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STOCHASTIC MODELLING OF THE LABOUR MARKET DYNAMICS WITH AN APPLICATION FOR MACEDONIA

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Abstract. In this paper a dynamic model of the labour market has been developed in order to describe the evolution of the unemployment in transition countries and particularly in Macedonia. The evolution of the numbers of workers in each of the three labour market states can be modelled by using differential equations. This model takes into consideration the demand side of the labour market by introducing the rates of job creation and job destruction modelled as stochastic processes. The simulation of the model will be used in order to analyse the impact of various adjustment mechanisms and policy instruments on the labour market outcomes when transition probabilities change over time. The results from simulations of the model with different levels of unemployment benefits will be used in designing appropriate passive labour market policies, which should be consistent with the socially optimal level of unemployment.

1. Introduction

The process of transition from centrally planned to a market oriented economy is characterised by tremendous changes in all spheres of the society. Transition economies during the 90's, as well as at the beginning of the 21st century have faced challenging tasks of establishing new political, economic and social systems. Bearing in mind the systemic character of transition, we would expect labour markets in transition countries to be highly dynamic. At the beginning of transition, labour market adjustment was associated with the labour shedding from declining state sector and improving employment possibilities in the growing private sector. Today, the private sector has a dominant share in all transition economies, but most of them are still fighting the problem of high unemployment and particularly long-term unemployment.

Labour mobility is an important factor for the optimal allocation of resources in the economy. Supposing that the allocation of resources in the centrally planned economies was far from being optimal, reallocation of labour during the transitional restructuring is expected to improve the productivity of transition economies. According to the principle of 'creative destruction', the jobs in the less productive sectors have been replaced by new jobs in more productive sectors, which ultimately leads to higher aggregate productivity and economic growth. Thus, the mass reallocation of labour from the state to the private sector that has occurred during transition is one of the main contributing factors for economic growth after the initial transitional recession.

The aim of this paper is to present a stochastic model of labour market dynamics in transition countries based on labour market flows. The Stock-flow approach, whose basic concepts are introduced in the second section of the paper, will

be used at the heart of this analysis. In the third section, a stylised model of labour market flows in transition countries will be introduced. In addition, in this section macedonian labour market flows as well as the rates of job creation and job destruction will be analysed and the extent of reallocation process will be assessed. In the following two sections the labour market dynamics will be modelled first as a markov process with constant transition probabilities and than as a stochastic process with transition probabilities changing over time. Finally, in the last section the relevant conclusion remarks will be derived.

2. Basic concepts for labour market flows

The overall rate of unemployment is the most frequently used indicator of labour market conditions. Even that unemployment rate can be disaggregated for various groups of population, it is characterised by its limited possibilities of reflecting the duration of unemployment spells. From the point of view of dynamism, we can distinguish two distinct types of labour markets: dynamic and sclerotic. Highly dynamic labour markets are those, where most of the workers go through unemployment experiencing short spells while searching for job. On the other hand, sclerotic labour markets are those, where considerable number of workers remain in the pool of unemployed for a long period of time. In both cases the overall unemployment rates can be equal, but the latter case is of more serious social concern because one group of workers remain without wage income for long periods of time.

The long-term unemployed are those workers who stay in the unemployment pool for one year or more. Workers who experience long-term unemployment by the course of time become weakly attached to the labour force and socially marginalized for two basic reasons. First, their skills become obsolete; second, there are adverse signalling effects to employers.

One of the most apparent phenomena among the long-term unemployed is the so-called state dependence, which means that the longer one person is unemployed the harder it is to quit the unemployment status for employment. Consequently, workers who experience long spells of unemployment can easily turn into the group of 'discouraged workers' who are detached from the work force and are more likely to declare themselves as non-participants rather then unemployed. Thus, the long-term unemployed are not attractive fillers of vacancies, implying that the unemployment rate, which includes long-term unemployed with the same 'weight' as short-term unemployed, does not give an accurate image of the labour market conditions.

A possible solution for this problem is to use a kind of weighted unemployment rate, where groups of workers with longer unemployment spells will be counted more heavily than those who experience shorter unemployment spells. Another possible approach is to use the probability of exiting unemployment instead of the unemployment rate itself. According to blanchard (1997), a better indicator of labour market conditions is not the unemployment rate, but rather the exit rate out of unemployment.

The usual measure of labour mobility in one economy is the labour turnover calculated as a sum of hirings and separations during a one-year period. Dividing the sum of workers who are hired or separated by average annual employment gives a rate of labour turnover. Hirings may be intended to fill vacated jobs or new openings. On the other hand, separations may be voluntary (quits) or involuntary (lay-offs). The difference between hirings and separations gives the net change in employment.

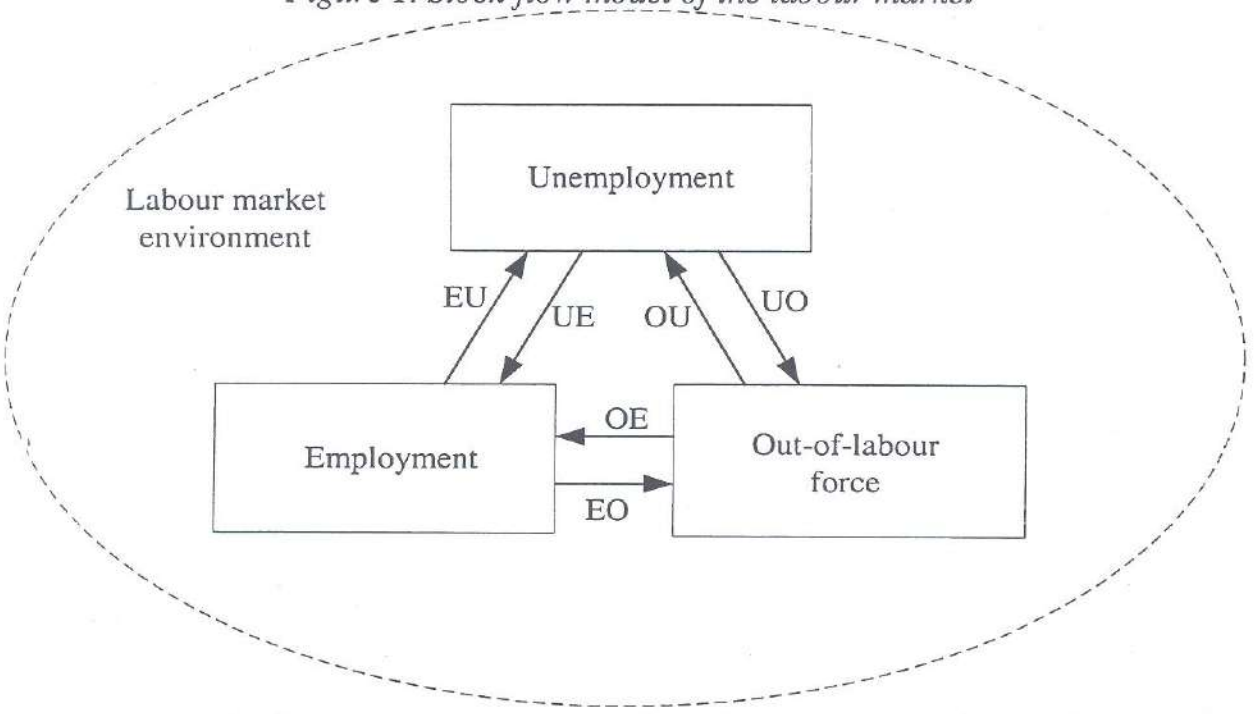
We have to distinguish between labour turnover and job turnover. Job turnover is defined as sum of job creation and job destruction during a one-year period. Job creation consists of all employment gains from opening or expanding establishments.

