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THE STOCHASTIC DYNAMIC ANALYSIS OF THE LABOUR MARKET THEORY AND PRACTICE

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English summary

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Budapest, 2014.

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1. Introduction

Unemployment is a harmful phenomenon from both the society's and the individual's point of view. Considering the society it causes problems that unexploited capacities impede the efficient work of the economy, the budget is encumbered by the drop out of tax revenues and increased social security benefits, whereas the individual can not obtain labour income. Exactly that is why the examination of unemployment is one of the major issues of economics. Labour market is, however, a special market, so theory has not been able and foreseeably will not be able to deliver a uniform framework for analysis in the near future.

The efficient work of the labour market is hampered by frictions, thus the market can not behave as a Walrasian model: assumptions relating to perfect competition are not met, above all the homogeneity and perfect information conditions. The sources of frictions are the dissimilar qualifications, desires of the labour force and the differentiated nature and distinct expectations of workplaces offered by companies. Further frictions are caused by the complexity of available information and the way actors are informed, which may not be full due to the above mentioned differentiations. Consequently, there are no perfectly informed agents, asymmetric information is frequent. Coordination difficulties also contribute to frictions, as a consequence of which not all job advertisements are applied for and not all unemployed workers find a job. Frictions are also generated by those mobility costs workers have to face while looking for a job. These costs hamper the reallocation of the labour regionally and among industries, and the predomination of market clearing forces.

These „search frictions" are in the focus of the so called search and matching models. Much before the birth of the above models *Hicks* [1932] already called the attention to the role of frictions: there is such a („normal") level of unemployment which does not provoke a change in wages. Hicks also considered frictions important from the point of view that real wages react to shocks more slowly in the presence of frictions and therewith cause short term imbalances. In the interpretation of *Keynes* [1936/1965] „normal" unemployment is not substantial, as a so-called *frictional unemployment* can be defined, which is compatible with full employment (*Petrongolo–Pissarides* [2001]).

At the end of the 1960's the basic conception according to which there exists an unemployment rate which was called as „*natural*" by *Friedman* [1968] and „*equilibrium*" by *Phelps* [1967], [1968] appeared more forcefully than any previous attempts before. In a „dynamic economy" unemployment has various sources, natural unemployment rate is the theoretical rate in this approach to which the economy converges in the long run. The natural rate depends on: the structural characteristics of the labour and goods market, the extent of market imperfections, the random fluctuations of demand and supply, the cost of obtaining information and mobility in the labour market. This rate is not constant of course, its value changes in the course of time. As Friedman argues, this rate, furthermore, can not be influenced by monetary policy in the long run. At the same time there exists a short-run trade-off between inflation rate and unemployment, which became well-known as *Phillips-curve*.

Stigler [1989a], [1989b] called the attention to incomplete information emerging from the cost of producing information. He stressed the importance of searching, when customers do not know the prices of sellers in the market. He constructed the first versions of search models. He presumed that job seekers know the variance of wage distribution and they are able to determine the mean of wages at least approximately, but they do not know what wage will be offered by which company. Therefore they recognise that it is worth searching for the best offers possible. Under these circumstances the question comes to the forefront how long job seekers might look for the right alternative. At the beginning of the 1970's formalised search models attribute the existence of unemployment primarily to the fact that job seekers do not dispose about adequate information on job opportunities offering high wages, so they take a sample and in case an offer fulfils their expectations they refuse (low paid) job offers. Thus the models focus on searches and the decision-making characteristic of employees' (supply), where key role is assigned to the so-called *reservation wages*.

Search models can be regarded as predecessors of search and matching models appearing later in economic theory. In these models searching frictions gain a more important role, whose „elegant" analysis was enabled by the introduction of the *matching function*. The models are built upon the generally observable phenomenon that in an economy unemployment and job vacancies appear at the same time, that is, unemployment is not reduced to the phenomenon of surplus in the labour market. A further important feature of these models is the presence of the so-called „*searching externalities*", as well as the job creation surplus (rent) resulting from frictions.

In a modern market economy continuous changes can be observed in the labour market as a consequence of globalisation, technical progress, production and financial innovations etc. The gaining ground of particular industries, while the overshadowing and breaking down of others, naturally influence the creation and destruction of jobs. And all these processes determine job finding and loss, affect the intention of becoming active or inactive, the way the number of unemployed changes through the inflow and outflow into and out of the labour force. Apart from the natural processes of the economy the role of the set of government policy instruments is not negligible either. Understanding and scrutinizing the processes of job finding and separation is not an easy task. It is difficult to determine the actual number of job seekers on the supply side of labour market as job seekers might not always be unemployed persons. Those searching for a job can be such inactive persons who are indeed looking for a job but do not fulfil those criteria which are set up for unemployed workers in certain procedures. Furthermore, job seekers can also be found among employed persons, they are those who would like to change jobs for one reason or another. The number of effective job seekers might significantly deviate from the number of unemployed persons no matter which (register or labour force survey) approach for estimation is applied. From the side of separation it is also cumbersome to segregate particular components. The separation can be generated namely as a result of more decisions: out of involuntary decisions of the individual (firings and layoffs), or out of the self-imposed intention of changing jobs (quits), together with the expiration of a non-renewed time-limited employment contract. At the same time dismissed workers and job leavers will not be all unemployed as they can even immediately find a job or become inactive.

The estimation and analysis of job finding and separation rates as well as probabilities are crucial for understanding unemployment processes and the reasons behind it. These analyses came to the forefront mainly after the appearance of search and matching models. This was further strengthened by the extension of labour market data availability in the developed countries, above all in the United States.

Analysing the labour market in the USA *Darby, Haltiwanger* and *Plant* [1986] observed that the inflow to unemployment and its composition play an important role in the processes of unemployment. In Britain *Pissarides* [1986] finds that the primary cause of increased unemployment rate in the 1970's and 1980's was the decrease in job finding because of the decline in labour demand. *Blanchard* and *Diamond* [1990] analysing the labour market of the United States show: the volatility of employment increments is more moderate than the volatility of employment loss. They have found that the role of separation (job loss) was dominant in the evolution of unemployment.

Later *Shimer's* [2005] and [2007] methods for determining separation and job finding rates gave a further impetus to this direction of research. His analysis showed the importance of the job finding rates. *Hall* [2005] also stressed the role of the more volatile job finding rate. *Davies, Faberman* and *Haltiwanger* [2006] have found that it was essential to distinguish between job leaving and layoffs within the separation: in less severe recessions the dominance of the rate of job finding, while in stronger recessions the dominance of the rate of separation is more characteristic. *Fujita* and *Ramey* [2008] also analysed the volatility of unemployment rate. Their analysis is based on the deviations of the unemployment rate from trend. They pointed out with the help of their method built upon variance-decomposition: there is no such essential difference between the contribution of job finding and separation rates and the results largely depend on the method of trend removal.

According to *Elsby, Michaels* and *Solon* [2009], in conformity with Shimer, the procyclical job finding rate[1] plays an important role in cyclical unemployment. However, in contrast to Shimer they suggest that countercyclical (dismissal) flow is relevant within separation mainly in times of severe recession. *Petrongolo* and *Pissarides* [2008] calculated job finding and separation rates with a procedure based on data observed in subsequent periods on flows between unemployed and employed persons stemming from labour force surveys. They examined the English and Spanish labour market with variance-decomposition relying on relation describing the change of steady-state unemployment. They pointed out that the contribution of separation rate to the variance of unemployment rate is more significant (over 40%). *Elsby, Hobijn* and *Sahin* [2008] were also estimating outflow (job finding) and inflow (separation) rates for the OECD countries. Significant deviations were observable between the rates: Anglo-Saxon and northern European countries can be featured by higher rates. According to their calculation the contribution of outflow rate to unemployment volatility shows notable discrepancies: in Anglo-Saxon countries it reaches 81% whereas in other countries a much lower measure, 50%.

Among the labour market analyses of Visegrad Countries we can not find similar examinations. *Münich* and *Svejnar* [2009] investigated the causes of Czech and Slovak unemployment and ascribed it on the one hand to the process of structure change characterised by significant flows and on the other hand to low demand for labour force (job advertisement). In Poland the inefficiently operating labour market caused problems rather, thanks to which the institutions and policy measures play an important role. The Hungarian case was more complicated, all or none of the above mentioned processes were a reason for the rate of unemployment. *Faggio* [2007] observed a negative correlation between the unemployment rate and the job creation of the private sector during the examination of transition economies. In his research he assigned an important role in the evolution of

[1] Or exit rate from unemployment.

unemployment to the transfer and tax policy, as well as the authorisation of foreign capital inflow.

Hurník and *Navrátil* [2005] using estimates of time-varying NAIRU (non-accelerating inflation rate of unemployment) show that the NAIRU in the Czech Republic had grown from quite stable 6 percent before 1996 by 1,5 percentage points and has remained at this higher level ever since. This increase in the NAIRU was caused by the worsening of labour market efficiency, the economic shocks (mainly the currency crisis), the new system of social benefits, the introduction of the new Labour Act and the raising of the minimum wage. G*ottvald* [2005] estimates transition probabilities for the period beginning from 1993 till 2000 using Czech labour force survey data. Before 1997 in the period of delayed restructuring the probability of remain unemployed was relatively low and the probability of finding a job after short term unemployment was relatively high. In the period 1997 to 1999 macroeconomic overheating turned into recession. This dramatically changed the values of transition probabilities: the probability of separation that causes unemployment rose, and the probability of finding a job fell. During the post recession period (after 2000) the problem of long-term unemployment (unemployment that lasts more then one year) became more serious.

Góra and *Walewski* [2002] study the Polish labour market and show that flows between activity and inactivity are of great importance. Later *Strawinski* [2008] examined the labour market flows using Shimer's method and new procedures too.

Within the Hungarian labour market investigations *Galasi* [2003] examining the job finding of unemployed persons confirmed: the job finding (exit) rate of unemployed persons is very low, the employment chances of certain inactive groups are more favourable than the chances of unemployed. Finding a job is also influenced by the job searching behaviour, which was analysed in other studies. *Galasi* [1996] examined the positive and negative effects of aid on job search, whereas according to the examination of *Galasi* and *Nagy* [2003] transfer payment only slightly reduces the probability of finding a job. *Micklewright* and *Nagy* [2001] revealed that giving up the job seeking increases with the duration of unemployment. They found a significant effect of local circumstances on job seeking probability. *Kézdi, Horváth* and *Hudomiet* [2005] regard the strong inactivity experienced by a country as a cause for low unemployment, which according to *Pula* [2005] and *Cseres-Gergely* [2007] is owing to the aid and pension system (disability and early retirement benefits). The results of *Kátay* and *Nobilis* [2009] indicate that the rising labour supply since 1997 in Hungary has been principally driven by the increasing average level of education and, most importantly, the gradual tightening of the conditions of old-age retirement. *Cseres-Gergely* [2010] and [2011] present a "raking procedure" of calculating labour market flows according to which the changes of stock values can be divided into labour market flows among employment, unemployment and inactivity.

Lubyová, *Ochranková* and *Vantuch* [1999] pointed out that there are some serious problems in the Slovak economy. The period starting in 1994 can be characterized by relatively high economic growth that was in the beginning export-led and then government spending-led, but structural reforms progressed very slowly, restructuring was delayed and took a long time and bankruptcy procedures were not effective. Most of the firms were indebted, their profitability was very low and the restructuring of firms progressed slowly as well. This was caused by the non-transparent coupon privatization. The Slovak economy was not characterized by a diversified production structure: the majority of regions were dependent only on a single industry. Job creation was very low in these areas, and this entailed that people couldn't find a job, the unemployment rate was high, and the problem of long-term unemployment became more and more serious. *Lubyova* and *Ours* [1997], by analysing the unemployment register data in the Slovak Republic between 1992 and 1995, showed that the financial incentives affect the duration of unemployment, but the modification of the aid system has insignificant effect on job finding. *Lubyova* and *Ours* [1998a] examined the position of job losers using LFS data. They found that the characteristics of job losers as sex, age and education are very important determinants of the job finding probability. These characteristics and the apparent differences in the features and capabilities of job seekers played more important role in finding a job than the distorting effects of the aid system. A significant proportion of the unemployed had very low probability of job finding. *Lubyova* and *Ours* [1998b] analysed the effects of active labour market programs. They found that the supported employment and retraining programs have a positive, while the public work programs have a negative impact on the job finding opportunities of the unemployed participants. *Páleník* [2009] identified the long-term unemployment, the unemployment among young people, the labour market situation of unqualified people, and the observed differences in employment in age, education and gender as the main weaknesses of the Slovak labour market.

