Evaluating labour market flexibility in V4 countries

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Abstract. This contribution focuses on evaluation of labour market flexibility in the V4 countries. These countries have similar historical destiny but the economic transition led to new labour market institutions. Labour market outcomes are thus quite different in the last decades. Using a small closed DSGE model with search and matching frictions, the main structural labour market differences among these countries are revealed. These differences are related to the changes in separation rates, matching efficiency, match elasticity of unemployed and the bargaining power of the workers. The models are identified using Bayesian techniques. Comparing the moments of simulated data, we can conclude that the estimated models are able to replicate the main statistical properties of the observed data. The labour market in Hungary seems to be the most flexible regarding the labour market dynamics in the light of the nascent economic recovery. On the other hand, all examined economies are similar to the extent of the low wage bargaining power of the workers.

Keywords: search and matching model, Bayesian estimation, DSGE model, labour market flexibility, V4 countries.

JEL classification: C51, E24, J60
AMS classification: 91B40, 91B51

1 Introduction

Labour market flexibility is an important factor of labour market dynamics. It has direct consequences on vacancies creation, unemployment dynamics and on responses of the economy to exogenous shocks. The goal of this contribution is to reveal possible structural differences among the labour markets of Visegrad countries (V4): the Czech Republic, Slovakia, Hungary and Poland. For these purposes, a small closed DSGE model with search and matching frictions with time-varying demand elasticity and separation rates will be estimated. There is no unique measure of the labour market flexibility but we will focus on some key structural difference which might be connected with the flexible labour markets. In particular, we will investigate the differences in the estimated separation rates, matching efficiency, match elasticity of unemployed and the bargaining power of the workers. Moreover, the labour market flexibility is evaluated with respect to the length and amplitude of the responses of the economies to the selected labour market shocks. A review of studies dealing with the labour market flexibility in the Czech and Slovak Republic may be found in Němec [7]. Behar [3] found out that tax wedges and duration of benefits in the Central and Eastern European (CEE) countries were important factors of the poor labour market outcomes. On the other hand, he concluded that labour market policies and institutions in the CEE countries are generally more flexible than those in the rest of Europe. Twenty-seven OECD countries are investigated by Hobijn and Sahin [4]. Their results provide relatively big differences in job-finding rates and separation rates which may suggest the heterogeneity in the European labour markets. We are convinced that the DSGE approach may improve our knowledge of the labour markets in V4 countries.

2 Model

In this contribution, we shall use a simple search and matching model incorporated within a standard DSGE framework. This model was developed by Lubik [5] and is described in Němec [6] and [7]. We will thus present and comment only the main equations and the log-linearized version of the model. Compared to previously mentioned papers two important enhancements have been made. First, the

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price elasticity of demand is more explicitly taken as a time-varying parameter that allows us to capture the aggregate output dynamics in a more consistent and reliable way. Previous attempts to treat this parameter as a constant required formulating an exogenous autoregressive process for output dynamics. Second enhancement concerns the time-varying separation rate. Incorporating this feature may further distinguish various sources of dynamics on the labour market. A representative household maximizes its expected utility function

$$E_t \sum_{j=t}^{\infty} \beta^{j-t} \left[\frac{C_j^{1-\sigma} - 1}{1-\sigma} - \chi_j n_j \right], \tag{1}$$

where symbol E_t represents expectation operator conditioned by the information available in time t, C_j is aggregate consumption, $n_j \in [0,1]$ is a fraction of employed household members, $\beta \in (0,1)$ is the discount factor and $\sigma \geq 0$ is the coefficient of relative risk aversion. Variable χ_j represents an exogenous stochastic process which may be taken as a labour shock. The budget constraint is defined as $C_t + T_t = w_t n_t + (1-n_t)b + \Pi_t$, where b is unemployment benefit financed by a lump-sum tax, T_t. Variable Π_t represents profits from ownership of the firms, and w_t is wage. There is no explicit labour supply because it is an outcome of the matching process. The first-order condition is thus simply $C_t^{-\sigma} = \lambda_t$, where λ_t is the Lagrange multiplier on the budget constraint.