On the other hand, job destruction consists of all employment losses from closing or contracting establishments. The job creation and job destruction rates can be calculated when the amount of job creation and job destruction are represented relative to the level of employment. In addition to these measures, we can calculate the job reallocation rate as a sum of job creation and job destruction rates and net employment growth rate as a difference between the job creation and job destruction rates. Finally, a measure that captures the amount of job reallocation, which is above the reallocation necessary to accommodate a given net employment growth rate, is the excess job reallocation rate and is calculated as gross employment growth rate minus the absolute value of the net employment growth rate.

Job flows reveal only the changes on the demand side of the labour market, whereas worker flows reflect simultaneously the dynamics on the demand and supply side (Davis et al., 2005). Labour turnover equals job turnover plus the movements into and out of ongoing jobs, which is called 'labour churning'. In some cases workers separate because jobs are terminated, but in other cases they move into and out of existing jobs because of inconvenient matching or other factors such as leaving the labour force due to retirement or other reasons. Thus, we can conclude that worker flows exceed job flows (haltiwanger and vodopivec, 2002) and real structural changes in an economy can be assessed through job turnover.

The best way of describing the transitions among the basic labour market states is by using the stock-flow model. The stock-flow model gives an insight into the number of workers who are employed, unemployed or out-of-labour force in the given reference period of the survey and the number of those who have changed the status between two surveys. Thus, the stock-flow model allows assessing not only the cross sectional state of the labour markets, but also the dynamism of transitions among the basic labour market categories. The stock-flow model is graphically presented in figure 1. We can use the following notation for the basic labour market states: *e*-employed, *u*-unemployed and *o*-out-of-labour force.

Figure 1. Stock-flow model of the labour market



On the basis of stocks and flows of workers among the basic labour market states, we can estimate the transitional matrix, which contains probabilities of

transition among these basic labour market states. There are nine possible transitions, which can be described with transitional matrix (1).

$$T = \begin{bmatrix} EE & EU & EO \\ UE & UU & UO \\ OE & OU & OO \end{bmatrix} = \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix} \quad \ldots (1)$$

The probability of one person to move from one to another state in the labour market is given by the expression (2).

$$p_{ij} = \frac{F_{ij}}{S_i} \quad \ldots (2)$$

where: $i, j = E,U,O$ and:

F_{ij} is the number of persons who moved from state i at time t into state j at time $t+1$;

S_i is the initial number of persons in the state i at time t.

The elements EE, UU and OO in (1) are peculiar because they represent the probabilities of maintaining the same status, either employment, unemployment or out-of-labour force. in the context of employment, we can further distinguish those who have maintained the same job and, those who have changed the job, experiencing so-called job-to-job movements. it is worth mentioning that in some cases the design of labour force surveys does not allow the capture of job-to-job movements, which is a source of underestimation of the labour force mobility.

Another limitation using Labour Force Survey data is the difficulty in assessing the so-called 'round tripping'. The 'Round tripping' is a situation where one person between two surveys moves from state i to state j and than turn back to the original state i. Because the survey registers only the state of the person at the beginning and on the end of the survey period, it is unable to cover the movements described above. Consequently, the results of the labour market flows can be biased in terms of underestimation of the 'round tripping' movements.

3. Labour market flows in transition countries with reference to Macedonia

The transitional process in post-socialist countries has affected all domains of societies including labour markets. Stylised models, which are frequently used to describe the labour market adjustment in transition countries after the initial shock, consist of two sectors (Blanchard, 1997). One sector is the state sector containing the 'old' jobs, while the other is the private sector containing 'new' jobs in the privatised or newly created private firms. We assume that the state sector is associated with obsolete technology, while the private sector is associated with investments in new technology. Thus, the productivity of the private employment is greater than the productivity of the state employment.

during the initial transitional recession, real output sharply declined and the labour market started to adjust. almost all socialist economies, initially were suffering from huge labour hoarding and a large state sector. thus, open unemployment emerged in all transition countries, as they gradually adopted the market orientation. rising unemployment is mostly due to the declining state sector where considerable number

of workers have been laid-off. there is a waste literature presenting empirical findings that job destruction in the state sector at the outset of transition was higher than the job creation that primarily was taking place in the private sector (Cazes and Nesporova, 2003; faggio and Konings, 2001; Bojanec and Konings, 1999). Another contributing factor to rising unemployment rates in some transition countries is the increasing number of new entrants who, facing poor employment opportunities stay unemployed for long period of time. On the other hand the growth of the private sector in the first phase of transition was not strong enough to receive the 'army' of unemployed. consequently, the net change in employment growth during the initial phase of transition in almost all transition countries was negative.

The second stage of transition, when the major restructuring process of the state sector has finished, is characterised by a so-called 'balanced path'. Assuming a reduced state sector, the major employment in the second stage is realised in the private sector, where workers are mainly pulled from unemployment. Thus, the growing employment opportunities in the private sector, once the state sector has restructured, help unemployment rates in transition countries gradually to converge toward the OECD average. Opposite to the initial phase of transition, the empirical findings in the more advanced phase show that job creation rates exceed the job destruction rates (Masso et al., 2005). However, this has not been a case for transitional countries that are lagging in the restructuring process (Faggio and Konings, 2001). We should mention that rising trends of unemployment in some transition countries, particularly the South-Eastern European countries have been prevented by various labour market adjustment mechanisms such as growing non-participation and emigration.

Nowadays, after the initial phase of ownership restructuring, the private sector represents a predominant part in Macedonian economy. For instance, the percentage share of workers in private firms in 2002 accounts for 52,4 per cent of total employment, while in 1996 the percentage share of employment in the private firms accounted for just 33,5 per cent of total employment. The emerging private sector in Macedonia, as well as in other transition countries has confirmed its role as a generator of employment. Despite, the importance of the growing private sector as a stabiliser of the economy, in the case of Macedonia its absorption capacity has not being sufficient to absorb additional unemployed from the still declining state sector.