The objective of my dissertation was twofold: Firstly to examine the theoretical aspects of modern labour market models. Secondly to conduct empirical analysis of the inactive labour proportion and composition by various criteria of the individual Visegrad countries, furthermore to examine the factors affecting the evolution of unemployment in the Visegrad countries during the period from the late 90s to the end of 2012. In the absence of labour flow data between active and inactive population this latter examination means the ceteris paribus analysis of separation (employment exit) and job finding rates. Therefore the primarily aim of my calculations is to test the models; the conclusions drawn from the results should be treated with considering these constraints. However, the positive tests suggest that the results and conclusions of the computation based on available flow data between active and inactive population can be used without constraints in directing labour market policy decisions.

The second chapter of the dissertation describes briefly the search models, their criticism, comments and the model versions. The third chapter presents the search and matching models. Following the contributions of some Nobel Prize winners this chapter delineate the theoretical preliminaries of these models, a basic search and matching model, the out of steady-state dynamics, in response to the new economic paradigm[2]. Furthermore, the typical characteristics of the new generation models, lessons of efficiency analyses, the possibility of investigating the role of policy measures, and the foundation of Shimer's critique will be discussed.

The fourth chapter describes the labour force survey procedures and methods in the Visegrad countries, and characterizes unemployment and inactivity trends and differences. I examined the differences in inactivity rates between each Visegrad country and the EU15 country-group by a technique based on standardisation. I analysed the contribution of young people (age group 15-24), people over 60 (age group 60-64) and people with primary education to differences in inactivity rates. Using Shimer's method I calculate the job finding and separation probabilities, its average values and based on that analyse the differences between the individual Visegrad countries. This is followed by an analysis of the cyclical properties of the transition probabilities based on correlation calculations. Then using Shimer's method and variance-decomposition I examine the relationships between unemployment and transition rates (probabilities), the contributions of rates to the variance of unemployment rate. In the last part I summarize the main results of the empirical analysis.

[2] See Móczár [2008].

2. The search model of unemployment

In this chapter I present the basic search model of unemployment. In this framework it plays a central role: how to optimize the acceptance of wage offers. The unemployed do not know the wages offered by firms, they are only aware of the distribution of wages. So the unemployed take a sample and try to maximize the present value of their expected future income. Their revenue in the future may be the wage if they become employed or the income during search if they remain unemployed. If they reject the wage offer then they remain unemployed. The question is what determines the decision rule of workers. The optimal search behaviour is determined by the so called "reservation wage": this is the minimum wage at which the unemployed accept the wage offer.

The search models explain the job finding of unemployed workers. The rejection of job offers causes unemployment in these models. The opposite flow (job losing) can be generated in search models, if we assume that jobs end for some exogenous reason. The basic statement of this type of models is as follows: the probability of finding a job equals the product of the contact probability (the probability of that the unemployed worker gets a job offer) and the probability of accepting (the probability of that the offered wage is at least the reservation wage).

Search models are consistent with some facts of the labour markets: it takes time to find an acceptable job, and these models can yield different wages, too (*Rogerson-Shimer-Whright* [2005], *Royal Swedish Academy of Sciences* [2010]).

3. The search and matching models

The labour market is a special market: it is not a perfect market. There are considerable frictions on the market because of: heterogeneities and information imperfections. The search and matching models elegantly handle these frictions with the introduction of the matching function. In this chapter I summarize the literature of search and matching models. I present the basic search and matching model, analyse the out of steady-state dynamics briefly describe the new generation models, the externalities on the labour market, the role of the government and the analysing possibilities of labour market policy. At the end of this chapter I demonstrate Shimer's critique.

3.1. The basic search and matching model

The frictions in these models are represented by the matching function $M = m(U,V)$: where U is the number of the unemployed and V is the number of job vacancies. Generally it is an increasing function in both arguments, concave, and homogeneous of degree one. The numbers of job vacancies and unemployed determinate θ $(\theta = V/U)$ the so-called labour market tightness. If L denotes the labour force then u (= U/L) is the unemployment rate and v (= V/L) is the vacancy rate.

Thanks to random selection the changes in the state of job vacancies and workers are Poisson processes and so the job filling's rate is $M/vL = q(\theta)$ and the job finding's rate is $M/uL = \theta q(\theta)$. There is another flow on the labour market: the workers move from employment to unemployment with the rate λ, this is the rate of job destruction.

If we assume that the labour force (L) is constant then the flow from employment to unemployment is $\lambda(1-u)L$; and the flow from unemployment to employment is $\theta q(\theta)uL$. Then the change in the unemployment rate is determined by the equation

(1) $\dot{u} = \lambda(1-u) - \theta q(\theta)u$.

In the steady state the unemployment rate doesn't change, thus the steady state unemployment rate is given as:

(2) $$u = \frac{\lambda}{\lambda + \theta q(\theta)}.$$

The equation (2) is one of the key equations of the model. It determines in the tightness-unemployment space a downward sloping and convex curve to the origin. This implies a negative relationship between unemployment and vacancies the so-called *Beveridge curve*. The changes in the job destruction rate and changes in the matching efficiency shift the Beveridge curve.

When a firm and a worker meet and agree upon an employment contract then job creation takes place. For simplicity we assume that the firms are small: each firm has only one job. This job is either vacant or occupied by a worker. Before job creation the firm has to open a job vacancy and has to search. The searching has costs: $pc > 0$ per unit of time. After job creation the job has p output that is constant and worker has w wage.

The number of job vacancies is endogenous. It is determined by the profit maximizing firms. The entry to the market of job vacancies is opened for any firm. Let V denote the present-discounted value of expected profit from a vacant job and J the present-discounted value of expected profit from an occupied job. The vacancy is filled at the rate $q(\theta)$ and the job is destroyed at the rate λ. With a perfect capital market over an infinite horizon V and J satisfy the Bellman equations

(3) $rV = -pc + q(\theta)(J - V)$ and

(4) $rJ = p - w + \lambda(V - J)$,

where r is the real interest rate. (3) and (4) say that the capital cost of a job (either vacant or occupied) is equal to the return on the asset. The return from a job vacancy involves an immediate cost $-pc$ and the prospect of finding a worker that yields $J - V$ net return. The return from an occupied involves an immediate profit $p - w$ and the risk of job destruction that yields loss of $V - J$. Because of free entry V is zero and so

(5) $J = \dfrac{pc}{q(\theta)}$ and

(6) $rJ = p - w - \lambda J$.

From (5) and (6) we can derive the *job creation condition* that is

$$(7) \quad p - w - (r+\lambda)\frac{pc}{q(\theta)} = 0.$$

Because of the properties of $q(\theta)$ the equation (7) represents a positive relationship between θ and w.

With exogenous and fixed search effort the workers can influence equilibrium through their influence on wage determination. An unemployed enjoys real return z and an employed earns w. Let U denote the present discounted value of the expected income stream of an unemployed and W the present discounted value of the expected income stream of an employed. An unemployed finds a job vacancy at the rate $\theta q(\theta)$ and an employed loses his job at the rate λ. So U and W satisfy the Bellman equations

$$(8) \quad rU = z + \theta q(\theta)(W - U) \text{ and}$$
$$(9) \quad rW = w + \lambda(U - W).$$

The wages are determined through individual worker-firm bargains and so the wages are derived from the generalised Nash bargaining solution. The individual wage w_i is determined by

$$(10) \quad w_i = \arg\max\left\{(W_i(w_i) - U)^{\beta}(J_i(w_i) - V)^{1-\beta}\right\},$$

where β can be interpreted as the worker's bargaining strength. The first-order maximization condition to (10) using (6) and (9) is

$$(11) \quad W_i(w_i) - U = \beta[J_i(w_i) + W_i(w_i) - V - U].$$

Equation (11) says that the worker's share of the total surplus, which is created by the occupied job, is β. Using (6) and (9) the wage is

$$(12) \quad w_i = rU + \beta(p - rU).$$

Equation (12) yields that all jobs offer the same wage. Equations (5), (8), (11) and (12) give the wage equation:

(13) $w = (1-\beta)z + \beta p(1 + c\theta).$

The steady state equilibrium is determined by equations (2), (7) and (13). Equations (7) and (13) determine w and θ, then $v = \theta u$ and the Beveridge curve determine u and v (*Pissarides* [2000], *Royal Swedish Academy of Sciences* [2010]).

3.2. Out of steady-state dynamics in the search and matching model

The out of steady state dynamics is determined by equations:

(14) $\dot{V} = rV - [-pc + q(\theta)(J - V)],$

(15) $\dot{J} = rJ - (p - w - \lambda J),$

(16) $\dot{U} = rU - [z + \theta q(\theta)(W - U)],$

(17) $\dot{W} = rW - [w + \lambda(U - W)].$

In the case of free entry on the market of job vacancies (14) implies that equation (5) holds. Another assumption is that the wages are determined by the Nash solution to the bargaining problem, and (11) and (13) hold too. Using equations (5), (15) and (13) the dynamic equation of the labour market tightness can be described as follows:

(18) $$\dot{\theta} = \phi(\theta) = -\frac{\beta q^2(\theta)}{q'(\theta)}\theta - \frac{(r+\lambda)q(\theta)}{q'(\theta)} + \frac{(1-\beta)(p-z)q^2(\theta)}{pcq'(\theta)}.$$

By linear approximation of (18) around the steady state we obtain

(19) $$\dot{\theta} = \phi(\theta^*) + \left.\frac{d\phi(\theta)}{d\theta}\right|_{\theta=\theta^*}(\theta - \theta^*) = \left[-\frac{\beta q^2(\theta^*)}{q'(\theta^*)} + r + \lambda\right](\theta - \theta^*) = A(\theta - \theta^*),$$

where A is a positive scalar because $q(\theta)$ is a decreasing function of θ.

The dynamics of the unemployment rate is given by (1), with linear approximation around the steady state we obtain

$$(20) \quad \dot{u} = -[\lambda + \theta^* q(\theta^*)](u - u^*) - \left.\frac{d[\theta q(\theta) u]}{d\theta}\right|_{u=u^*;\theta=\theta^*} (\theta - \theta^*),$$

where the coefficient of u is negative and the coefficient of θ is negative too, because $\theta q(\theta)$ is an increasing function of θ.

The system of equations (19) and (20) determine the dynamics of θ and u. Since the Jacobian matrix of the system has a negative determinant, the necessary and sufficient conditions for a saddle-point are satisfied. This all with the responses to changes in productivity yield that during the business cycle the vacancies and unemployment depict anticlockwise loops around the Beveridge curve (*Pissarides* [2000] and [1985]).

3.3. Initial criticism and the new generation of the search and matching models

In this subchapter I shortly describe the criticism of the search and matching models. The subject of the first criticism was the exogenous job destruction assumption because the empirical study of *Davis-Haltiwanger-Schuh* [1996] shows that the rate of job destruction is more sensitive to shocks than the rate of job creation. This criticism yielded the model of endogenous job destruction (*Mortensen-Pissarides* [1994]).

The base for further criticism was that the first models focused only on labour market flows between employment and unemployment and so the rate of labour turnover was equal to the rate of job turnover. But this is not true because firms replace quitting employees. There are other flows on the labour market too: flows from employment or unemployment to inactivity (which include: retirements), from inactivity to unemployment (or employment) and there is job-to-job quitting too. The generalization of the search and matching model could handle these facts (see *Pissarides* [2000] Chapter 4).

Another important fact is that workers can influence the equilibrium through their choice of search intensity. Changes in the search activity can shift the Beveridge curve and so search activity can strengthen the effects of productivity on unemployment (see *Pissarides* [2000] Chapter 5).

In reality there are some unobservable characteristics of jobs and workers which influence the productivity of the job. This yields different productivities and that not all firm-worker meets end with an employment contract. This fact is the base of the model with stochastic job matching (see *Pissarides* [2000] Chapter 6).

