do not affect those in the private sector. More specifically, it is assumed that employment (or, equivalently, the mass of firms) in the public sector in period $t = 0$ is given by $E_{1,0} \in (0, 1)$ all state-owned firms are inefficient and there is no private

employment: $N_0 = 0$. This implies that the number of restructured state-owned companies at $t = 0$ is 0, i.e. $E_{E,0} = 0$. For $t \geq 1$ those values evolve according to two recursive formulas:

$$E_{I,t+1} = \rho_E^t (E_{I,0} - \underline{E}) + \underline{E}$$
$$N_{t+1} = (1 - \sigma) N_t + M(U_t, V_t)$$

The first formula describes the law of motion for employment in the obsolete units. By $\underline{E} < E_{I,0}$ we denote the number of the employed by inefficient SOEs at the end of transition. Since $\rho_E \in (0,1)$ then $\{E_{I,t}\}_{t=0}^{+\infty}$ is decreasing and converges to $\underline{E}$. From what was said above, it means that employment in restructured units is given by: $E_{E,t} = \phi_E (E_{I,0} - E_{I,t})$. The second equation is the law of motion for employment in the private sector. By $\sigma \in (0, 1)$ we denote the separation rate (separations take place at the beginning of the period) which describes the proportion of private jobs that are destroyed and their workers become unemployed. This implies that the total number of unemployed agents is:

$$U_t = 1 - (1 - \sigma) N_t - E_{I,t} - E_{E,t}$$

A representative household/worker consists of measure one of members. Its income is composed of wages w_t (that are assumed to be equal across private and state-owned companies), unemployment benefits b_t received by the unemployed, a private firm's profits $\pi_{F,t}$ and taxes/transfers τ_t. A private firm consists, like in the standard DMP model, of an infinite number of jobs that are either dormant, opened as vacancies or filled and used in the production process (see Andolfatto 1996 for more details about this specification). The value of the latter type of job is given by the following recursive formula:

$$J_t = (\phi_A - w_t) - \phi_\tau \tau_t + \beta (1 - \sigma) J_{t+1}$$

where ϕ_τ is the ratio between taxes paid by firms and households and w_t is taken as given by firms.

The decision whether a dormant job should become a vacancy is governed by the following zero--profits-from-entry condition:

$$\kappa = q(x_t) \cdot \beta J_{t+1}$$

It is assumed that the surplus resulting from a successful match between a worker and a firm is split according to the standard Nash bargaining protocol. More specifically, wage w_t is set to solve the following FOC implied by the Nash bargaining problem:

$$(1 - \eta)[S_{W,t} - S_{U,t}] = \eta J_t$$

where $\eta \in (0, 1)$ is workers' bargaining power, $S_{W,t}$ is lifetime utility of the employed household member in period t and $S_{U,t}$ is the discounted future utility of the unemployed worker.

They are given by the following system of Bellman equations:

$$S_{W,t} = w_t + (1-\sigma)\beta S_{W,t+1} + \sigma\beta S_{U,t+1}$$

$$S_{U,t} = b_t + f(x_{t+1})\beta S_{W,t+1} + (1 - f(x_{t+1}))\beta S_{U,t+1}$$

where $f(x_{t+1})$ is the job finding rate that is implied by *M*.

It is assumed that b_t is a fixed proportion of w_t, i.e.:

$$b_t = vw_t$$

where $v \in (0, 1)$ can be interpreted as replacement rate.

The fiscal authority collects taxes levied on households and firms, earns profits from state-owned companies and uses them to finance unemployment benefits. This means that the government budget constraint is given by:

$$bU_t = \tau_t(1 + \phi_t(1-\sigma)N_t) + E_{I,t}(1 - w_t) + E_{I,t}(\phi_A - w_t)$$

Tax rate τ_t is set to balance the budget in every period. Observe that if $w_t > 1$, then the public sector generates losses that have to be covered by taxpayers (recall that 1 is the standardized productivity in the public sector). This situation provides some rationale for a quick transition process (i.e., ρ_E is close to 1) to avoid higher tax burden τ_t generated by subsidies transferred to the unproductive public sector. Notice that higher taxes decrease J_t which in turn causes a drop in job creation according to the zero--profit-from-entry condition.