Declining participation rates coupled with rising long-term unemployment represent indicators, which suggest that there exist considerable informal employment. The size of informal economy in Macedonia both, as a percentage share of GDP and as a participation of the labour force in the informal sector compared with other transition countries is relatively high. For instance, Schneider (2002) estimates that the average size of the unofficial economy in Macedonia as a percentage of GDP in 2000-01 was 45,1 per cent, whereas the percentage of the unofficial labour force was 35,1 per cent. Therefore, having in mind growing informal employment, it is more relevant to distinguish between the informal and formal sector rather than state and private sector.

An estimated transitional matrix for labour market flows in Macedonia based on the labour force survey data is given in the Table 1.

Table 1. Gross labour market flow rates in Macedonia

	Employed 2003	Unemployed 2003	Out-of-labour force 2003
Employed 2002	88,97%	5,80%	5,23%
Unemployed 2002	9,76%	73,42%	16,82%
Out-of-labour force 2002	1,86%	3,82%	94,32%

Source: Macedonian statistical office, labour force survey

Comparing the gross labour market flows in Macedonia with those in other transition countries, we can draw the fallowing conclusions:

- The inflow rate to unemployment from employment is among the highest, while the flow rate from employment to out-of-labour force is in the range observed for other transition countries;
- The outflow rate from unemployment to employment is among the lowest, while the flow rate from unemployment to out-of-labour force is in the range observed for other transition countries;
- The flow rate from out-of-labour force to employment is relatively low, while the flow rate from out-of-labour force to unemployment is in the range observed for other transition countries;

A careful analysis of macedonian labour market flow rates shows that the inflow rate to unemployment from employment even in the later phase of transition is very high, which means that the process of transitional restructuring is still not terminated. on the other hand, the outflow rate from unemployment is very low with approximately a twice-higher probability of the unemployed quitting the unemployment pool to go into non-participation than to employment. Thus, facing poor employment possibilities in the labour market, macedonian unemployed are more likely to stay in the unemployment pool or to become discouraged workers turning out-of-labour force than to become employed. this fact explains the persisting high unemployment and particularly the high long-term unemployment rate in macedonia.

In order to complete the picture about labour market dynamism, we further pursue with an analysis of demand side of the Macedonian labour market. The labour market demand during the first decade of transition in Macedonia is represented by the aggregate rates of job creation, job destruction (Table 2). Additionally, the gross job reallocation rates, net employment growth rates and excess job reallocation rates have been calculated.

Table 2. Rates of job creation and job destruction in Macedonia

Year	Job creation rate	Job destruction rate	Gross job reallocation rate	Net employment growth rate	Excess job reallocation rate
1992	2.0	7.4	9.4	-5.4	4.0
1994	2.3	13.4	15.7	-11.1	4.6
1995	0.9	9.1	10.0	-8.2	1.8
1996	1.4	7.4	8.8	-6.0	2.8
1997	1.1	11.4	12.5	-10.3	2.2
1998	3.0	9.9	12.9	-6.9	6.0
1999	2.4	4.9	7.3	-2.5	4.8

Source: Micevska and Eftimoski (2003) and, authors' calculations

From Table 2 we can notice that job destruction rate in Macedonia was higher than the job creation rate over the whole first decade of transition. However, this gap was wider during the period 1992-1997, with tendency to narrow by the late 90's as transitional process enters in the more mature phase. As a consequence, the gross job reallocation rate is relatively high due to the high job destruction rate, whereas the net employment growth rate is negative. Moreover, the excess job reallocation rate is relatively low by international standards, which suggests that substantial reallocation processes in Macedonia during the first decade of transition have not occurred.

4. A dynamic analysis of the labour market

The previously described stock-flow approach can be used for analysis of the labour market in transition countries. The aim of this section is to analyse the labour market dynamism, through the evolution of transition probabilities between the basic labour market states. Transition probabilities reflect the characteristics of the labour supply as well as the evolution on the demand side of the economy.

First suppose that the transition probabilities are time invariant. In this case we can assume that the transition probabilities obey a Markov stochastic process or Markov chain. A Markov chain can be absorbing or ergodic, depending on whether there exists an absorbing state in which the system can be locked after a certain number of transitions. In an ergodic Markov chain all states communicate, the state space is finite and rates of transitions between the states are constant over time.

Denote with s_t the vector of probability distribution among the states for a given period t. For an ergodic Markov process there exists a so-called stationary distribution s_∞, which designates a stable distribution that does not depend on the initial vector. The stationary distribution can be conceived as an equilibrium state of the system. The calculation of the stationary distribution is straightforward from the condition that for very large t, s_t and s_{t+1} are the same:

$$s_\infty = s_\infty T \qquad \ldots (3)$$

Using the transition matrix of labour market flows in Macedonia between 2002 and 2003 as described in Table 1, gives:

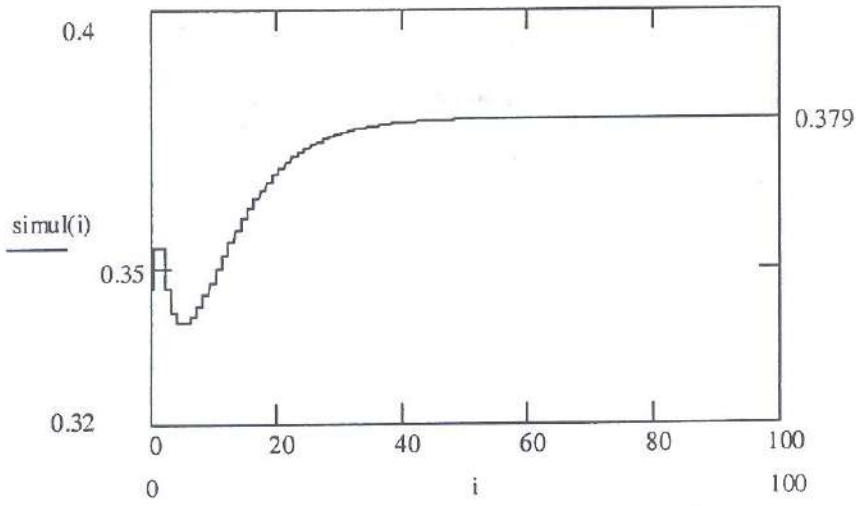
$$T = \begin{array}{c} \\ E \\ U \\ O \end{array} \begin{bmatrix} \\ 0.8897 & 0.0580 & 0.0523 \\ 0.0976 & 0.7342 & 0.1682 \\ 0.0186 & 0.0382 & 0.9432 \end{bmatrix}$$

Assuming that transition matrix is constant over time and, having in mind the necessary condition for calculating the stationary distribution, we obtain the following stationary distribution (see Appendix 1):

$$\begin{array}{cccc} & E & U & O \\ s_\infty = & [0.231 & 0.141 & 0.629] \end{array} \qquad U^* = \frac{0.141}{0.141 + 0.231} = 0.379$$

The iterative procedure of calculating the equilibrium unemployment rate when transition probabilities are assumed to be constant over time, is graphically presented on Figure 2.