3.4. Externalities, efficiency and government measures

The search and matching environment is characterized by externalities. When an unemployed determines his search intensity he seeks to increase the probability of getting a job and maximize the present value of future income, but generally he ignores two external effects. One of them is the negative externality (congestion) that he causes to the other unemployed, the other one is a positive externality, from which the firms will benefit as his activity increases the likelihood of that a vacant job gets filled. The presence of externalities resulted in a series of efficiency studies. The Nobel Laureates have greatly contributed to this area.

Mortensen [1982a] and [1982b] examines the conditions for optimal intensity and in the case of linear matching function he concluded that assigning "property rights" to the job yields optimality: thus the side which initiated the contact claims the entire surplus from the job, the other side is compensated only for its costs. This rule is called as Mortensen's rule. The major result of the efficiency studies is nevertheless the so-called Hosios condition: the equilibrium will be effective if the elasticity of the matching function with respect to unemployment is equal to the worker's relative bargaining power (*Hosios* [1990]).

Diamond [1982] pointed out that the established equilibrium is not always the best and the economy could get stuck in a bad equilibrium. In this case only the government can motivate agents with demand management (fiscal instruments) and lead out the economy from this bad equilibrium (*Royal Swedish Academy of Sciences* [2010], *Rogerson-Shimer-Wright* [2005]).

3.5. Labour market policy in the search and matching model

In this subchapter I shortly describe the possibility of the analysis of various policy instruments as: tax subsidy (τ), proportional tax rate (t), tax [$T(w) = tw - (1 - t)\tau$], employment subsidy (a), hiring subsidy (pH), firing cost (pF) and after tax replacement rate (ρ) or unemployment benefit [$b= \rho(w - T(w))$]. These policy instruments affect the Bellman equations (3), (4), (8) and (9) and yield

(21) $rV = -pc + q(\theta)(J + pH - V)$,

(22) $rJ = p + a - w + \lambda(V - J - pF)$,

(23) $rU = z + b + \theta q(\theta)(W - U)$,

(24) $rW = w - T(w) + \lambda(U - W)$.

There are some new characteristics of the basic model because of policy instruments. Policy instruments affect the payoffs from job creating, the loss from job destruction, labour's share of the total surplus. And these instruments also yield wage differential: the wage of insiders (the employed) is not equal to the wage of outsiders (the unemployed) (see *Pissarides* [2000] Chapter 9).

3.6. Shimer's critique and wage rigidity

Shimer [2005] argues that the search and matching model cannot generate the observed business-cycle-frequency fluctuations in unemployment and job vacancies. *Shimer* [2004] shows that one possible solution is wage rigidity: it increases the sensitivity of job finding and unemployment to the productivity shocks. Beside the fully rigid wages there are other solutions too: *Gertler–Trigary* [2009] allows for staggered multiperiod wage contracting, *Kennan* [2010] allows for informational rents. *Hall–Milgrom* [2008] suggests the modification of the so-called "threat points". They suppose parties who are making offers moreover so an offer is followed by a counter-offer. Their study shows: when we take into account the delay costs of bargaining then wages are less sensitive to productivity shocks and this increases the sensitivity of unemployment.

In the literature of search and matching models, however, it is not uniformly accepted that wage rigidity is the only solution to the problem. *Hagedorn–Manovski* [2008] shows that this could be a calibration problem: mainly the bad calibration of the value of non-market activity. *Mortensen* and *Nagypál* [2007] underline: when the elasticity of the matching function and the opportunity cost of a match are set at reasonable values then the model can generate more volatile labour market tightness. They find important the role of job-to-job quits too. *Pissarides* [2009] argues that wage rigidity is not the right explanation to the problem because wages in new matches are volatile. He modified a basic model by breaking up the proportional vacancy costs of the model into a proportional vacancy cost and a fixed matching component. With this modification the model can generate more volatile tightness and job finding, and is consistent with wage flexibility in new matches.

4. The labour market analysis of the Visegrad countries

In this chapter I analyse the labour markets of the Visegrad countries. First I investigate the unemployment and inactivity rates, then job finding and separation rates. The probabilities are computed on the basis of Shimer's method [2007]. I compare the cyclical movements in the GDP, in the transition probabilities and in other labour market variables. Using variance-decomposition methods we examine the role of separation and job finding rates in the labour market processes, especially in the evolution of the unemployment rate.

4.1. The methodology of the Labour Force Survey

In this subchapter I demonstrate the methods of the Labour Force Survey (LFS) in each of the countries under examination. The LFS is a representative sample and its main goal is to give a picture about the situation on the labour market. This part of the work describes the main characteristics of the survey. The population covered by the survey is observed through households. The main characteristics of this survey are common: the sample has some subsamples, and partial rotation is carried out every quarter.

In the Czech Republic and Slovakia the sample has 5 subsamples, and in every quarter one of the subsamples is substituted by a new one. In Hungary the sample has six subsamples, and one of the subsamples is newly observed in every quarter. In Poland the survey has four subsamples: two of these belong to the survey of the previous quarter, one newly observed subsample and one that was introduced into survey one year before.

Then I define the three main groups on the labour markets: unemployed, employed and the economically inactive population. The unemployed are such persons who are not employed, are actively looking for a job over four weeks and are able to take a job within two weeks. The employed are such persons who performed for at least one hour any work generating pay or income during the reference week, or had work but did not perform it. These two groups form the economically active population, the so called labour force. The persons who are neither employed nor unemployed (not in the labour force) form the economically inactive population (*Český štatistický úřad* [2012], *Štatistický úrad Slovenskej republiky* [2012], *Główny Urząd Statystyczny* [2012], *KSH* [2006]).

Using the quarterly data of the Labour Force Survey I analyse the labour markets of the Visegrad countries. I use the following data of the Eurostat database:

- The number of unemployed workers,
- The number of employed workers,
- Economically inactive population,
- The unemployment rate,
- The employment rate,
- The inactivity rate,
- The detailed duration data of unemployment (by the following groups: less than 1 month, 1-2 months, 3-6 months, 6-11 months, 12-17 months, 18-23 months, 24-47 months, 48 months or more)
- The number of economically inactive population by willingness to work (the groups are: do not want to work; would like to work but is not seeking employment; seeking employment but not ILO unemployed).

The work examines two age groups:

- 15-64,
- 25-59.

The data were available for different periods:

- Czech Republic and Slovak Republic: 1998Q1-2012Q4,
- Poland: 2000Q1-2012Q4,
- Hungary: 1999Q1-2012Q4.

4.2. Unemployment and inactivity in the Visegrad countries

In this subchapter I analyse and compare the trends in the unemployment and inactivity rates. My main observations in this subchapter are:

- The labour market of the Czech Republic is characterized with the most favourable data: it has not only the lowest mean of unemployment and inactivity rates, but had the lowest values of these rates in the most part of the observed period.
- The mean of the unemployment rate in Hungary is low in both age groups, but this is caused by the low activity of population. Thanks to the "Hungarian crisis" the unemployment rate in Hungary was constantly growing after 2004. Hungary has

had the most serious problem of inactivity: the inactivity rate was the highest during the whole period, but now it has a decreasing tendency.

- Poland had a high mean of unemployment rate, because of its big unemployment problem from 2000 till 2004. Thanks to increasing economic growth the unemployment rate decreased and it reached its minimum value in 2008 before the global crisis. The inactivity rate in Poland is high, but from 2007 there has been downward movement in the rate.
- Slovakia had a great unemployment problem at the beginning of this decade, similarly to Poland, from 2007 the Slovak unemployment rate has been the highest, and thus it also has the highest mean of unemployment rate in both age groups. But the tendency of unemployment is positive, it reached its minimum value in 2008. But during the global crisis it has risen sharply. Nevertheless, the problem of inactivity is not so serious as in Poland or in Hungary.
- There are big differences in unemployment and inactivity rates between the Visegrad countries, but the data show, that there is a slight tendency of convergence, the differences between countries are smaller. Before the global crisis this distinct tendency in unemployment was caused by the fast economic growth in Poland and Slovakia. The reduction of inactivity rate in Hungary (and Poland since 2007) was the main cause of the decreasing differences between the inactivity rates of Visegrad countries.
- The analysis of the two age groups shows, that the age group 25-59 can be characterized by almost the same differences as the age group 15-64. This is quite an interesting observation, which shows that there were other more important causes of the differences than the willingness to study and differences in the early retirement systems.

In this subchapter I analyse the differences in the inactivity rates of the Visegrad countries by decomposition based on standardisation[3]. Through the method applied I examine the differences in inactivity rates between each Visegrad country and the EU15 country-group on the basis of its components, while I take as standard population the population of the EU15 country-group. Thus, the age group 15-64 is divided into *n* subgroups and I compare the inactivity rate of the Visegrad countries to the EU15 country-group. The differences in inactivity rates are divided into two components:

[3] See *Kátay* [2009].

$$ir_{15-64,HU} - ir_{15-64,EU15} = \sum_{i=1}^{n} w_{i,HU} ir_{i,HU} - \sum_{i=1}^{n} w_{i,EU15} ir_{i,EU15} =$$

$$= \sum_{i=1}^{n} \left(w_{i,HU} - w_{i,EU15}\right) ir_{i,HU} + \sum_{i=1}^{n} w_{i,EU15} \left(ir_{i,HU} - ir_{i,EU15}\right) = K_{pop} + K_{inact}$$

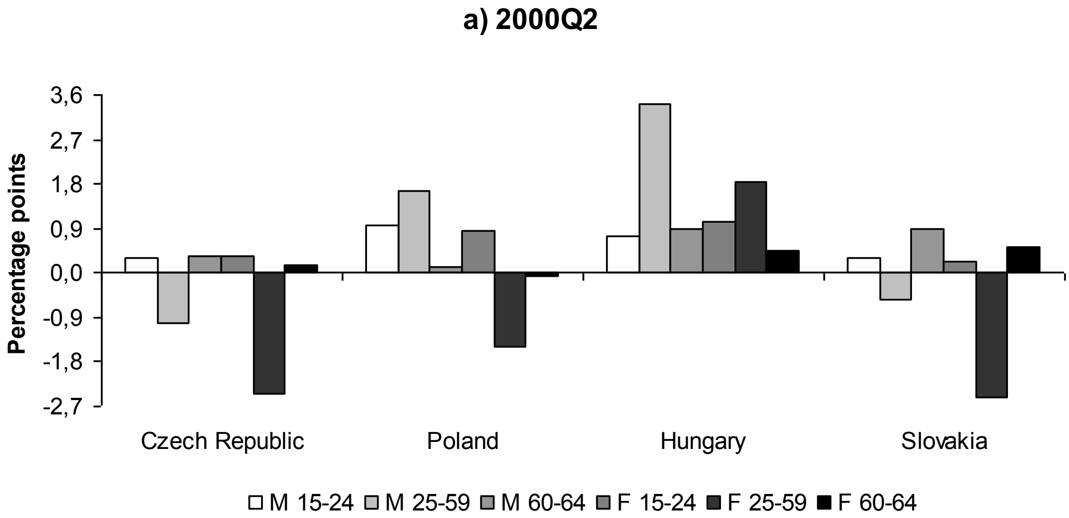
where i is the index of subgroups, w_i indicates the distribution ratio (weights of subgroup i in the population aged 15-64) and ir_i is the inactivity rates of subgroup i. The first component, K_{pop}, shows how much of the differences in the inactivity rate of the age group 15-64 is explained by the different population structure between the particular Visegrad countries and the EU15 country-group. The second component, K_{inact}, which is the remaining part of differences, is caused by the different inactivity rates of the particular countries and of the EU15 country-group.