The labour market is characterized by search frictions captured by a standard Cobb-Douglas matching function $m(u_t, v_t) = \mu_t u_t^{\xi} v_t^{1-\xi}$, where unemployed job seekers, u_t, and vacancies, v_t, are matched at rate defined by $m(u_t, v_t)$. Parameter $0 < \xi < 1$ is a match elasticity of the unemployed, and μ_t is stochastic process measuring the efficiency of the matching process. Aggregate probability of filling a vacancy may be defined as $q(\theta_t) = m(u_t, v_t)/v_t$, where $\theta_t = \frac{v_t}{u_t}$ is a standard indicator of the labour market tightness. The model assumes that it takes one period for new matches to be productive. Moreover, old and new matches are destroyed at a separation rate, $0 < \rho_t < 1$, which corresponds to the inflows into unemployment and is considered as a time-varying parameter. The labour force is normalised to one and evolution of employment or equivalently employment rate, $n_t = 1 - u_t$, is given by $n_t = (1-\rho_t)\left[n_{t-1} + v_{t-1} q(\theta_{t-1})\right]$.

The model assumes monopolistic behaviour of the firm in each sub-market. Demand function of a firm is defined by $y_t = \left(\frac{p_t}{P_t}\right)^{-1-\omega_t} Y_t$, where y_t is firm's production (and its demand), Y_t is aggregate output, p_t is price set by the firm, P_t is aggregate price index and ω_t is time-varying demand elasticity. Production function of each firm is $y_t = A_t n_t^{\alpha}$, where A_t is an aggregate technology (stochastic) process and $0 < \alpha \leq 1$ introduces curvature in production. The firm controls the number of workers, n_t, number of posted vacancies, v_t, and its optimal price, p_t, by maximizing the inter-temporal profit function

$$E_t \sum_{j=1}^{\infty} \beta^{j-t} \lambda_j \left[p_j \left(\frac{p_j}{P_j}\right)^{-(1+\omega)} Y_j - w_j n_j - \frac{\kappa}{\psi} v_j^{\psi} \right], \tag{2}$$

subject to the employment accumulation equation and production function. Profits are evaluated in terms of marginal utility λ_j. The costs of vacancy posting is $\frac{\kappa}{\psi} v_t^{\psi}$, where $\kappa > 0$ and $\psi > 0$. For $0 < \psi < 1$, posting costs exhibit decreasing returns. For $\psi > 1$, the costs are increasing while vacancy costs are fixed for $\psi = 1$. The first order condition represents the evolution of current-period marginal value of a job, τ_t, and a link between the cost of vacancy, $\kappa v_t^{\psi-1}$ and the expected benefit of a vacancy in terms of the marginal value of a worker (adjusted by the job creation rate, $q(\theta_t)$) and a stochastic discount factor $\beta_{t+1} = \beta \frac{\lambda_{t+1}}{\lambda_t}$. Wages are determined as the outcome of a bilateral bargaining process between workers and firms. Both sides of the bargaining maximize the joint surplus from employment relationship:

$$S_t \equiv \left(\frac{1}{\lambda_t} \frac{\partial \mathcal{W}_t(n_t)}{\partial n_t} \right)^{\eta} \left(\frac{\partial \mathcal{J}_t(n_t)}{\partial n_t} \right)^{1-\eta}, \tag{3}$$