Figure 2. Equilibrium unemployment rate with constant transition probabilities



The equilibrium unemployment rate is very high which, corresponds to initially observed low probability to exit unemployment. It is also close to the official LFS unemployment rate in 2003 which is 36.7 per cent. We can also argue that the equilibrium unemployment rate is affected by all policy instruments that influence the transition probabilities among the basic labour market states.

The evolution of numbers of workers in each of the three labour market states can be modelled with three differential equations (4), (5) and (6). On the left side of each differential equation is represented the change in the given labour market state for an arbitrarily small time interval. On the right side of each equation there are two elements with positive signs that make increasing and, two elements with negative signs that makes decreasing the number of workers in the given state for a given time interval.

The system of differential equations will have the following form:

$$\frac{dE(t)}{dt} = p_{21}U(t) + p_{31}O(t) - p_{12}E(t) - p_{13}E(t) \qquad \ldots (4)$$

$$\frac{dU(t)}{dt} = p_{12}E(t) + p_{32}O(t) - p_{21}U(t) - p_{23}U(t) \qquad \ldots (5)$$

$$\frac{dO(t)}{dt} = p_{13}E(t) + p_{23}U(t) - p_{31}O(t) - p_{32}O(t) \qquad \ldots (6)$$

In order to simulate the changes in time of each of the labour market states, we can transform the above differential equations in difference equations as follows:

$$\frac{E_{t+\Delta t} - E_t}{\Delta t} = p_{21}U_t + p_{31}O_t - p_{12}E_t - p_{13}E_t \qquad \ldots (7)$$

$$\frac{U_{t+\Delta t} - U_t}{\Delta t} = p_{12}E_t + p_{32}O_t - p_{21}U_t - p_{23}U_t \qquad \ldots (8)$$

$$\frac{O_{t+\Delta t} - O_t}{\Delta t} = p_{13}E_t + p_{23}U_t - p_{31}O_t - p_{32}O_t \qquad \ldots (9)$$

After elementary transformation of the above system of difference equations we get the following expressions:

$$E_{t+\Delta t} = E_t + p_{21}U_t\Delta t + p_{31}O_t\Delta t - p_{12}E_t\Delta t - p_{13}E_t\Delta t \quad \ldots (10)$$

$$U_{t+\Delta t} = U_t + p_{12}E_t\Delta t + p_{32}O_t\Delta t - p_{21}U_t\Delta t - p_{23}U_t\Delta t \quad \ldots (11)$$

$$O_{t+\Delta t} = O_t + p_{13}E_t\Delta t + p_{23}U_t\Delta t - p_{31}O_t\Delta t - p_{32}O_t\Delta t \quad \ldots (12)$$

The *MathCad* simulations of the above system of difference equations allowing for various values of Δt are given in Appendix 2. In the case where Δt is equal to 1, the labour market reaches the same stationary distribution, which confirms that the above system of difference equations accurately describes the dynamic changes in the labour market. Furthermore, this approach will be used in order to analyse the impact of various adjustment mechanisms and policy instruments on the labour market outcomes when transition probabilities change over time.

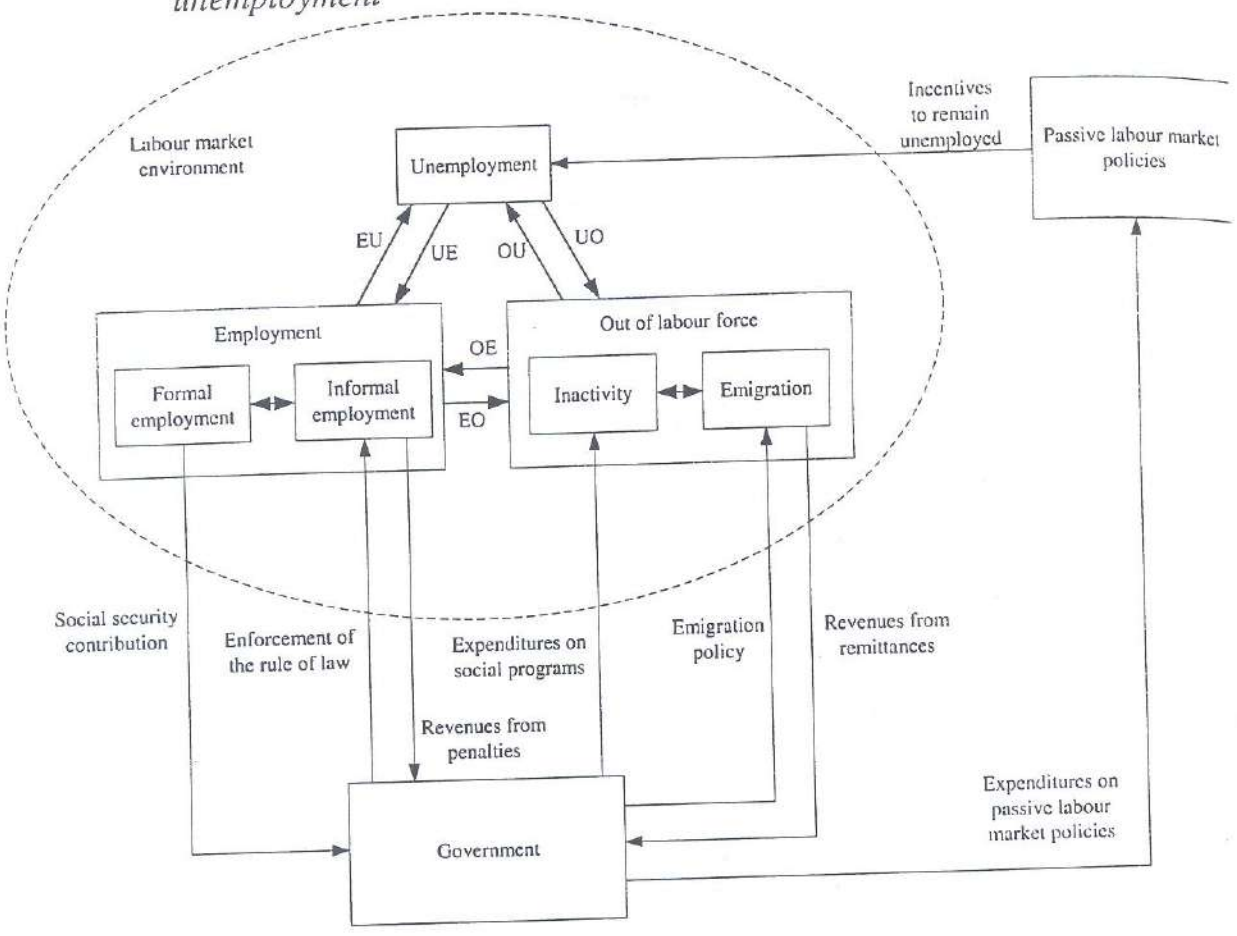
5. Stochastic modelling of the labour market dynamics