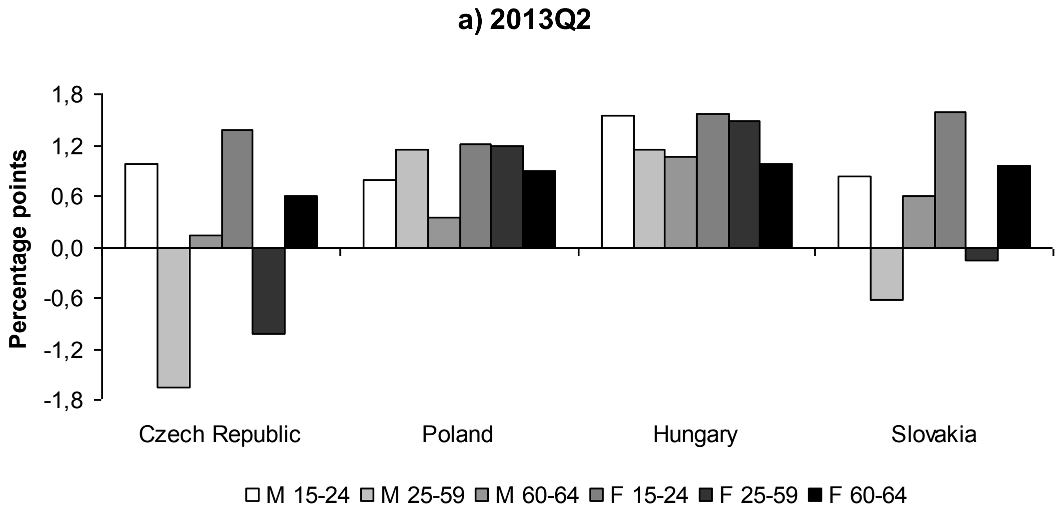
The decomposition is carried out in each of the Visegrad countries. First, the groups were formed on the basis of gender and age. Based on age three subgroups are distinguished: young people (age group 15-24), the middle-aged (25-59) and people over 60 (age group 60-64). Thus on the basis of gender and age the age group 15-64 was divided into six subgroups. According to this decomposition I analyse the role of young people and people over 60 in the evolution of inactivity.

Then, I use a finer decomposition of the population. This decomposition in addition to gender and age also takes into consideration the educational composition of the population. According to qualification three other categories are distinguished: primary (ISCED 0-2), secondary (ISCED 3-4) and tertiary (ISCED 5-6) education. Thus, in accordance with the study of *Kátay* [2009] based on age, gender and education the population of people aged 15-64 was divided into 18 subgroups. My goal is to analyse the role of people with primary education in inactivity as often emphasised in the literature.

My calculations reveal that in Hungary even in the second quarter of 2013 the contribution of people younger than 60 years was (specifically) high. The decreasing tendency of differences in inactivity rate was mainly due to the decreased contribution of men aged 25 to 59 (see Figure 1). However, an international comparison shows that the contribution of people older than 60 years is also high, especially among men. The inactivity problems of Poland were mainly caused by the momentous contribution of people aged 25 to 59. In 2013 the inactivity rate of the 15-64 year old population in the Czech Republic and Slovakia was also higher than the rate of the EU15 country-group. This was caused by the contribution of people aged 15 to 24 and 60 to 64.

Figure 1: The contributions of age groups arising from differences in inactivity by gender to the differences in inactivity rates between each Visegrad country and the EU15 country-group





Source: Own computation based on Eurostat data

My calculations also show that the contribution of people with primary education to the differences in inactivity rates has a decreasing tendency in all Visegrad countries, but it is still significant.

4.3. Examination of labour market flows in the Visegrad countries

This subchapter presents *Shimer's* method [2007] to compute job finding and separation rates and probabilities. He models a continuous time environment in which data are available only at discrete time. He assumed that during period *t* unemployed workers find a job according to a Poisson process with rate $f_t \equiv -log(1-F_t)$, where f_t is the job finding rate and F_t is the job finding probability. On the other side, employed workers lose their job according to a Poisson process with rate $s_t \equiv -log(1-S_t)$, where f_t is the job finding rate and F_t is the job finding probability. In this approach the unemployment and the short term unemployment evolve according to

$$(25) \quad \dot{U}_{t+\tau} = s_t E_{t+\tau} - f_t U_{t+\tau},$$

$$(26) \quad \dot{U}_t^s = s_t E_{t+\tau} - f_t U_t^s(\tau),$$

where $\dot{U} = dU/dt$, *t* denote discrete time, $\tau \in [0,1)$, $E_{t+\tau}$ is the number of employed, $U_{t+\tau}$ is the number of unemployed and $U_t^s(\tau)$ is the number of short term unemployed (who were employed at some point of time during the period) at time $t+\tau$. The initial condition $U_t^s(0) = 0$ is a technical data, and $U_{t+1}^s \equiv U_t^s(1)$ denote the number of short term unemployed at the end of period *t*. The solution of differential system (25) and (26) determines the job finding probability:

$$(27) \quad F_t = 1 - \frac{U_{t+1} - U_{t+1}^s}{U_t}.$$

The link between job finding probability and job finding rate determines the job finding rate. The equation that expresses the separation rate is

$$(28) \quad U_{t+1} = \frac{L_t s_t}{s_t + f_t}\left(1 - e^{-s_t - f_t}\right) + U_t e^{-s_t - f_t},$$

where *e* is the Euler's number and $L_t = E_t + U_t$ denotes the economically active population during period *t*, which is constant since Shimer doesn't allow entry or exit from the labour force. Equation (28) determines the separation rate (s_t). Then the relationship between separation rate and separation probability ($s_t \equiv -log(1-S_t)$) determines S_t.

Following this method and using the unemployment, employment and short term unemployment data of the LFS I compute job finding and separation probabilities for both age groups. My results are summarized in Table 1, where we can compare my results with those of *Hobijn–Sahin* [2007].

Table 1: Average separation and job finding probabilities in the Visegrad countries

Country	Separation probability			Job finding probability		
	15-64	25-59	Hobijn–Sahin [2007]	15-64	25-59	Hobijn–Sahin [2007]
Czech Republic	0,016	0,012	0,028	0,180	0,156	0,223
Poland	0,027	0,019	0,029	0,176	0,155	0,201
Hungary	0,016	0,013	0,029	0,165	0,147	0,180
Slovakia	0,018	0,012		0,097	0,084	0,160

Source: Own computation based on LFS quarterly data

The main observations are:

- The Czech Republic with the lowest unemployment rate has the most favourable transition probabilities: the separation probability is one of the lowest, and the job finding probability is the highest.
- The second country with quite a low value of the unemployment rate is Hungary, she has a low separation probability and quite a high job finding probability.
- Poland's mean unemployment rate was high in both age groups, but there has been a big reduction in the Polish unemployment rate since 2004. Polish separation probability and job finding probability is also high which can be explained, that the Polish labour market is characterized by relatively significant labour market flows.
- My results for Slovakia show that the cause of unemployment problems is the lowest job finding probability. The separation probability does not deviate notably from the probabilities of Hungary and Poland.

4.4. The cyclical behaviour of labour market variables

In this subchapter seasonally adjusted series of separation and job finding rates and probabilities are computed. I use the TRAMO-SEATS filter method to adjust seasonally the time series of unemployment, short time unemployment, employment and labour force. From these seasonally adjusted series I compute seasonally adjusted time series of the transition rates and probabilities based on equations (27) and (28). In this subchapter I briefly describe the evolution of these time series.

4.4.1. Analysis of the cyclical components

In this part I assess the dynamic relationships at business cycle frequencies between labour market variables and GDP[4]. I take the logarithm of seasonally adjusted time series and use the Hodrick–Prescott filtering method with the standard smoothing parameter of 1600. The dynamic relationships are measured in terms of contemporaneous correlations and cross-correlations at various leads and lags between the detrended data.

Table 2: The correlation matrix of detrended data in the Visegrad countries (for the age group 15-64)

Variables	*u*	*e*	*i*	*F*	*S*	*P*	*GDP*
				Czech Republic			
u	1,000	–0,903[1]	–0,419[1]	–0,040	0,387[1]	–0,214[5]	–0,609[1]
e		1,000	0,030	–0,005	–0,378[1]	0,151	0,562[1]
i			1,000	0,172	–0,011	0,067	0,113
F				1,000	–0,341[1]	0,479[1]	0,354[1]
S					1,000	–0,731[1]	–0,709[1]
P						1,000	0,863[1]
GDP							1,000
				Poland			
u	1,000	–0,896[1]	–0,457[1]	–0,515[1]	0,117	0,306[2,5]	–0,760[1]
e		1,000	0,154	0,457[1]	–0,196	–0,461[1]	0,800[1]
i			1,000	0,504[1]	–0,273[2,5]	0,373[1]	0,319[1]
F				1,000	–0,089	0,153	0,578[1]
S					1,000	–0,129	–0,316[2,5]
P						1,000	0,033
GDP							1,000
Variables	*u*	*e*	*i*	*F*	*S*	*P*	*GDP*
				Hungary			
u	1,000	–0,598[1]	–0,049	–0,128	0,139	–0,084	–0,379[1]
e		1,000	–0,754[1]	0,348[1]	–0,157	0,287[2,5]	0,604[1]
i			1,000	–0,333[1]	0,179	–0,222[5]	–0,399[1]
F				1,000	–0,015	0,184	0,418[1]
S					1,000	–0,113	–0,143
P						1,000	0,876[1]
GDP							1,000

[4] Millions of euro, chain-linked volumes, reference year 2000 (at 2000 exchange rates).

Variables	u	e	i	F	S	P	GDP
				Slovakia			
u	1,000	–0,973[1]	–0,114	–0,033	0,115	–0,392[1]	–0,744[1]
e		1,000	–0,031	0,045	–0,130	0,361[1]	0,726[1]
i			1,000	–0,134	–0,210	0,159	0,100
F				1,000	–0,517[1]	0,498[1]	0,370[1]
S					1,000	–0,520[1]	–0,420[1]
P						1,000	0,876[1]
GDP							1,000

Comment: The analysed variables are: u – unemployment rate, e – employment rate, i – inactivity rate, F – job finding probability, S – separation probability, P – productivity and real GDP. Upper indexes (1; 2,5; 5) are those significance levels in percent at which the correlation is significant.

Source: Own computation based on LFS data

I examine the contemporaneous correlation between the GDP-cycle and the cycle of labour market variables. The following conclusions can be drawn:

- The employment rate and the job finding probability in all Visegrad countries and the inactivity rate in Poland are *procyclical*;
- The unemployment rate in all Visegrad countries, the inactivity rate in Hungary and the separation probabilities in the Czech Republic, in Poland and Slovakia are *countercyclical*;
- Czech and Slovak inactivity rates and the separation rate in Hungary are *acyclical*.

Other observed relationships are:

- There is a strong negative correlation between unemployment and employment rates in the Czech Republic (–0,903), Poland (–0,896) and Slovakia (–0,973). This correlation is significant in Hungary too, but it is weaker (–0,598).
- There is a significant negative correlation between inactivity and unemployment rates in the Czech Republic (–0,419), and in Poland (–0,457).
- A robust negative correlation can only be observed in Hungary between inactivity and employment rates (–0,754).