where $\eta \in [0,1]$ is the bargaining power of workers, $\frac{\partial \mathcal{W}_t(n_t)}{\partial n_t}$ is the marginal value of a worker to the household's welfare and $\frac{\partial \mathcal{J}_t(n_t)}{\partial n_t} = \tau_t$ is the marginal value of a worker to the firm. After straightforward adjustments are carried out, one can get the expression for the bargained wage. The model assumes that unemployment benefits, b, are financed by lump-sum taxes, T_t, where a condition of balanced budget holds, i.e. $T_t = (1-n_t)b$. Social resource constraint is thus $C_t + \frac{\kappa}{\psi} v_t^{\psi} = Y_t$. The technology shock A_t, the labour shock χ_t, the matching shock μ_t, the time-varying demand elasticity ω_t and the separation rate ρ_t are assumed to be independent $AR(1)$ processes (in logs) with coefficients ρ_i, $i \in (A, \xi, \mu, \omega, \rho)$ and autoregression residuals $\epsilon_t^i \sim N(0, \sigma_i^2)$. In the following log-linearized equations, the line over a variable means its steady-state value. Steady-state values are derived simply from the non-linear equations. Initial steady-state values which are common for all economies are calibrated as follows: $\overline{\mu} = \overline{A} = \overline{\chi} = \overline{p} = \overline{P} = 1$, $\overline{\rho} = 0.03$, $\overline{\omega} = 10$, $\overline{\beta} = 0.98$. Country specific steady states for the Czech Republic $\overline{u} = 0.0831$, $\overline{v} = 0.0114$, for the Slovak Republic $\overline{u} = 0.1359$, $\overline{v} = 0.0055$, for Hungary $\overline{u} = 0.1027$, $\overline{v} = 0.009$, and for Poland $\overline{u} = 0.1418$, $\overline{v} = 0.002$. Remaining steady-states are computed using these values and the prior means of all parameters. The variables with a tilde represent the gaps from their steady-states. It should be mentioned, that the gaps are computed as log-differences, e.g. $\tilde{u} = \log u - \log \overline{u}$.

$$\tilde{\lambda}_t = -\sigma \tilde{C}_t \qquad \tilde{m}_t = \tilde{\mu}_t + \xi \tilde{u}_t + (1-\xi)\tilde{v}_t$$

$$\tilde{q}_t = \tilde{m}_t - \tilde{v}_t \qquad \tilde{\theta}_t = \tilde{v}_t - \tilde{u}_t$$

$$\tilde{n}_t = -\frac{\overline{u}}{1-\overline{u}}\tilde{u}_t \qquad \tilde{n}_t = \frac{1}{\overline{n}+\overline{vq}}\left[\overline{n}\tilde{n}_{t-1} + \overline{vq}(\tilde{v}_{t-1}+\tilde{q}_{t-1})\right] - \frac{\overline{\rho}}{1-\overline{\rho}}\tilde{\rho}_t$$

$$\tilde{y}_t = (-1-\overline{\omega})(\tilde{p}_t - \tilde{P}_t) - \overline{\omega}\log\left(\frac{\overline{p}}{\overline{P}}\right)\tilde{\omega}_t + \tilde{Y}_t \qquad \tilde{y}_t = \tilde{A}_t + \alpha \tilde{n}_t$$

$$(\psi - 1)\tilde{v}_t = \tilde{q}_t + E_t\left(\tilde{\beta}_{t+1} + \tilde{\tau}_{t+1}\right) - \frac{\overline{\rho}}{1-\overline{\rho}}\tilde{\rho}_t \qquad \tilde{\beta}_t = \tilde{\lambda}_t + \tilde{\lambda}_{t-1}$$

$$\tilde{\tau}_t = \frac{1}{\alpha\frac{\overline{y}}{\overline{n}}\frac{\overline{\omega}}{1+\overline{\omega}} - \overline{w} + (1-\overline{\rho})\overline{\beta}\overline{\tau}} \times \left[\alpha\frac{\overline{y}}{\overline{n}}\frac{\overline{\omega}}{1+\overline{\omega}}(\tilde{y}_t - \tilde{n}_t + \overline{\omega}\tilde{\omega}_t) - \overline{w}\tilde{w}_t + \overline{\tau}\overline{\beta}E_t\left((1-\overline{\rho})(\tilde{\beta}_{t+1} + \tilde{\tau}_{t+1}) - \overline{\rho}\tilde{\rho}_t\right)\right]$$