Labour market stocks and flows represent the workers behaviour on the labour market. In order to build a consistent model of sustainable rate of unemployment it is necessary also to consider the demand side of the labour market. This can be generally represented by simultaneous processes of job creation and job destruction. As described in section 2, job creation and job destruction express all gains/losses in employment. Consequently, the employment growth is a difference between job creation and job destruction and can take positive or negative values. The conceptual framework for building the model of sustainable rate of unemployment that comprises the aforementioned features is presented in Figure 3.

The dashed ellipse in Figure 3 encompasses the labour market environment. It consists of the stocks of workers in each of the three basic labour market states i.e. employment, unemployment and out-of-labour force as well as the flows of workers between them. Furthermore, within the status of employment we can distinguish between formal and informal employment, whereas in the out-of-labour force contingent can be separately considered the inactivity and emigration.

The government which is presented outside the labour market environment can directly or via appropriately designed passive labour market policies influence the stocks and flows of workers in the labour market. Thus, the arrows coming from the government toward the labour market represent the policy instruments, whereas the arrows going toward the government represent the feed back effects from the labour market functioning. As relevant budget revenues in the model we consider: Social security contribution from formal employment, revenues from penalties and revenues from remittances. On the other hand, the government expenditures in the sphere of labour market mostly consist of: Expenditures on unemployment benefits and other social programs as well as enforcement of the rule of law.

Figure 3. Conceptual framework for building the model of sustainable rate of unemployment



In order to develop a model of labour market dynamics we are going to use the theoretical background from the structural model of sustainable rate of unemployment based upon the Blanchard's assumptions. This is presented more in details in Appendix 3. Having in mind the changing character of the labour market institutions in the context of transition from centrally planned to market oriented economy, the development of a dynamic model appears somewhat problematic. However, with given assumptions, we can use the model in order to project different scenarios of the labour market development.

For this purpose the processes of job creation and job destruction will be modelled as stochastic processes with transitional probabilities changing over time. According to Pissarides (2000), job creation and job destruction can be considered as Poisson processes with given rates. Suppose that jobs are created according to a Poisson process with rate μ, whereas they are destroyed according to a Poisson process with rate ν. Furthermore, we disaggregate the rate of job creation into rate of job creation in the formal sector (μ^f) and rate of job creation in the informal sector (μ^i). Previously, in section 3 it was pointed out that the job destruction in Macedonia was higher than the job creation over the whole first decade of transition (see Table 2). Having in mind that the unemployment pool has recently remained stagnant, we can assume that above condition in the labour demand still applies. As a consequence, it is pertinent to assume that in the case of Macedonia ν is greater than μ.

The job creation and job destruction processes can be endogenised as functions of the level of profitability. In other words, the rate of job creation μ, can be expressed as a function of the average product per worker and the market wage. It is reasonable to expect that job creation will rise as the difference between the average product per worker and market wage increases. On the other hand, job destruction even though driven by the same factors, is pushed in the opposite direction from the job creation. A number of empirical results show the negative covariance between the job creation and job destruction (Mortensen and Pissarides, 1994). Thus, the rate of job destruction can be simply represented as a reciprocal value of the rate of job creation. The formal development of the expression for the rate of job creation is presented in Appendix 3.

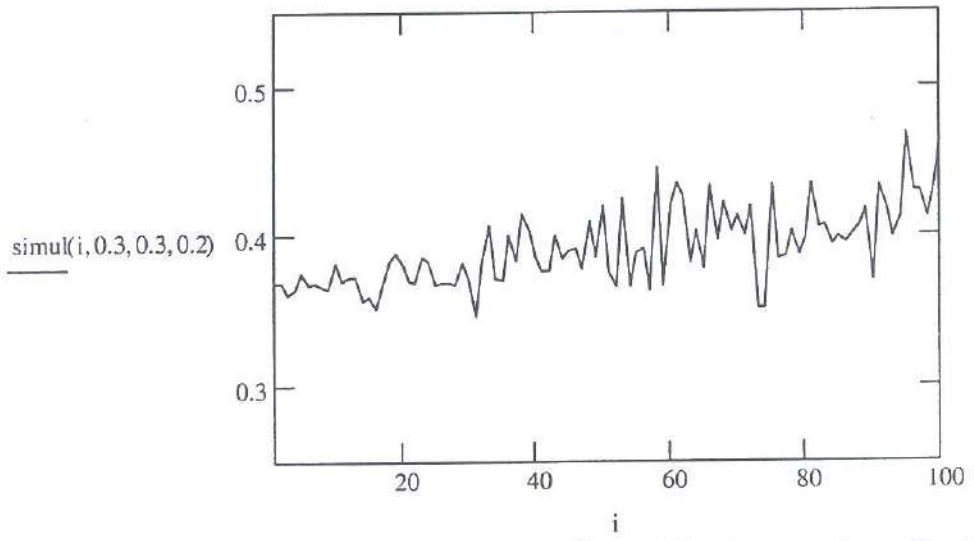
Consequently, the job creation will develop according to a Poisson process with rate μ, which in turn is a sum of the rates of job creation in the formal sector μ^f and in the informal sector μ^i. Furthermore, the rate of job destruction (ν), will be determined as a reciprocal value of the total rate of job creation.

The worker flow rates, i.e. the transition probabilities between the basic labour market states can be further expressed as fractions of the job creation and job destruction rates. For example, the probability p_{12} which represents the flow rate from employment to unemployment is a fraction of the rate of job destruction. Similarly, p_{13} which is the flow rate from employment to out-of-labour force is a fraction of the job destruction rate. We also assume that these two fractions together with the fractions of employed who directly move from one job to another sum up to one. On the other hand, the probabilities p_{21} and p_{31} which represent the flow rates from unemployment and out-of-labour force respectively into employment are fractions of the job creation rate. Together with a fraction of job-to-job movements they also sum up to one. Furthermore, we assume that probability p_{23} is a function of the job destruction, since a higher rate of job destruction discourages more unemployed and pushes them to inactivity. In this case the probability p_{32} is expressed as a function of the job creation rate.