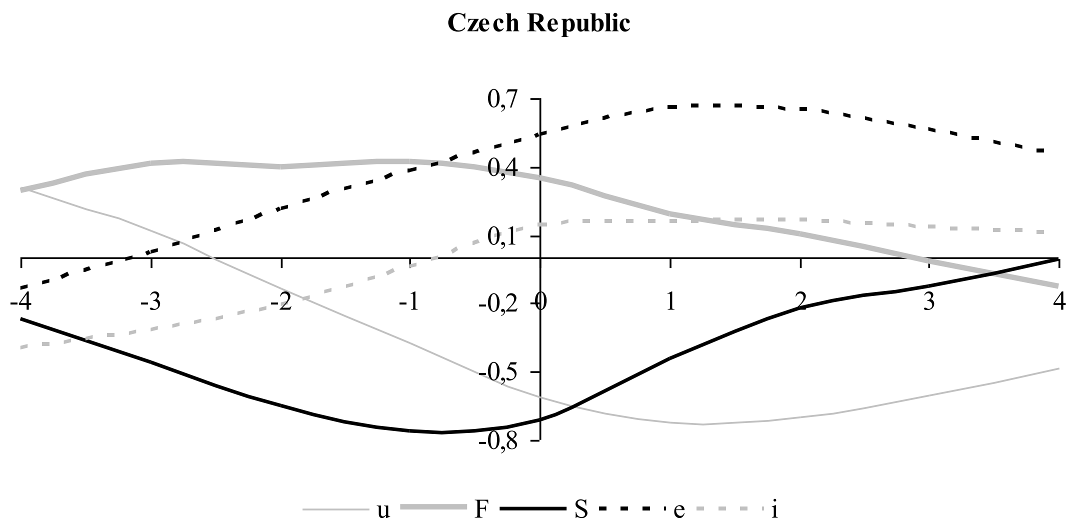
The main conclusions made on the basis of the above data are as follows:

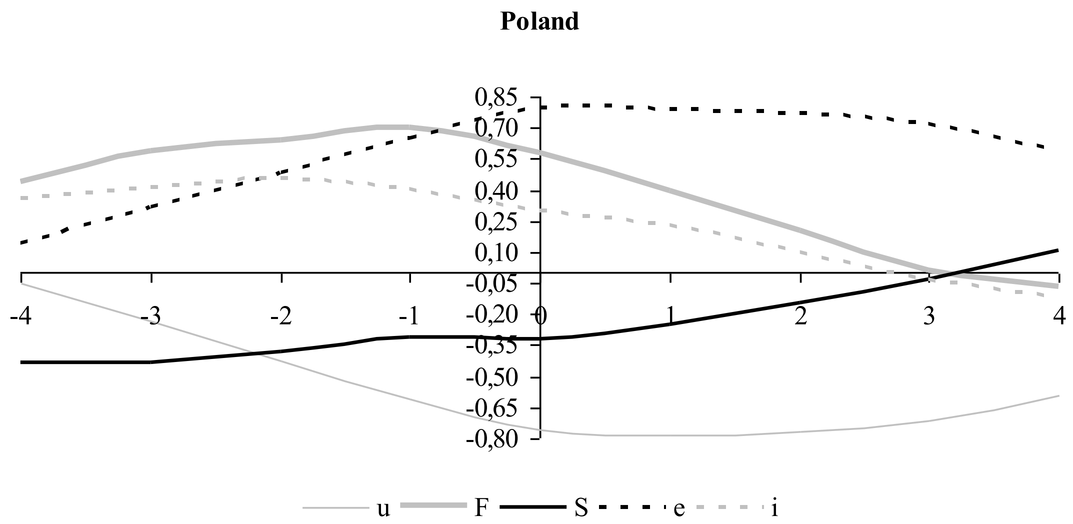
- The analysis of Slovakia reflects, that the major labour market flows are the flows between unemployment and employment.
- The Czech Republic has similar characteristics as Slovakia, here we can also focus on flows between unemployment and employment. Only one value shows that the flows of inactive population can matter: it is the significant negative correlation between inactivity rate and unemployment rate.

- Poland has a strong negative correlation between unemployment rate and employment rate (though a little weaker than Slovakia and the Czech Republic), but it has a procyclical inactivity rate, and significant negative correlation between unemployment and inactivity rates. There are also more signs that the flows of inactive population can matter.
- Hungary is the country with unambiguous signs that we cannot ignore the flows between inactivity and both unemployment and employment.

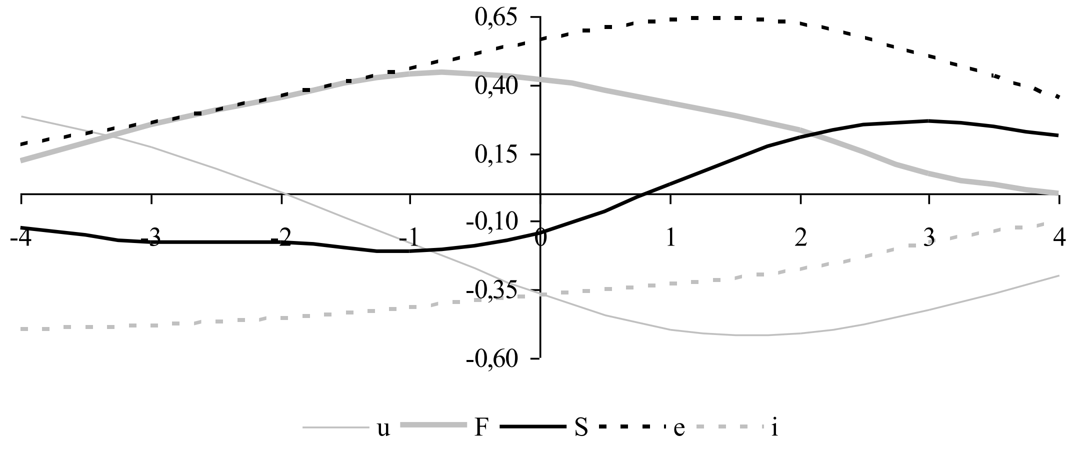
I also computed cross-correlations. The results for Hodrick–Prescott filtered data are shown in Figure 2.

Figure 2: The cross-correlations between the GDP-cycle and labour market variables in the Visegrad countries (for the age group 15-64)

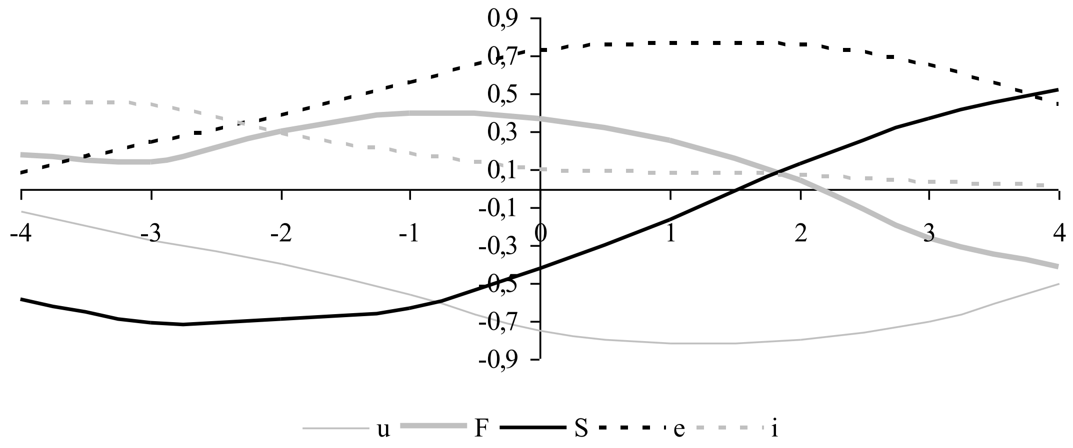




Hungary



Slovakia



Comment: Cross-correlations: *Corr*(X_t,$Y_{t+/-i}$), where *X* is the GDP-cycle and *Y* is the cyclical component of the labour market variables. The cross-correlation is computed for discrete values but for clarification the points are linked with continuous curves. The analysed variables are listed in the comment of Table2.

Source: Own computation based on LFS data

The main conclusions are:

- The unemployment rate is highly (except Hungary) countercyclical and tends to lag the GDP-cycle.
- The employment rate is highly procyclical and tends to lag the GDP-cycle.
- The inactivity rate is weakly procyclical in Poland, and weakly countercyclical in Hungary and tends to lead the GDP-cycle.
- The job finding probability is procyclical (strongly in Poland) and tends to lead the GDP-cycle.
- The separation probability is countercyclical (strongly in the Czech Republic and Slovakia, moderately in Poland) and tends to lead the GDP-cycle.

4.4.2. Analysis of the first-differenced series

I use another detrending method: first order differences. I take the first order difference (period-to-period change) of the logarithm of labour market variables and GDP and so I calculate first-differenced series. In this case I focus only on the contemporaneous correlation analysis. The correlations between differenced time series are summarized in Table 3.

I examine the contemporaneous correlation between first-differenced series of GDP and first-differenced series of labour market variables. Conclusions from these calculations are the follows:

- Employment rates are *procyclical*;
- The unemployment rate in all countries, and the separation probability in the Czech Republic and in Hungary are *countercyclical*;
- All other labour market variables are *acyclical*:
    - Employment rate in Czech Republic (only in the age group 15-64);
    - Inactivity rate in all Visegrad countries;
    - Job finding probability in all Visegrad countries;
    - Separation probability in Poland and Slovakia.

Table 3: The correlation matrix of the first-differenced series in the Visegrad countries (for the age group 15-64)

Variables	*u*	*e*	*i*	*F*	*S*	*P*	*GDP*
				Czech Republic			
u	1,000	–0,791[1]	–0,230[5]	0,229[5]	0,093	–0,110	–0,453[1]
e		1,000	–0,327[1]	–0,178	0,045	–0,155	0,207
i			1,000	0,005	–0,072	0,315[1]	0,238[5]
F				1,000	0,087	0,193	0,104
S					1,000	–0,521[1]	–0,492[1]
P						1,000	0,895[1]
GDP							1,000
				Poland			
u	1,000	–0,784[1]	–0,214	–0,091	0,014	0,302[2,5]	–0,615[1]
e		1,000	–0,268[5]	0,102	0,003	–0,458[1]	0,593[1]
i			1,000	–0,028	0,025	0,240[5]	–0,040
F				1,000	0,464	0,059	0,094
S					1,000	–0,105	–0,161
P						1,000	0,235[5]
GDP							1,000

Variables	*u*	*e*	*i*	*F*	*S*	*P*	*GDP*
				Hungary			
u	1,000	–0,575^{1}	–0,040	0,371^{1}	–0,001	–0,114	–0,373^{1}
e		1,000	–0,755^{1}	–0,106	0,002	–0,072	0,231^{5}
i			1,000	–0,166	0,017	0,209	0,014
F				1,000	0,036	0,007	0,058
S					1,000	–0,314^{1}	–0,240^{5}
P						1,000	0,880^{1}
GDP							1,000
				Slovakia			
u	1,000	–0,920^{1}	–0,082	0,177	–0,043	–0,137	–0,444^{1}
e		1,000	–0,202	–0,158	0,040	0,095	0,408^{1}
i			1,000	–0,226^{5}	–0,005	–0,024	–0,054
F				1,000	–0,145	0,191	0,121
S					1,000	–0,132	–0,090
P						1,000	0,904^{1}
GDP							1,000

Comment: The analysed variables are: *u* – unemployment rate, *e* – employment rate, *i* – inactivity rate, *F* – job finding probability, *S* – separation probability, *P* – productivity and real *GDP*. Upper indexes (1; 2,5; 5) are those significance levels in percent at which the correlation is significant.

Source: Own computation based on LFS data

Other observed relationships are the follows:

- There is a strong negative correlation between unemployment and employment rates: the strongest in Slovakia (–0,920), very strong in the Czech Republic and Poland too (–0,791 and –0,784), and the weakest in Hungary (–0,575).
- There is a weak negative correlation between inactivity and unemployment rates in the Czech Republic (–0,230).
- The negative correlation between inactivity and employment rates is strong in Hungary (–0,755), and weak, but it is significant in the Czech Republic (–0,327) and Poland (–0,268).

Conclusions:

- The analysis of the Slovak first-differenced series of labour market variables confirms the results of the analysis of cyclical components: we can focus only on the labour market flows between unemployment and employment.
- The Czech Republic has also similar characteristics in this case. We can focus on flows between unemployment and employment too. Only the weak correlation values between the inactivity rate and the unemployment rate or employment rate show that the flows of inactive population can matter.

- Poland has a strong negative correlation between the unemployment rate and the employment rate (–0,784 – it is a little weaker than Slovakia's and the Czech Republic's corresponding values), and a weak negative correlation between the employment rate and the inactivity rate. Consequently, the analysis of the differenced data does not absolutely clearly confirm the conclusion drawn from the analysis before, that the flows of inactive population matters.
- The analysis of Hungarian first-differenced time series, however, verifies that in Hungary the flows between inactivity and employment matters.

4.5. Components of unemployment dynamics in the Visegrad countries

Another fundamental goal of my thesis was the analysis of the impact of the separation and job finding process on the unemployment rate. I study this question on the database of the Visegrad countries. I investigated whether the separation or the job finding is the dominant process or how big role they play in the dynamics of the unemployment rate of the individual Visegrad countries. So in this subchapter I examine the relationship between the transition rates and the unemployment rate.