$$\tilde{w}_t = \frac{1}{\overline{w}}\left[\eta\left(\alpha\frac{\overline{\omega}}{1+\overline{\omega}}\frac{\overline{y}}{\overline{n}}(\tilde{y}_t - \tilde{n}_t + \frac{1}{1+\overline{\omega}\tilde{\omega}_t}) + \kappa\overline{v}^{\psi-1}\overline{\theta}\left((\psi-1)\tilde{v}_t + \tilde{\theta}_t\right)\right) + (1-\eta)\overline{\chi}\overline{C}^{\sigma}(\tilde{\chi}_t + \sigma\tilde{C}_t)\right]$$

$$\tilde{Y}_t = \frac{1}{\overline{C} + \frac{\kappa}{\psi}\overline{v}^{\psi}}\left(\overline{C}\tilde{C}_t + \kappa\overline{v}^{\psi}\tilde{v}_t\right)$$

$$\tilde{A}_t = \rho_A\tilde{A}_{t-1} + \epsilon_t^A \quad \tilde{\chi}_t = \rho_\chi\tilde{\chi}_{t-1} + \epsilon_t^\chi \quad \tilde{\mu}_t = \rho_\mu\tilde{\mu}_{t-1} + \epsilon_t^\mu \quad \tilde{\omega}_t = \rho_\omega\tilde{\omega}_{t-1} + \epsilon_t^\omega \quad \tilde{\rho}_t = \rho_\rho\tilde{\rho}_{t-1} + \epsilon_t^\rho$$

We have thus five shocks (ϵ_t^i) for four observed variables – $\tilde{u}$, $\tilde{v}$, $\tilde{w}$ and $\tilde{Y}$). The model consists of 20 endogenous variables, five shocks and 13 parameters. Due to the fact that the price gaps, $\tilde{p}$ and $\tilde{P}$, are undetermined and out of importance in our model, they may be treated as zero variables.

3 Estimation results and model evaluation

The models for the V4 countries are estimated separately using the quarterly data sets covering a sample period from 1998Q1 to 2012Q4. The observed variables are real output (Y), hourly earnings (w), unemployment rate (u) and rate of unfilled job vacancies (v).[1] Parameters of the model are estimated using Metropolis-Hasting algorithm (two chains, 2000000 draws per chain with 80% draws burned-in) combined with Kalman filtering procedures that are necessary to evaluate likelihood function of the model (see An and Schorfheide [2]). All computations have been performed using Dynare toolbox for Matlab (version 4.3.2) developed by Adjemian et al. [1]. Table 1 reports the model parameters and the corresponding prior densities and calibrated (fixed) values. The priors and calibrated quantities are the same for all four economies. These quantities proceed from those used by Lubik [5] or Němec [7]. The standard deviations of the prior densities are rather uninformative. Table 2 presents the means and standard deviations of the posterior densities including the 90% highest posterior density intervals (HPDI). All generated chains converged to the stationary distribution. Parameters are mostly identified from the data. There are only two exceptions: parameter representing unemployment benefits, b, and the scale parameter in the vacancy posting costs, κ. This result is not surprising because we have incorporated two time varying parameters which are able to capture the influence of these non-identified parameters. This fact does not speak against the quality of our model. Both parameters are rather auxiliary parameters which do not

[1] The original data come from database of OECD. Unfilled job vacancies for Slovakia were taken from the Ministry of Labour, Social Affairs and Family of the Slovak Republic (SAFSR). The following variables were used: GDP - expenditure approach (chained volume estimates, national reference year, OECD), index of hourly earnings (manufacturing, 2005=100, OECD), registered unemployment (level, OECD), unfilled job vacancies (level, OECD and SAFSR). The time series are seasonally adjusted by the data providers using the TRAMO/SEAT procedure. The variables were transformed using logarithmic transformation and de-trended using Hodrick-Prescott filter with the smoothing parameter $\lambda = 1600$. The variables used are thus expressed as corresponding gaps. This approach is fully consistent with the log-linear equations.