The development of unemployment rate over 100 time intervals are calibrated with appropriate values of the parameters ($\theta = 0.5$, $a = 0.3$, $c^f = 1.5$, $c^i = 1$, $r = 0.005$) and policy instruments ($b = 0.3$, $\pi = 0.3$ and $\delta = 0.2$). The results from the simulations are graphically presented in Figure 4, whereas the calculations in *MathCad* are presented in Appendix 4. In addition to the previously stated values of the parameters and policy instruments, we have been using a particular redistribution of the job creation and job destruction between the transition probabilities. The sensibility of the modelling outcomes to the particular choice of redistribution remains one of the weakest features of the dynamic model. We calibrate the fractions of job destruction attributed to worker flow from employment to unemployment and from employment to out-of-labour force to be 40 percent in both cases and, allowing 20 percent of job destruction to occur in form of job-to-job movements. On the other hand, the fractions of job creation attributed to worker flow from unemployment to

employment is 80 percent, whereas the fraction attributed to the flow from out-of-labour force to employment is 10 percent. Finally, we assume that the reactivity of transitions from out-of-labour force into unemployment to intensity of job creation is higher than the reactivity of transition other way round to intensity of job destruction. For this purpose, we put 0.4 as a factor of the job destruction relative to the number of unemployed in determining the probability of transition from employment to out-of-labour force, whereas, we put 0.6 as the factor of job creation relative to the number of inactive in determining the probability the other way around.

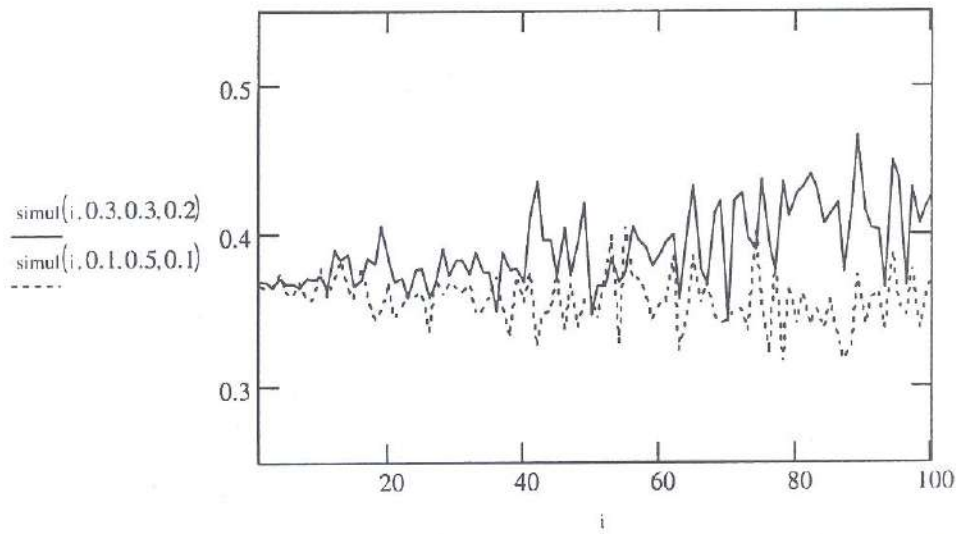
Figure 4. Simulation of the stochastic labour market model



From the simulation in Figure 4 we notice that with given values for the policy instruments the unemployment rate during a short time period remains stable, but in the long run increases dramatically, which means that this policy mix does not result in a sustainable rate of unemployment. Furthermore we need to explore with different values for the parameters in order to obtain falling or at least not rising unemployment rate in the long run.

In order to assess the effects of the various labour market policy regimes, we can further simulate the development of the unemployment rate with different values of the policy instruments, and by holding everything else constant. For instance, suppose that the generosity of unemployment benefits has been tightened from $b = 0.3$ to $b = 0.1$, the penalty rate has been increased from $\pi = 0.3$ to $\pi = 0.5$ and the probability of those who work in the informal sector and claim unemployment benefit has been reduced form $\delta = 0.2$ to $\delta = 0.1$. The results of simulation with this second policy regime are presented in Figure 5. In order to make a comparison we present this together with the results from the previous simulation.

Figure 5. Simulations of the stochastic labour market model with different policy regimes



From Figure 5, we notice that with both policy regimes, in the short run the unemployment rate remains stable, but in the long run with the second policy regime the unemployment rate gradually decreases, whereas with the initial policy regime it increases. According to these results we can argue that restricted unemployment benefits accompanied with a stricter application of the rule of law in the informal sector as well as stricter monitoring among the registered unemployed leads to a more sustainable unemployment rate on the long run.

Having in mind the fact that each policy regime in the long run results in different labour market outcomes, there is possibility of existing multiple labour market equilibria. Generally, those policies that foster job creation in the formal sector lead to lower and sustainable unemployment rate in the long run. In the opposite case, when formal job creation is insufficient, in the long run the unemployment rate will remain high and persistent, probably accompanied with various labour market adjustment mechanisms that would naturally arise as a consequence of the high social cost of unemployment.

6. Conclusion

Labour market flows are an important indicator of labour force mobility. A usual measure of the labour force mobility is the labour turnover rate, calculated as a sum of all separations and hirings during a one-year period relative to the average annual employment. Additionally, the stock-flow model is an effective tool for the presentation of labour market flows by assessing the number of workers in each labour market category for a given reference period, and the number of those who change the status between two reference periods. On the basis of stocks and flows of workers among the basic labour market states, we can estimate the transitional matrix, which contains probabilities of transition among the basic labour market states.

Analysis of the labour market flows is particularly relevant in the assessment of dynamism of the labour markets in transition countries. Bearing in mind the systemic changes during transition, we would normally assume that labour markets in transition countries are highly dynamic. A stylised model of labour market flows in transition

countries describes the reality of labour market adjustment by dividing the employment in two sectors: the private sector and state sector. The first stage of transition is characterised by the sharp decline of the state sector, where considerable number of workers has been laid-off. In the second stage, the expanding private sector starts to absorb workers mainly from the pool of unemployed contributing to a decrease of unemployment rates. These stylised facts for the labour market dynamics in transition countries have been confirmed by a number of empirical findings from the job creation and job destruction.

Labour market flow rates in Macedonia between 2002 and 2003 have been estimated from the labour force survey data. The principal characteristics of gross labour market flows in Macedonia can be summarised as follows:

- The inflow rate to unemployment from employment is one of the highest among transition countries. The high inflow rate implies that the process of transitional restructuring in Macedonia is still not terminated;
- The outflow rate from unemployment to employment is among the lowest in transition countries. The low outflow rate explains the stagnant pool of unemployment and persisting long-term unemployment;
- The probability of the unemployed going into non-participation is about twice then the probability of becoming employed. This fact confirms the existence of the phenomenon of 'discouraged workers' among the unemployed;
- The probability of the unemployed to go in private employment is about four times higher then probability to go in employment in other types of ownership. Thus, despite the insufficient demand for labour, the private sector is the main generator of employment;

A dynamic model of sustainable rate of unemployment has been developed in order to describe the evolution of the unemployment in transition countries. This model takes into consideration the demand side of the labour market by introducing the rates of job creation and job destruction modelled as stochastic processes. The results from simulations of the model with different regimes of the passive labour market policies show that high level of unemployment benefits coupled with low penalty rate in the informal sector and lax monitoring among the registered unemployed in the long run result in unsustainable unemployment rate. Having in mind the changing nature of the labour market institutions in transition countries, the applicability of the findings from the dynamic model has to be taken with a dose of caution.