First I apply Shimer's method [2007]. Using the computed job finding (*f*) and separation (*s*) rates we get the steady-state rate of unemployment from equation (25) ($\dot{U}_{t+\tau} = 0$ and $E_{t+\tau} = L_{t+\tau} - U_{t+\tau}$)::

(29) $$u^* = \frac{s}{s+f}.$$

Shimer [2007] observed a very strong correlation between u^*_{t} and $u_{\mathrm{t+1}}$ in the USA, where $u_{\mathrm{t+1}}$ is the actual unemployment rate in the next period. Shimer examines the role of the separation rate with the definition of $u^*_s = \frac{s}{s+\bar{f}}$, and the role of the job finding rate with $u^*_f = \frac{\bar{s}}{\bar{s}+f}$, where $\bar{f}$ and $\bar{s}$ denote the average values of job finding and separation rates in the period surveyed. He computes correlations between the cyclical components of these theoretical rates, and constructs measures of contributions of finding and separation rates to unemployment.

I compute the theoretical rates defined by Shimer. The correlation analysis of the theoretical rates based on averaging suggests that:

- in the Czech Republic the separation and the job finding has almost equal importance;
- in Poland the job finding is dominant;
- in Hungary and Slovakia the separation is dominant.

Shimer uses another method based on regressions. He defines beta measures that show how much of the variance of u_{t+1} is explained by the separation and job finding:

$$(30) \quad \beta_s = \frac{Cov\left(u^c_{t+1}, u*^c_{st}\right)}{Var\left(u^c_{t+1}\right)},$$

$$(31) \quad \beta_f = \frac{Cov\left(u^c_{t+1}, u*^c_{ft}\right)}{Var\left(u^c_{t+1}\right)},$$

where c in the upper indexes refers to the cyclical components[5] of unemployment rates. The two betas are the slope parameters of the regression equations $u*^c_{st} = \alpha + \beta_s u^c_{t+1}$ and $u*^c_{ft} = \alpha + \beta_f u^c_{t+1}$. This is not an exact decomposition, but the sum of the two betas gives nearly one for the U.S. data. So Shimer looked at these values as measures of the importance of separation and job finding in the evolution of unemployment.

I have done similar empirical investigation for the Visegrad countries. The sum of the betas (sum of (30) and (31)) was nearly one. So (30) and (31) gives only approximate values.

The results of my computations based on the data of the Visegrad countries are the following:

- For the age group 15-64:
    - in Poland the weight of job finding (64,4 percent) is higher than the weight of separation;
    - in the other Visegrad countries the separation is dominant, which is confirmed by the following weights:

[5] I follow Shimer and use the Hodrick–Prescott filter with the smoothing parameter of 100 000 that is a much lower frequency filter than is commonly used in business cycle analyses of quarterly data. Thus we remove a smaller portion of cyclical volatility than by standard smoothing parameter of 1600.

        - in the Czech Republic: 68,6 percent;
        - in Hungary: 72,6 percent;
        - in Slovakia: 49,3 percent.
- For the age group 25-59:
    - in Poland the job finding is dominant (71,1 percent);
    - in the other Visegrad countries the separation is dominant:
        - in the Czech Republic: 74,3 percent;
        - in Hungary: 73,0 percent;
        - in Slovakia: 59,8 percent.

Following *Petrongolo–Pissarides* [2008] I use (29) to compute the difference of unemployment rates:

$$(32)\quad \Delta u^*_t = (1-u^*_t)u^*_{t-1}\frac{\Delta s_t}{s_{t-1}} - u^*_t(1-u^*_{t-1})\frac{\Delta f_t}{f_{t-1}} = C_t^s + C_t^f .$$

Equation (32) expresses the change in the unemployment rate as the sum of two factors: C_t^s depends on the change of the separation rate, and C_t^f depends on the change of the job finding rate. Based on equation (32) I can define the contribution of the separation and job finding rates to the change in unemployment rate. Using variance-decomposition based on (32) I obtain the contribution of the separation rate to the variation of unemployment:

$$(33)\quad \beta_s = \frac{Cov(\Delta u^*_t, C_t^s)}{Var(C_t^s)},$$

and the contribution of the job finding rate is:

$$(34)\quad \beta_f = \frac{Cov(\Delta u^*_t, C_t^f)}{Var(C_t^f)}.$$

Results from the variance-decomposition based on the Petrongolo–Pissarides [2008] method can be summarised as follows:

- In the case of the Czech Republic the correlation analysis shows that the method on the Czech data cannot be tested.

- In the remaining Visegrad countries the contribution of the job finding rate to the variation of unemployment is higher than the contribution of the separation rate:
  - For the age group 15-64:
    - in Poland: 52,29 percent;
    - in Hungary: 86 percent;
    - in Slovakia: 88,59 percent.
  - For the age group 25-59:
    - in Poland: 72,33 percent;
    - in Hungary: 87,73 percent;
    - in Slovakia: 95,28 percent.

The related correlation analysis points out that the method underestimates the weight of job finding in Poland, and overestimates it in Hungary and Slovakia.

Another possibility is provided by *Fujita-Ramey* [2007]. They used a log-linearizing method. Log-linearizing the equation (29) around the trend values $u^*_{t,tr} = \frac{s_{t,tr}}{s_{t,tr} + f_{t,tr}}$ gives the following decomposition:

$$(35)\quad ln\left(\frac{u^*_t}{u^*_{t,tr}}\right) = \left(1-u^*_{t,tr}\right)ln\left(\frac{s_t}{s_{t,tr}}\right) - \left(1-u^*_{t,tr}\right)ln\left(\frac{f_t}{f_{t,tr}}\right) + \varepsilon_t = \widetilde{C}^s_t + \widetilde{C}^f_t + \varepsilon_t,$$

where *tr* denotes the trend components of the variables. Equation (35) expresses the deviations of the unemployment rate from trend as a sum of three factors: one of them depends on the deviation of the separation rate from trend, the second depends on the deviation of the job finding rate from trend, and the third is a residual term. Similarly to (33) and (34) the contribution measures $\widetilde{\beta}_s$, $\widetilde{\beta}_f$ and $\widetilde{\beta}_\varepsilon$ to equation (35) can be define as follows:

$$(36)\quad \widetilde{\beta}_s = \frac{Cov\left(\ln\left(\frac{u^*_t}{u^*_{t,tr}}\right), \widetilde{C}^s_t\right)}{Var\left(\ln\left(\frac{u^*_t}{u^*_{t,tr}}\right)\right)},$$

$$(37)\quad \tilde{\beta}_f = \frac{Cov\left(\ln\left(\frac{u^*_t}{u^*_{t,tr}}\right), \tilde{C}^f_t\right)}{Var\left(\ln\left(\frac{u^*_t}{u^*_{t,tr}}\right)\right)},$$

$$(38)\quad \tilde{\beta}_\varepsilon = \frac{Cov\left(\ln\left(\frac{u^*_t}{u^*_{t,tr}}\right), \varepsilon\right)}{Var\left(\ln\left(\frac{u^*_t}{u^*_{t,tr}}\right)\right)}.$$

The correlation analysis based on equation (35) points out that we should not use this method in the case of Slovakia. The calculations for the other Visegrad countries deliver the following results:

- For the age group 15-64:
  - in the Czech Republic the weight of separation is slightly higher (52,57 percent) than the weight of job finding,
  - in Poland and in Hungary job finding is dominant with the following weights:
    - in Poland: 60,12 percent;
    - in Hungary: 76,14 percent.
- For the age group 25-59:
  - job finding is dominant in all the three Visegrad countries:
    - in the Czech Republic: 56,35 percent;
    - in Poland: 65,44 percent;
    - in Hungary: 80,15 percent.

The related correlation analysis points out that the method underestimates the weight of separation in the Czech Republic and the weight of job finding in Poland, and overestimates the weight of job finding in Hungary.

5. Resume and conclusions

My dissertation contains theoretical and empirical studies. The theoretical labour market models are found suitable for comparing empirical labour movements in the Visegrad countries with similar economic indicators, especially in the explanation of unemployment. This conclusion is interesting, because these models are mainly built on the specialities of the U.S. labour market, but they test very adequate questions and thus can be used to analyse differently developed countries. The latter conclusion of course assumes that on the basis of model calculations only those countries are comparable that follow almost the same methods of labour force surveys and are at similar levels of development (concerning their labour market) as well. However, by further investigating them, it is possible to specify the adequate method or even the theoretical models tailored to the different labour market particularities of the Visegrad countries.

In the theoretical part of my thesis I studied the approach that gives an elegant answer to the following empirical issues related to unemployment: Why do unemployed sometimes reject job offers? How is it possible that there simultaneously exist unemployed and vacancies as well? What determines the number of unemployed and vacancies? What is the relationship between trends in unemployment and job finding and separation processes? How can the government influence the unemployment and the labour market performance?

The second and the third chapters contain my basic research: I present the "search" models in the former and the "search and matching" models in the latter with the corresponding mathematical background. After the 1970's these models have significantly contributed to the development of economic theories. The Nobel Laureates in Economic Sciences in 2010 *Diamond*, *P. A.*, *Mortensen, D. T.* and *Pissarides, Ch. A.* developed a model environment, which plays an important role in the treatment of labour market frictions (the dissimilar qualifications, desires of the labour force and the differentiated nature and distinct expectations of workplaces offered by companies). But only a few researchers have dealt with these models in the Hungarian literature. *Galasi* [2007] and *Horváth* [2006] have dealt with this topic, but only with a little theoretical mathematical discussion. This thesis present the search and matching models of labour market, the evolution of the underlying theory and the relating critical comments as well. I analyse in detail the non-equilibrium dynamics[6] of the

[6] See Móczár (2008).

basic model. A growing number of empirical studies and observations opened the space for new generations of these models. One of the advantages of these models is that they create an excellent environment for testing the consequences of government measures. I outline the measures that can be analysed in these models and the main features of government's labour market policies. Since Shimer's critique and in the focus of the debate about the explanatory ability of these models some new ideas have appeared. I summarize the recent theoretical contributions (rigid wages[7]) to the debate about the explanatory power of these models and the empirical findings on the values of parameters.

The empirical part of the thesis involves three basic questions. The first question focuses on the composition of the inactive population, the second on the cyclical movements of labour market variables and the third on the determinants of unemployment dynamics.

This empirical part of the thesis (the fourth Chapter) examines the labour markets of the Visegrad countries, in particular the dynamics of unemployment rates and their components, the evolution of inactivity rates and the composition of inactivity. First I reviewed the methodology of the labour force survey and the specific characteristics of the representative sample and rotation methods in the Visegrad countries. Then I analysed the evolution of the unemployment and inactivity rates of two age groups: the age group 15-64 and the age group 25-59. In the average unemployment rate we could observe significant differences between countries: the lowest in the Czech Republic and the highest in Slovakia. The analysis of the average inactivity rates of countries also shows significant differences: the highest appears in Hungary and the lowest in the Czech Republic. However, the evolution of the rates in time causes that the observed differences gradually decline. In the next subchapter I analyse the observed differences in inactivity rates of each Visegrad country and the EU15 country-group. I examine the inactivity rate gap of the 15-64 year old population based on gender and age (age groups: 15-24, 25-59 and 60-64), or gender, age and education (groups: primary, secondary and higher education) to analyse the contribution of men and women, young people (age group 15-25) and people above 60, or people with primary education to the observed differences in inactivity rates. My calculations reveal that in Hungary even in the second quarter of 2013 the contribution of people younger than 60 years is high. The decreasing tendency of differences in inactivity rates is mainly due to the decreased contribution of men aged 25 to 59. However, an international comparison shows that the contribution of people older than 60 years is also high, especially among men. The inactivity

[7] See *Shimer* [2004], *Gertler–Trigary* [2009], *Kennan* [2010], *Hall–Milgrom* [2008].

problems of Poland were mainly caused by the contribution of people aged from 25 to 59. The inactivity rate of 15-64 year old population in the Czech Republic and Slovakia was also higher than the rate of the EU15 country-group. This was caused by the contribution of people aged form 15 to 24 and from 60 to 64. The contribution of people with primary education to the differences in inactivity rates has a decreasing tendency in all Visegrad countries, but it is still significant.