The probability that a vacancy is filled satisfies the following consistency condition:

$$q(x_t) = \frac{M(U_t, V_t)}{V_t}$$

and the job finding rate is specified as:

$$f(x_t) = \frac{M(U_t, V_t)}{U_t}$$

Profits generated by the private sector satisfy the following equation:

$$\pi_{F,t} = (\phi_A - w) \cdot (1-\sigma) \cdot N_t - \kappa V_t$$

We now turn to the discussion on the mechanisms that are associated with changes in ρ_E. On the one hand, higher ρ_E (a more rapid transition) leads to higher rate of unemployment as private firms are not able to absorb workers from restructured SOEs immediately due to labour market frictions. This in turn decreases output and leads to larger aggregate expenditures on unemployment benefits. The latter

implies an increase in taxes needed to cover additional transfers (paid also by private firms), which hampers job creation and makes the initial increase in unemployment more persistent.

On the other hand, higher ρ_E and higher unemployment decrease market tightness x, which leads to lower effective cost of hiring new workers $\kappa / g(x)$ which stimulates private employment in firms that are more productive. On top of that, if $w_t > 1$ then a more rapid transition leads to lower government expenditures needed to finance the losses of state-owned companies. Moreover, higher unemployment level decreases wages w_t, which boosts profits of state-owned companies and fuels budget revenues. This effect, in turn, puts a downward pressure on taxes. Observe that if we relaxed the assumption about exogenous nature of restructuring by endogenizing this process, then a drop in w_t would disincentivize the government from the transformation of inefficient state-owned companies as they become more profitable. This observation bears a deep analogy to the results of Caballero and Hammour (1996b) who conclude that rigid wages support cleansing, while flexible wages that decrease in recessions hamper the restructuring processes.

4 Numerical example

We use numerical methods to simulate the transition path of an economy that starts with the initial employment level in obsolete SOEs $E_{I,0} \in (0, 1)$ and private employment N_0 and with transition parameter ρ_E. Table 1 presents the values of the parameters that are used for simulations.

The period in the model corresponds to a quarter. We calibrate the values of the parameters using data for Poland or base them on literature. We set the value of β so that the real annual interest rate is equal to 4% and the value of κ so that the unemployment rate after transition is equal to 8.8%, which is the average unemployment rate based on the Polish Labour Force Survey for the years 2008–2016. According to the World Bank, the Polish transition finished in 2008 so we take the mean of unemployment rates for the period that follows this year. Parameter ϕ_E is calibrated for the employment in the private sector to be equal to 73% of the total employment (which is the value of this ratio in 2008) at the end of transition. The value for $E_{I,0}$ is almost one as it is assumed that all workers had job in 1989 and the value of employment in the private sector at the beginning of transition is $N_0 = 0$. It seems that this value of N_0 is a good approximation as the actual proportion of workers hired in private firms amounted to about 10% in 1989. The value of separation rate σ is taken from Skibinska (2016). The value of ϕ_A is set so that GDP increases by 75% during the transition period of 1989–2008 (which is consistent with AB and the OECD data). One has to notice that the reallocation of workers between the unproductive SOEs and private firms is the only driver of the productivity growth in the model which is a good approximation for the findings of Song, Storesletten and Zilibotti (2011). Parameters ϕ_τ and v are calibrated to match the corresponding values from the data. Values of α and η are based on the literature (den Haan, Ramey, Watson 2000).

As it has already been mentioned, we use the specification of the matching function suggested by den Haan, Ramey and Watson (2000):

$$M(U, V) = \frac{U \cdot V}{(U^\alpha + V^\alpha)^{1/\alpha}}$$

where $\alpha > 1$. Transition is calculated using a simple "shooting" algorithm.