REFERENCES

[1] Blanchard, O. (1997) *The Economies of Post-Communist Transition,* Clarendon Press Oxford;

[2] Bojanec, Š. and Konings, J. (1999), *Job Creation, Job Destruction and Labour Demand in Slovenia*, Comparative Economic Studies, XLI, No.2-3, pp.135-149;

[3] Cazes, S. and Nesporova, A. (2003), *Labour Markets in Transition, Balancing Flexibility and Security in Central and Eastern Europe*, International Labour Office, Geneva;

[4] Davis, S., Faberman, R and Haliwanger, J. (2005), *The Flow Approach to Labour Market: New Data Sources, Micro-Macro Links and the Recent Downturns*, IZA Discussion Paper, No.1639;

[5] Faggio, G. and Konings, J. (2001) *Job Creation and Job Destruction and Employment Growth in Transition Countries in the 90's*, IZA Discussion Paper, No.242, January;
[6] Haltiwanger, J. and Vodopivec, M. (2002), *Worker flows, job flows and firm wage policies: An analysis for Slovenia*, IZA Discussion Paper, No.569, September;
[7] Masso, J., Eamets, R. and Philips, K. (2005), *Job creation and job destruction in Estonia: labour reallocation and structural changes*, IZA Discussion Paper, No.1707, August;
[8] Micevska, M. and Eftimoski, D. (2003), *The failure of the labour market in Macedonia: a labour demand analysis*, Cerge-ei project "Labour market and social policies in Macedonia", rrc iii;
[9] Mortensen, D. and Pissarides, C. (1994), *Job creation and job destruction in the theory of unemployment,* Review of economic studies, 61, pp.397-415;
[10] Pissarides, C. (2000), *Equilibrium unemployment theory*, MIT press, Cambridge, Massachusetts;
[12] Schneider, F. (2002), *The size and development of the shadow economies of 22 transition and 21 OECD countries*", IZA discussion paper, 514 (June);

Appendix 1

Simulation with constant transition probabilities

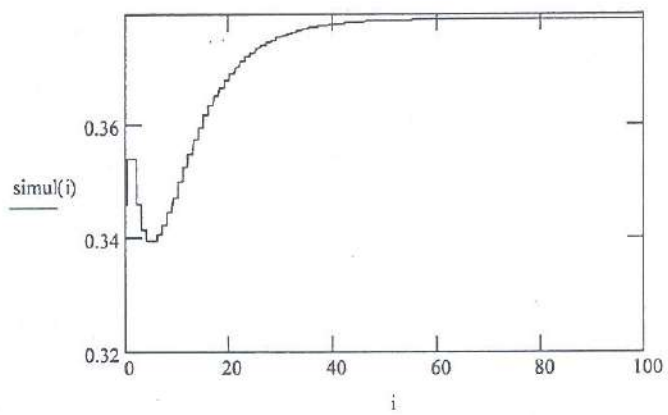
Stationary distribution

$p11 := 0.8897 \quad p12 := 0.0580 \quad p13 := 0.0523$

$p21 := 0.0976 \quad p22 := 0.7342 \quad p23 := 0.1682$

$p31 := 0.0186 \quad p32 := 0.0382 \quad p33 := 0.9432$

$$
\begin{aligned}
&simu(n) := \left|\begin{array}{l}
E \leftarrow 545100 \\
U \leftarrow 315900 \\
O \leftarrow 718500 \\
v \leftarrow (E\ U\ O) \\
\text{for } i \in 1..n \\
\quad \left|\begin{array}{l} E \leftarrow E \cdot p11 + U \cdot p21 + O \cdot p31 \\ U \leftarrow E \cdot p12 + U \cdot p22 + O \cdot p32 \\ O \leftarrow E \cdot p13 + U \cdot p23 + O \cdot p33 \end{array}\right. \\
v \leftarrow (E\ U\ O) \\
\frac{U}{U+E}
\end{array}\right.
\end{aligned}
$$



simu(100) = 0.379

Appendix 2

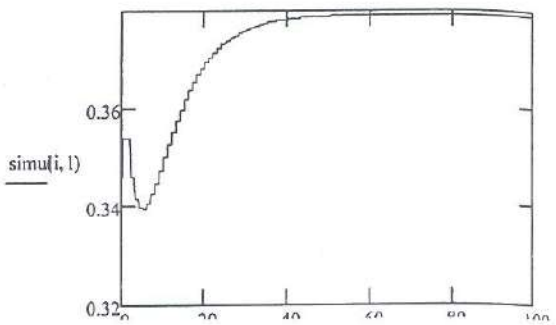
Simulation with constant transition probabilities

Difference equations

p11 := 0.8897 p12 := 0.0580 p13 := 0.0523

p21 := 0.0976 p22 := 0.7342 p23 := 0.1682

p31 := 0.0186 p32 := 0.0382 p33 := 0.9432




```
simu(n, delta) := | E ← 545100
                  | U ← 315900
                  | O ← 718500
                  | v ← ( E U O )
                  | for i ∈ 1..n
                  |     E ← E + p21 · U · delta + p31 · O · delta − p12 · E · delta − p13 · E · delta
                  |     U ← U + p12 · E · delta + p32 · O · delta − p21 · U · delta − p23 · U · delta
                  |     O ← O + p13 · E · delta + p23 · U · delta − p31 · O · delta − p32 · O · delta
                  | v ← ( E U O )
                  | U / (U + E)
```

Appendix 3

We distinguish between formal employment (E^f) and informal employment (E^i). The average product of the workers in the formal sector is higher than the average product in the informal sector. Denote with y^i the average product per worker in the informal sector and put for convenience $y^i = 1$. In this case, average product per worker in the formal sector will be $y^f = 1 + \theta$, where $\theta > 0$.

We assume that hiring in both formal and informal sectors are functions of the profitability per employed worker, which is defined as a difference between the worker's product and the market wage. Denote with H^f and H^i hiring functions in the formal and informal sector respectively, and with w^f and w^i the market wage in the formal and informal sector respectively. If reactivity of hiring to profitability is proportional constant a, than hiring functions will take the following forms:

$$H^f = a(y^f - w^f) = a(1 + \theta - w^f) \qquad \ldots (1)$$

$$H^i = a(y^i - w^i) = a(1 - w^i) \qquad \ldots (2)$$

We also for convenience normalise the market wage in the interval (0,1), i.e. $0 \le w \le 1$.