Following Shimers' method [2007] the work examines two important components of labour market flows: the job finding and the separation rates in a stochastic approach, as probability discretizations of adequate stochastic processes. The average job finding probability is the highest on the Czech labour market: in the age group 15-64 the average probability that an unemployed finds a work is 0,180, and in the age group 25-59 it is 0,156. This probability is quite low, but it is still the highest among Visegrad countries. The lowest probability characterizes the Slovak labour market with values 0,097 and 0,084. My computation shows that the lowest average separation rate can be detected in the Czech and Hungarian labour markets: with values of 0,016 in the age group 15-64, and 0,012 in the age group 25-59. The highest probabilities are observable in Poland with values 0,027 and 0,019.

The next subchapter investigates the cyclical behaviour of labour market variables (unemployment rate, employment rate, inactivity rate, separation and job finding probabilities). First I use the TRAMO-SEATS filter method to adjust data seasonally then I take the logarithm of seasonally adjusted time series. Because neither of the detrending methods is perfect, I also considered the Hodrick–Prescott filtering and first order differences to get the detrended data.

First I analyse the volatility of labour market variables by the so-called relative volatility. This means that I compute the ratio of the standard deviation in labour market variables to the standard deviation in GDP. The least volatile variables are the employment and inactivity rates. The unemployment rate is more volatile than real GDP. Comparing the standard deviation of transition probabilities and GDP I found that the former is remarkably higher than the latter. The most volatile variable is the job finding probability.

I use contemporaneous and cross-correlation analysis to test the cyclical properties of variables using real GDP as cyclical indicator. The cyclical evolution of GDP was followed by pro-, counter- and acyclical movements in the labour market variables. More precisely in the case of Hodrick–Prescott filtering ($\lambda = 1600$) contemporaneous correlation analysis shows the following cyclical properties:

- Procyclical movement characterizes the temporal evolution of employment rates and job finding probabilities in all Visegrad countries, and the inactivity rate in Poland.
- The unemployment rates in all Visegrad countries, the inactivity rate in Hungary and the separation probability in the Czech Republic, Poland and Slovakia were countercyclical.
- Acyclical behaviour in the inactivity rates can be detected in the Czech Republic and Slovakia, and in the time series of the separation probability in Hungary.

With a low frequency filter (λ = 100 000) I find that the Hungarian unemployment rate and the separation probability are moderately countercyclical, and the job finding probability is acyclical.

The correlation analysis based on the first-differenced series shows the following cyclical movements in the main labour market variables:

- the employment rate is procyclical (except for the Czech Republic, age group 15-64),
- the unemployment rate in all Visegrad countries, the separation rate in the Czech Republic for both age groups, in Hungary for age group 15-64 and in Poland for age group 25-59 are countercyclical.

I note without comparison that in the U.S. the job finding rate is procyclical and very volatile, while the unemployment rate and more or less the separation rate are countercyclical (*Braun–De Bock–DiCecio* [2006], *Elsby–Michaels–Solon* [2009], *Fujita–Ramey* [2007], *Hall* [2005], *Shimer* [2005], *Yashiv* [2008]).

The results of the cross-correlation analysis between the cyclical components of real GDP and the labour market variables reveal that:

- the unemployment rate and the employment rate are lagging variables in all Visegrad countries;
- the inactivity rate in Poland and in Hungary is a leading variable;
- the job finding rate in all Visegrad countries and the separation rate in the Czech Republic, Poland and Slovakia are leading variables.

By simultaneous correlation analysis of detrended data I investigate which labour market flows are important in the Visegrad countries. I analyse the relationships between unemployment, employment and inactivity rates using correlations between the detrended data (cyclical components and differences) of these rates. Based on this the Slovak and the

Hungarian case is clear. The flows between employment and unemployment are important on the Slovak labour market, while in Hungary the flows between labour force and out of labour force are important too. The Czech labour market is more like the Slovak with the difference that there are some signs (weak negative correlation between inactivity rate and unemployment or employment rates) that the flows between labour force and out of labour force can matter too. The Polish labour market is characterized by strong negative correlation between employment and unemployment rates, and weak negative correlations between the inactivity rate and the unemployment or employment rates. Thus, based on the correlation analysis, taking into account the flows of inactive population (out of labour force) is important in Hungary, and there are some signs that it can matter in the Czech Republic and Poland as well. However, in the absence of adequate statistical data I could not perform these calculations so we have only seen the theoretical justification of this conjecture.

The fundamental objective of the 4.5. subchapter is to analyse the effects of the separation and job finding processes on the unemployment rate on the database of the Visegrad countries. I investigate whether the separation or the job finding is dominant in the dynamics of the unemployment rate in each Visegrad country.

How much does the evolution of separation and job finding rates matter in the dynamics of unemployment rate? Following the *Shimer* [2007] study I defined theoretical unemployment rates based on the average values of transition rates. The correlation analysis of these theoretical rates shows that in the dynamics of unemployment:

- the separation and job finding rates have almost the same importance in the Czech Republic;
- the job finding is dominant in Poland;
- while the separation rate is dominant in Hungary and in Slovakia.

First I quantify the contribution of the separation and job findings rates to the dynamics of unemployment based on Shimer's beta indices. Following Shimer I use very low frequency filtering because I don't want to remove much of the cyclical volatility. The other variance decomposition techniques are based on the assumption that the variance of the unemployment rate is determined by the separation and job finding rates. I use to methods based on *Petrongolo* and *Pisssarides* [2008] and *Fujita* and *Ramey* [2007]. The former is based on the analysis of the variance in the first difference of the unemployment rate, the latter on the deviation from trend in the unemployment rate. I investigate the correct use of the methods and the accuracy of the estimates by correlation analysis. Variance decomposition inspections of differences show that the (Petrongolo–Pissarides) method cannot be tested on the Czech data. This correlation analysis points out that the weight of job finding is underestimated in Poland, and overestimated in Hungary and in Slovakia. The correlation analysis based on the regression equation of *Fujita* and *Ramey* [2007] suggests that the procedure cannot be used for Slovakia. In this case the correlation analysis indicated that the weight of separation is underestimated in the Czech Republic, the weight of job finding is underestimated in Poland while overestimated in Hungary.

We can ask carefully the following questions: What characterizes the Visegrad countries? Are they close to the Anglo-Saxon countries where the weight of separation is only about 20 percent? Or are they closer to Continental European countries where the weight of separation is circa 50 percent (*Elsby–Hobijn–Sahin* [2008])? The results of my investigations in the Visegrad countries are summarized below.

In the Czech Republic I find that for the age group 15-64 the separation rate is dominant with a weight between 54 and 68 percent. In the age group 25-59 the weight of separation is between 44 and 74 percent depending on the used frequency of detrending. The job finding is dominant in Poland. Its variance-ratio is between 60 and 64 percent in the age group 15-64. The weight of job finding is between 66 and 71 percent for the age group 25-59. In the case of Slovakia the result are less reliable. The Petrongolo–Pissarides method has detected a major dominance of job finding, but this weight is quite overestimated in this model. The correlation analysis and the Shimer's beta values suggest that the contribution of separation is nearly 50 percent for both age groups. Thus, the Czech Republic is closer to the continental European countries and the results of Slovakia show that too. Prior to my analysed period (before 1998) these two countries did not implement radical reforms, they did not authorize the participation of foreigners in privatization, and the foreign direct investment (FDI) flows were not so high as in Hungary. The delayed restructuring of these countries may be the reason why separation was so important on the Czech and Slovak labour markets. The results of Poland show a contribution measure of separation between 23 and 40 percent for the age group 15-64 and between 21 and 34 percent for the age group 25-59. This means that Poland is between the groups of Anglo-Saxon and continental European countries. The restructuring was important in Poland too, but to a lesser extent than in the Czech Republic or Slovakia. However, the economic restructuring in Poland may be the cause of a very high separation rate from 2000 to 2004.

The case of Hungary is different. Shimer's procedure based on low frequency detrending shows that the separation rate is dominant: the weight is nearly 73 percent for both age groups. Since 2004 the continuously rising separation rate has played an important role in the rising trend of unemployment. The source of these tendencies appeared first after 2006 as a consequence of the internal and then the global crisis, and since 2010 due to the fact that the prospects of the economy have not improved significantly. The Fujita–Ramey decomposition based on the recommended frequency filtering ($\lambda = 1600$) for quarterly data pointed out that with the weight of 76 percent in the age group 15-64 and 80 percent in the age group 25-59 the job finding rate is dominant. Thus, in Hungary the upward trend of the unemployment rate is essentially dominated by the increase of the separation rate, while from the point of view of the short term cyclical unemployment the job finding rate was important. From this it follows that in the current situation more attention should be given to the design of economic policy to reduce separations.

However the study of *Elsby–Hobijn–Sahin* [2008] draws attention to the fact that the procedures based on the equilibrium unemployment rates have to be modified in the case of most countries, because they are characterized with differences between equilibrium and observed unemployment rates. Some signs of that can be detected in this study too. The next step in the analysis of labour markets in the Visegrad countries could be to apply this method. An analysis of the detailed Labour Force Survey data could open further perspectives, for example by examining the role of flows between inactivity and unemployment or employment, and using the dynamics based on cointegration instead of correlation analysis.

References

Blanchard, O. J. – Diamond, P. A. [1990]: „The Cyclical Behavior of the Gross Flows of U.S. Workers”. *Brookings Papers on Economic Activity*. Vol 1990 (2), pp. 85–155.

Braun, H. – De Bock, R. – DiCecio, R. [2006]: „Aggregate Shocks and Labour Market Fluctuations“. *Federal Reserve Bank of St. Louis Working Paper*. 2006-004A. http://research.stlouisfed.org/wp/2006/2006-004.pdf

Český štatistický úřad [2012]: Zaměstnanost a nezaměstnanost podle výsledků VŠPS – Metodika. http://www.czso.cz/csu/redakce.nsf/i/zam_vsps

Cseres-Gergely, Zs. [2007]: „Inactivity in Hungary – the persistent effect of the pension system”. *Budapest Working Papers on the Labour Market*. BWP 2007/1.

Cseres-Gergely, Zs. [2010]: „Munkapiaci áramlások, gereblyézés és a 2008 végén kibontakozó gazdasági válság foglalkoztatási hatásai”. *Budapesti Munkagazdaságtani Füzetek*. BWP 2010/4.

Cseres-Gergely, Zs. [2011]: „Munkapiaci áramlások, konzisztencia és gereblyézés”. *Statisztikai Szemle*. Vol 89 (5), pp. 481–500.

Darby, M. R. – Haltiwanger, J. C. – Plant, M. W. [1986]: „The Ins and Outs of Unemployment: The Ins Win”. *UCLA Working Paper*. No. 411. http://www.econ.ucla.edu/workingpapers/wp411.pdf

Davis, S. J. – Faberman, R. J. – Haltiwanger, J. C. [2006]: „The Flow Approach to Labor Markets: New Data Sources and Micro-Macro Links”. *Journal of Economic Perspectives*. Vol 20 (3), pp. 3–26.

Davis, S. J. – Haltiwanger, J. C. – Schuh, S. [1996]: *Job Creation and Destruction*. MIT Press. Cambridge.

Diamond, P. A. [1982]: „Aggregate Demand Management in Search Equilibrium”. *Journal of Political Economy*. Vol 90 (5), pp. 881–894.

Elsby, M. – Hobijn, B. – Sahin, A. [2008]: „Unemployment Dynamics in the OECD”. *NBER Working Paper*. No. 14617. http://www.nber.org/papers/w14617.pdf

Elsby, M. – Michaels, R. – Solon, G. [2009]: „The Ins and Outs of Cyclical Unemployment”. *American Economic Journal: Macroeconomics 2009*. Vol 1 (1), pp. 84–110.

Faggio, G. [2007]: „Job Destruction, Job Creation and Unemployment in Transition Countries: What Can We Learn?”. *CEP Discussion Paper*. No. 798.

Friedman, M. [1968]: „The Role of Monetary Policy”. *American Economic Review.* Vol 58 (1), pp. 1–17.

Fujita, S. – Ramey, G. [2007]: „The Cyclicality of Separation and Job Finding Rates”. *Research Department*, *Federal Reserve Bank of Philadelphia Working Paper*. No. 07-19/R. http://www.philadelphiafed.org/research-and-data/publications/working-papers//2007/wp07-19.pdf

Galasi, P. [1996]: „Munkanélküliek álláskeresési magatartása”. *Közgazdasági Szemle.* Vol 43 (9), pp. 805–815.