The results of simulations are presented in Figure 1 and 2. We consider 3 variants of the transition episodes that are associated with 3 various values of ρ_E that determines the pace of transition: 0.8, 0.9 and 0.95. It is clear that faster transitions (associated with lower values of ρ_E) reach the targeted level of output and employment in the private sector quicker: in the case of ρ_E equal to 0.8 the targeted level of output and employment is reached after 5 years, whereas for ρ_E equal to 0.95 these levels are not reached even after 20 years. However, reaching the targeted level quicker happens at some cost as a higher pace of restructurization leads to a sharp increase in the unemployment level and recession. When transition is fast (ρ_E equal to 0.8), unemployment in the short run reaches about 30% and is more than two times bigger in comparison to a slow transition (ρ_E equal to 0.95), in which case the unemployment rate rises only slightly and slowly. The output change is negative in the short run for the case of quick transition but gains momentum after a few quarters and surpasses the change in output associated with a slow transition around the fourth quarter.

Let us be more specific about the social desirability of various scenarios of transitions characterized with different rates ρ_E (speed of restructuring). To compare them directly, we will calculate the value of the following welfare criterion for each value of ρ_E separately:

$$W = \sum_{t=0}^{+\infty} \beta^t \cdot C_t$$

In other words, the value of W is a discounted sum of instantaneous utilities from consumption, that is characterized by a linear utility function, at time t (recall that $t = 0$ corresponds to the first period of transition). From the resource constraint for the market of goods:

$$C_t = Y_t - \kappa V_t$$

where Y_t is the aggregate output given by:

$$Y_t = \phi_A \cdot [(1-\sigma) \cdot N_t + E_{E,t}] + E_{I,t}$$

Figure 3 presents the relationship between ρ_E and W. Our model indicates that quicker transitions (associated with a lower level of ρ_E) are more socially desirable. This result clearly shows that benefits from a faster transition to the regime in which $E_{I,0} = 0$ (full restructuring and no obsolete SOEs), which enables a higher level of aggregate output relatively quickly, outweigh the costs generated by a transient, sharp increase in the unemployment level and an abrupt drop in output associated with faster restructuring. This result indicates that "shock therapy" during which ρ_E attains low levels is more socially desirable than the scenario in which government tries to avoid a sharp increase in unemployment and thus sets ρ_E at a relatively high level. One remark is in order here: the result pointing to higher desirability of faster restructuring depends heavily on the assumption of households' preferences. More precisely, if one assumed preferences described with an increasing and strictly concave utility function, then an abrupt drop in output (and consumption) which is associated with faster transition would become extremely costly in terms of welfare as it would be at odds with consumption smoothing motives of households. This suggests that under more realistic assumptions about preferences the curve presented in Figure 3 could exhibit a hump-shaped pattern. This issue, however, is beyond the scope of this paper and may potentially become an interesting subject for future research.

5 Conclusions

Labour reallocation has been an inherent feature of transformation processes in Central and Eastern Europe as well as former Soviet Union countries. Theory foundations laid by Aghion and Blanchard (1994) suggest that key components of these processes are worker flows from the public to the private sector. However, these foundations focus less on the frictional approach to labour market dynamics developed by Diamond, Mortensen and Pissarides (Mortensen, Pissarides 1992), which is the workhorse of modern labour market economics. Similarly, empirical literature analysing job and worker flows during transition in CEECs and FSU uses the framework described by Aghion and Blanchard as theoretical background but does not pay too much attention to the search and matching model.

We add to the literature by combining the search and matching model with the concepts of Aghion and Blanchard. In this way we extend the search and matching model to the process of transition from a centrally planned to a market economy and account for flows from the public to the private sector. We use numerical methods to simulate this model using the data for Poland. The obtained results show that faster transition (associated with a faster restructuring of state-owned enterprises) leads to a quicker convergence to the post-transitional equilibrium characterized by high GDP and high employment in the private sector. Faster transition is also related to higher welfare as the level of higher GDP is reached faster. Nonetheless, this comes at the cost of negative output growth and higher unemployment in the short run.

Our findings provide an interesting theoretical explanation for labour reallocation during the transformation period in one of the Central and Eastern European and former Soviet Union countries, namely Poland. They can be extended to other CEECs and FSU countries and can also be used to test empirically if flows from the public to the private sector were the driving force of this reallocation.