Denote with V^U, V^{Ef} and V^{Ei} the values of being unemployed and being employed in the formal or in the informal sector respectively in terms of expected utility:

$$rV^U = b + \left(\frac{H^f}{U}\right)(V^{Ef} - V^U) + \frac{dV^U}{dt} \qquad \ldots (3a)$$

$$rV^U = b + \left(\frac{H^i}{U}\right)(V^{Ei} - V^U) + \frac{dV^U}{dt} \quad \ldots (3b)$$

$$rV^{Ef} = w^f + \quad + \frac{dV^{Ef}}{dt} \quad \ldots (4)$$

$$rV^{Ei} = w^i + \delta b + \quad + \frac{dV^{Ei}}{dt} \quad \ldots (5)$$

where, r is a discount factor and, b is an unemployment benefit per worker including the other entitlements, while δ is the probability of a worker employed in the informal sector claiming unemployment benefit. Equations (3a) and (3b) have the same structure, except the differentiation of the change in value of being unemployed which is viewed relative to formal employment in the former and to informal employment in the latter. The number of hirings either in the formal or in the informal sector relative to the number of unemployed $\frac{H}{U}$ represents a proxy for the labour market condition in terms of the level of labour demand. This ratio can be used as an indicator for labour market tightness. We can assume that the value of being employed in the formal sector is higher than value of being employed in the informal sector, whereas both are higher than the value of being unemployed. For convenience, assume that these values are constant over time and satisfy the following conditions: $V^{Ef} = V^U + c^f$, $V^{Ei} = V^U + c^i$ and $c^f > c^i$.

By differencing (4) and (3a), we can obtain the expression for the market wage in the formal sector:

$$w^f = b + c^f\left(r + \frac{H^f}{U}\right) \quad \ldots (6)$$

Similarly, by differencing (5) and (3b), we can obtain the expression for the market wage in the informal sector:

$$w^i = (1-\delta)b + c^i\left(r + \frac{H^i}{U}\right) \quad \ldots (7)$$

Let introduce the government policy instruments that may affect the level of hiring in the formal and in the informal sector. Suppose that the government imposes a pay-roll tax at rate τ on the employed in the formal sector. On the other hand, the penalty rate π is function of the strength of enforcement of the rule of law and relative size of the informal sector. Therefore, the equations (1) and (2) will be modified as follows:

$$H^f = a\left[y^f(1-\tau) - w^f\right] = a\left[(1+\theta)(1-\tau) - w^f\right] \quad \ldots (8)$$

$$H^i = a\left[y^i(1-\pi) - w^i\right] = a(1-\pi-w^i) \quad \ldots (9)$$

By replacing the expression for the market wage in the formal sector (6) in equation (8), we can obtain the formulation for hiring in the formal sector as a function of unemployment:

$$H^f = \frac{aU}{U + ac^f}\left[(1+\theta)(1-\tau) - c^f r - b\right] \quad \ldots (10)$$

Similarly, by replacing the expression for the market wage in the informal sector (7) in equation (9), we can obtain the formulation for hiring in the informal sector again as a function of unemployment:

$$H^i = \frac{aU}{U + ac^i}\left[1 - \pi - c^i r - (1-\delta)b\right] \qquad \ldots (11)$$

Finally, we introduce the government budget constraint. In its simplest form, the budget constraint states that unemployment benefits are entirely financed by the pay-roll tax from the formal employment. Consequently, the budget constraint has the following expression:

$$Ub = (1-U)\tau \qquad \ldots (12)$$

The budget constraint as stated in (12) assumes normalisation of the labour force to one. This means that the non-participation category has still not been considered in the model. From (12), it is possible to express the tax rate τ and to replace in (10). Thus we will have the following expression for the formal hiring:

$$H^f = \frac{aU}{U + ac^f}\left[(1+\theta)\left(1 - \frac{Ub}{1-U}\right) - c^f r - b\right] \qquad \ldots (13)$$

Appendix 4

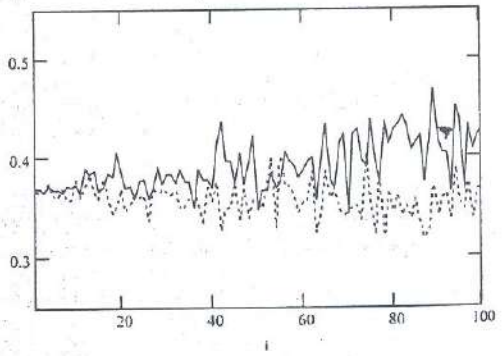
Stohastic model $r := 0.005$ $cf := 1.5$ $ci := 1$ $a := 0.3$ $\theta := 0.5$ $p21 := 0.0976$

$simul(n, b, \pi, \delta) :=$

$E \leftarrow 0.3451$
$U \leftarrow 0.2000$
$O \leftarrow 0.4549$
$v \leftarrow (E\ U\ O)$
for $i \in 1..n$
$\mu f \leftarrow a \cdot \left[(1+\theta)\cdot\left(1 - b\cdot\frac{U}{E}\right) - b - cf\cdot(r + p21)\right]$
$\mu i \leftarrow a \cdot \left[1 - \pi - ci\cdot r - (1-\delta)\cdot b\right]$
$\mu \leftarrow \mu f + \mu i$
$v \leftarrow \frac{a}{\mu}$
$JC \leftarrow (rpois(1, \mu)_0 \cdot 0.01)\cdot E$
$JD \leftarrow (rpois(1, v)_0 \cdot 0.01)\cdot E$
$p12 \leftarrow 0.4\cdot\frac{JD}{E}$
$p13 \leftarrow 0.4\cdot\frac{JD}{E}$
$p21 \leftarrow 0.8\cdot\frac{JC}{U}$
$p31 \leftarrow 0.1\cdot\frac{JC}{O}$
$p23 \leftarrow 0.4\cdot\frac{JD}{U}$
$p32 \leftarrow 0.6\cdot\frac{JC}{O}$
$E \leftarrow E + p21\cdot U + p31\cdot O - p12\cdot E - p13\cdot E$
$U \leftarrow U + p12\cdot E + p32\cdot O - p21\cdot U - p23\cdot U$
$O \leftarrow O + p13\cdot E + p23\cdot U - p31\cdot O - p32\cdot O$
$v \leftarrow (E\ U\ O)$
$\frac{U}{U+E}$

$i := 1..100$

$\frac{simul(i, 0.3, 0.3, 0.2)}{simul(i, 0.1, 0.5, 0.1)}$



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