Galasi, P. [2003]: „Munkanélküliségi indikátorok és állásnélküliek munkaerő-piaci kötődése”. *Budapesti Munkagazdaságtani Füzetek*. BWP 2003/2.

Galasi, P. [2007]: *Munkagazdaságtan mikroökonómiai megközelítésben*. BCE Emberi erőforrások tanszék. Budapest.

Galasi, P. – Nagy, Gy. [2003]: „A munkanélküli-ellátás változásainak hatása a munkanélküliek segélyezésére és elhelyezkedésére”. *Közgazdasági Szemle*. Vol 50 (7-8), pp. 608–634.

Gertler, M. – Trigary, A. [2009]: „Unemployment Fluctuations with Staggered Nash Wage Bargaining”. *Journal of Political Economy*. Vol 117 (1), pp. 38–86.

Główny Urząd Statystyczny [2012]: *Labour Force Survey in Poland I Quarter 2011*. Główny Urząd Statystyczny. Warszawa.

Góra, M. – Walewski, M. [2002]: „Bezrobocie równowagi w Polsce – wstępna analiza i próba oszacowania”. *Polska Gospodarka.* Vol 2002 (4), pp. 36-40.

Gottvald, J. [2005]: „Czech Labour Market Flows 1993-2003”. *Finance a úvěr – Czech Journal of Economics and Finance*. Vol 55 (1–2), pp. 41–53.

Hagedorn, M. – Manovski, I. [2008]: „The Cyclical Behavior of Equilibrium Unemployment and Vacancies Revisited”. *ECB Working Paper Series*. No. 853.

Hall, R. E. [2005]: „Job Loss, Job Finding, and Unemployment in the U.S. ECONOMY over the Past Fifty Years”. *NBER Working Paper*. No. 11678. http://www.nber.org/papers/w11678

Hall, R. E. – Milgrom, P. [2008]: „The Limited Influence of Unemployment on the Wage Bargain”. *American Economic Review*. Vol 98 (4), pp. 1653–1674.

Hicks, J. R. [1932]: *The Theory of Wages*. Macmillan. London.

Hobijn, B. – Sahin, A. [2007]: „Job-Findig and Separation Rates in the OECD”. *Federal Reserve Bank of New York Staff Reports*. No. 298.

http://www.econstor.eu/bitstream/10419/60714/1/541550497.pdf

Horváth, G. [2006]: „A munkapiaci intézmények hatása a munkanélküliségi rátára”. *Közgazdasági Szemle*. Vol 53 (9), pp. 744–768.

Hosios, A. J. [1990]: „On the Efficiency of Matching and Related Models of Search and Unemployment”. *Review of Economic Studies*. Vol 57 (2), pp. 279–298.

Hurník, J. – Navrátil, D. [2005]: „Labour Market Performance and Macroeconomic Policy: The Time-Varying NAIRU in the Czech Republic”. *Finance a úvěr – Czech Journal of Economics and Finance*. Vol 55 (1-2), pp. 25-40.

Kátay, G. (editor) [2009]: Az alacsony aktivitás és foglalkoztatás okai és következményei Magyarországon. *MNB-tanulmányok*. 79.

Kátay, G. – Nobilis, B. [2009]: „Driving Forces Behind Changes in the Aggregate Labour Force Participation in Hungary”. *MNB Working Papers*. 2009/5.

Kennan, J. [2010]: „Private Information, Wage Bargaining, and Employment Fluctuations”. *Review of Economic Studies*. Vol 77 (2), pp. 633–664.

Keynes, J. M. [1936/1965]: *A foglalkoztatás, a kamat és a pénz általános elmélete*. Közgazdasági és Jogi Könyvkiadó. Budapest.

Kézdi, G. – Horváth, H. – Hudomiet, P. [2005]: „Labour Market Trends, 2000-2003”. *TÁRKI Social Report Reprint Series*. No. 11.

KSH [2006]: *A munkaerő-felmérés módszertana. Statisztikai módszertani füzetek*. Központi Statisztikai Hivatal. Budapest.

Lubyová, M. – Ochranková, D. – Vantuch, J. [1999]: „Background study on employment and labour market in the Slovak Republic“. *Working Document*, European Training Foundation. Bratislava.

Lubyová, M. – Ours, J. C. [1997]: „Unemployment dynamics and the restructuring of the Slovak unemployment benefit system“. *European Economic Review*. Vol 41 (3-5), pp. 925–934.

Lubyová, M. – Ours, J. C. [1998a]: „Unemployment durations of job losers in a labour market in transition“. *Tilburg University, Center for Economic Research Discussion Paper*. No. 1998-127. http://arno.uvt.nl/show.cgi?fid=3702

Lubyová, M. – Ours, J. C. [1998b]: „Effects of Active Labor Market Programs on the Transition Rate from Unemployment into Regular Jobs in the Slovak Republic“. *The William Davidson Institute at the University of Michigan Business School Working Paper*. No. 213. http://wdi.umich.edu/files/publications/workingpapers/wp213.pdf

Micklewright, J. – Nagy, Gy. [2001]: „Az álláskeresés információs értéke és dinamikája”.

Közgazdasági Szemle. Vol 48 (7–8), pp. 599–614.

Móczár, J. [2008]: *Fejezetek a modern közgazdaság-tudományból. Sztochasztikus és dinamikus nemegyensúlyi elméletek, természettudományos közelítések*. Akadémiai Kiadó. Budapest.

Mortensen, D. T. [1982*a*]: „The Matching Process as a Noncooperative Bargaining Game". In: *McCall, J.* (editor): *The Economics of Information and Uncertainty*. University of Chicago Press. pp. 233–258.

Mortensen, D. T. [1982*b*]: „Property Rights and Efficiency in Mating, Racing, and Related Games". *American Economic Review*. Vol 72 (5), pp. 968–979.

Mortensen, D. T. – Pissarides, Ch. A. [1994]: „Job Creation and Job Destruction in the Theory of Unemployment". *Review of Economic Studies*. Vol 61 (3), pp. 397–415.

Mortensen, D. T. – Nagypál, É. [2007]: „More on Unemployment and Vacancy Fluctuations". *Review of Economic Dynamics*. Vol 10 (3), pp. 327–347.

Münich, D. – Svejnar, J. [2009]: „Unemployment and Worker-Firm Matching: Theory and Evidence from East and West Europe". *The World Bank Policy Research Working Paper Series*. No. 4810. http://ideas.repec.org/p/wbk/wbrwps/4810.html

Páleník, V. [2009]: „Slovenský trh práce v európskom kontexte". In: Páleník, V. (editor) [2009]: *Zborník príspevkov z vedeckej konferencie. Ekonómia trhu práce a jej implikácie pre Slovensko*. Inštitút zamestnanosti. Bratislava. pp. 22–29.

Petrongolo, B. – Pissarides, Ch. A. [2001]: „Looking into the Black Box: A Survey of the Matching Function". *Journal of Economic Literature*. Vol 39 (2), pp. 390–431.

Petrongolo, B. – Pissarides, Ch. A. [2008]: „The Ins and Outs of European Unemployment". *American Economic Review*. Vol 98 (2), pp. 256–262.

Phelps, E. S. [1967]: „Phillips Curves, Expectations of Inflation and Optimal Unemployment Over Time". *Economica*. Vol 34 (Aug), pp. 254–281.

Phelps, E. S. [1968]: „Money-Wage Dynamics and Labor-Market Equilibrium". *Journal of Political Economy*. Vol 76 (4), pp. 678–711.

Pissarides, Ch. A. [1985]: „Short-Run Equilibrium Dynamics of Unemployment, Vacancies and Real Wages". *American Economic Review*. Vol 75 (4), pp. 676–690.

Pissarides, Ch. A. [1986]: „Unemployment and Vacancies in Britain". *Economic Policy.* Vol 1 (3), pp. 499-559.

Pissarides, Ch. A. [2000]: *Equilibrium Unemployment Theory*. Second edition. MIT Press. Cambridge.

Pissarides, Ch. A. [2009]: „The Unemployment Volatility Puzzle: Is Wage Stickiness the

Answer?”. *Econometrica*. Vol 77 (5), pp. 1339–1369.

Pula, G. [2005]: „Az euró bevezetésével járó strukturális politikai kihívások: munkapiac”. *MNB-tanulmányok*. 41.

Rogerson, R. – Shimer, R. – Wright, R. [2005]: „Search-Theoretic Models of the Labor Market: A Survey”. *Journal of Economic Literature*. Vol 43 (4), pp. 959–988.

Royal Swedish Academy of Sciences [2010]: *Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2010: Markets with Search Frictions*. The Royal Swedish Academy of Sciences [Kungl. Vetenskaps-Akademien]. Stockholm.

Shimer, R. [2004]: „The Consequences of Rigid Wages in Search Models”. *NBER Working Paper*. No. 10326. http://www.nber.org/papers/w10326

Shimer, R. [2005]: „The Cyclical Behavior of Equilibrium Unemployment and Vacancies”. *American Economic Review*. Vol 95 (1), pp. 25–49.

Shimer, R. [2007]: „Reassessing the Ins and Outs of Unemployment”. *NBER Working Paper*. No. 13421. http://www.nber.org/papers/w13421

Štatistický úrad Slovenskej republiky [2012]: Metodické vysvetlivky: Trh práce. http://www.statistics.sk/pls/elisw/utlData.htmlBodyWin?uic=80

Stigler, G. J. [1989*a*]: „Az információszerzés közgazdaságtana”. In: *Stigler, G. J.*: *Piac és állami szabályozás. Válogatott tanulmányok*. Közgazdasági és Jogi Könyvkiadó. Budapest. pp. 232–253.

Stigler, G. J. [1989b]: „Információszerzés a munkaerőpiacon”. In: *Stigler, G. J.*: *Piac és állami szabályozás. Válogatott tanulmányok*. Közgazdasági és Jogi Könyvkiadó. Budapest. pp. 254–273.

Strawinski, P. [2008]: „What drives the Unemployment Rate in Poland”. *MPRA Paper*. No. 11372. http://mpra.ub.uni-muenchen.de/11372/1/MPRA_paper_11372.pdf

Sugár, A. [1999]: „Szezonális kiigazítási eljárások (II.)”. *Statisztikai Szemle*. Vol 77 (10-11), pp. 816-832.

Yashiv, E. [2008]: U.S. Labour Market Dynamics and the Business Cycle. Prepared for ESSIM 2008. *Proceedings*. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.968&rep=rep1&type=pdf

List of publications

Book chapter:

Berde, É. – Morvay, E. [2006]: „A bolognai folyamat és munkaerő-piaci kihatása három országban“. In: Berde, É. – Czenky, K. – Györgyi, Z. – Híves, T. – Morvay, E. – Szerepi, A.: *Diplomával a munkaerőpiacon*. Felsőoktatás és Munkaerőpiac. Felsőoktatási Kutatóintézet. Budapest. pp. 39–72.

Publications in refereed journals:

Berde, É. – Morvay, E. [2007]: „Külföldi tapasztalatok a bolognai folyamat munkaerő-piaci hatásairól“. *Statisztikai Szemle*. Vol 85 (5), pp. 406–430.

Morvay, E. [2012a]: „Munkapiac keresési súrlódásokkal“. *Közgazdasági Szemle*. Vol 59 (2), pp. 139–163.

Morvay, E. [2012b]: „Sztochasztikus ciklikus munkaerő-áramlás a visegrádi országokban“. *Statisztikai Szemle*. Vol 90 (9), pp. 815–843.

Other:

Morvay, E. [2010]: „Munkaerő-piaci trendek átmeneti gazdaságokban: Magyarország és Szlovákia“. In: *Spring Wind 2010. Tavaszi Szél 2010*. Konferenciakötet. Doktoranduszok Országos Szövetsége. Pécs. pp. 356–370.

Morvay, E. [2010]: „Magyarország és Szlovákia: Munkaerő-piaci trendek és problémák“. *A VIRTUÁLIS INTÉZET KÖZÉP-EURÓPA KUTATÁSÁRA KÖZLEMÉNYEI*. Szeged. Vol 2 (1), pp. 105–113.