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Appendix

Table 1
Parameters

Parameter	Description	Value
β	discount factor	0.99
κ	cost of a vacancy	4.7
ρ_E	inverse pace of transformation	0.8/0.9/0.95
ϕ_E	number of workers in restructured SOEs	0.26
$E_{I,0}$	initial share of employment in SOEs	0.999
$\underline{E}$	employment in SOEs after transformation	0
σ	job destruction rate	0.003
ϕ_A	productivity in restructured SOEs/private sector	2.1
ϕ_τ	share of tax burden levied on private firms	0.546
α	matching efficiency	1.3
υ	replacement rate	0.226
η	bargaining power of workers	0.5

Figure 1
Transition paths: short run

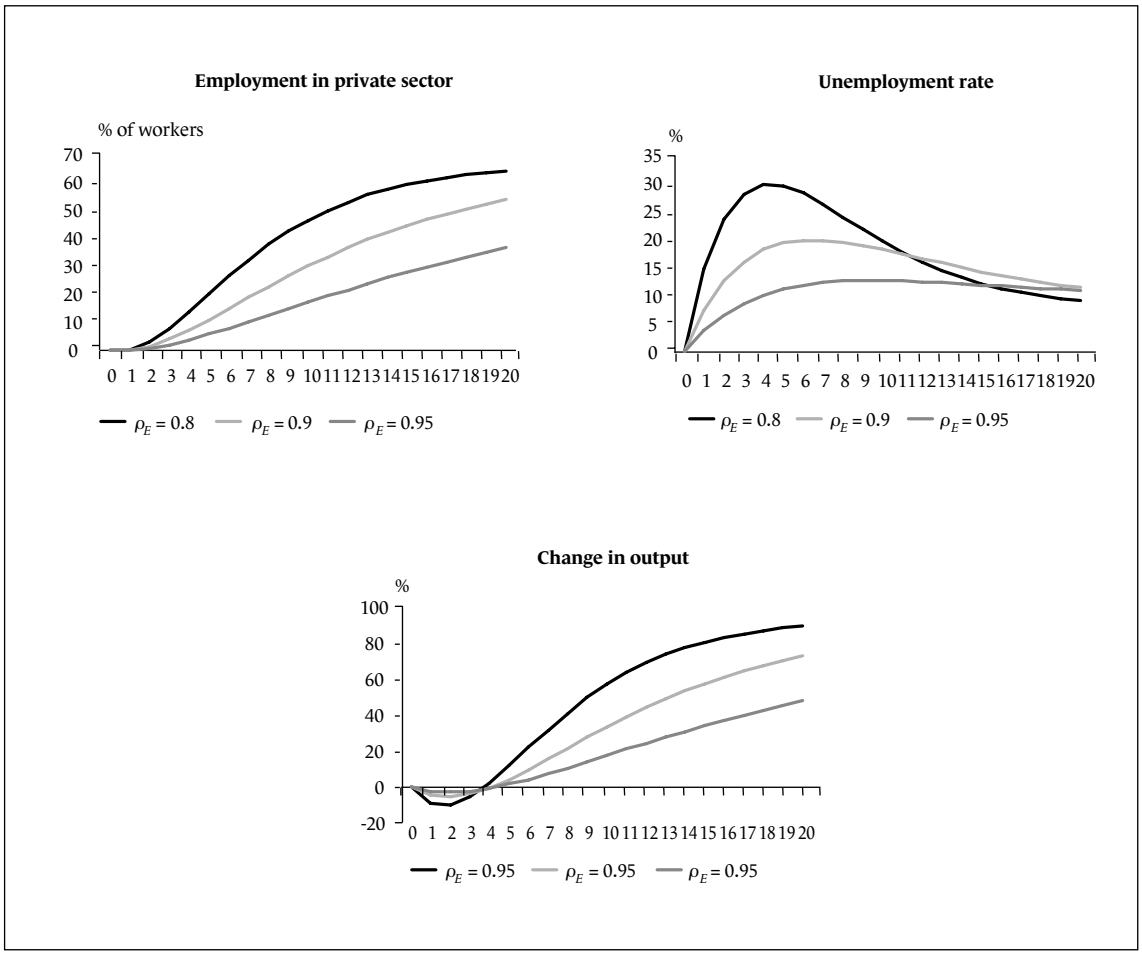

Figure 2
Transition paths: long run

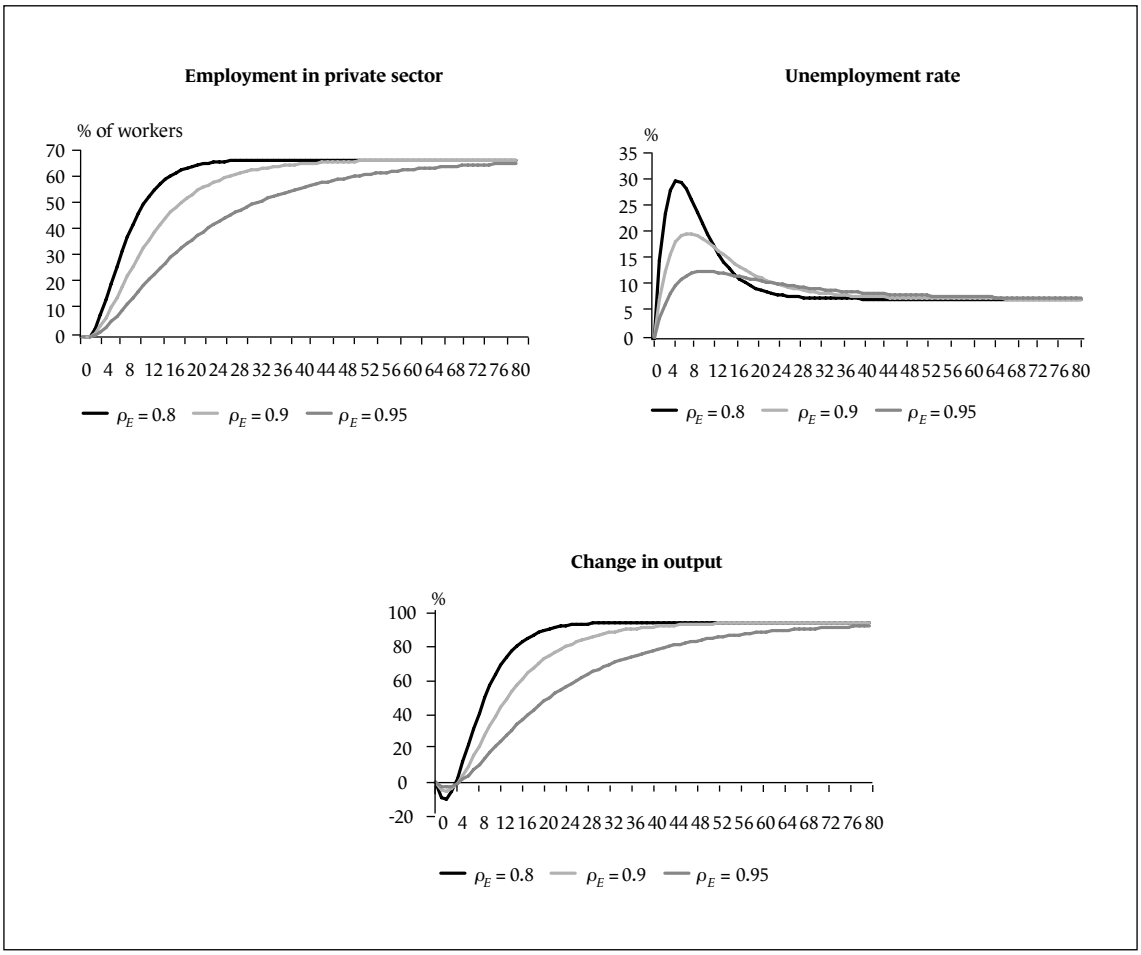

Figure 3
The speed of transition and welfare