contribute to the overall model dynamics. The results for the cross-correlations, sample moments and autocorrelation coefficients of the observed and simulated data are not presented here but the fit of all models is outstanding. Regarding our estimates we can see that the structural parameters of V4 countries are different although we could found some common patterns among two or three of them. As an example, take a look on the parameter σ. From this point of view households in the Czech Republic and Hungary are very similar. Slovak households are less risk averse and on the other hand Polish households are more risk sensitive. As for the parameters of persistence of shocks and their standard deviations, it is clear that the shocks hitting the economies and their labour markets did not either coincide or last for the same time period. Different observed history does not imply opposing dynamic properties of the economies (see Figure 2).

Description	Parameter	Density	Mean	Std. Dev.
Discount factor	β	fixed	0.98	–
Labour elasticity	α	fixed	0.67	–
Relative risk aversion	σ	gamma	1.00	0.50
Match elasticity	ξ	beta	0.70	0.10
Bargaining power of the workers	η	uniform	0.50	0.30
Unemployment benefits	b	beta	0.30	0.15
Elasticity of vacancy creation cost	ψ	gamma	1.00	0.50
Scaling factor on vacancy creation cost	κ	gamma	0.10	0.05
AR coefficients of shocks	$\rho_{\{\chi,A,\mu,\omega,\rho\}}$	beta	0.50	0.20
Standard deviation of shocks	$\sigma_{\{\chi,A,\mu,\omega,\rho\}}$	inv. gamma	0.05	∞

Table 1 Prior densities and description of estimated parameters

	CZE	SVK	HUN	POL
σ	0.4673	0.2149	0.4556	1.4005
	(0.2533; 0.6849)	(0.0989; 0.3261)	(0.1716; 0.7277)	(0.5410; 2.2139)
ξ	0.7422	0.8622	0.8740	0.6307
	(0.6911; 0.7936)	(0.8154; 0.9370)	(0.5069; 0.7634)	(0.5069; 0.7634)
η	0.0257	0.0418	0.2920	0.3451
	(−0.0196; 0.0697)	(-0.0196;0.0943)	(−0.0102; 0.6226)	(0.0961; 0.5934)
b	0.3003	0.3008	0.2998	0.3007
	(0.0537; 0.5291)	(0.0580; 0.5342)	(0.0599; 0.5361)	(0.0568; 0.5314)
ψ	2.1346	1.7226	0.9314	1.7422
	(1.3679; 3.0180)	(0.9624; 2.4648)	(0.5142; 1.4588)	(1.0964; 2.3904)
κ	0.1013	0.1012	0.1204	0.1006
	(0.0230; 0.1757)	(0.0239; 0.1754)	(0.0270; 0.2072)	(0.0236; 0.1755)
ρ_χ	0.6602	0.2308	0.7115	0.8095
	(0.4942; 0.8354)	(0.0679; 0.3878)	(0.5661; 0.8577)	(0.7007; 0.9192)
ρ_A	0.8418	0.4832	0.8059	0.7405
	(0.7511; 0.9374)	(0.3038; 0.6545)	(0.6991; 0.9175)	(0.6065; 0.8781)
ρ_μ	0.7282	0.8264	0.6350	0.5971
	(0.5689; 0.9050)	(0.6688; 0.9715)	(0.3859; 0.8817)	(0.3324; 0.8581)
ρ_ω	0.9056	0.8500	0.6903	0.8334
	(0.8474; 0.9670)	(0.7619; 0.9425)	(0.5495; 0.8337)	(0.7445; 0.9247)
ρ_ρ	0.6644	0.7436	0.6125	0.4593
	(0.4277; 0.8941)	(0.4578; 0.9617)	(0.4234; 0.8164)	(0.2197; 0.6984)
σ_χ	0.0082	0.0132	0.0149	0.0349
	(0.0068; 0.0095)	(0.0109; 0.0155)	(0.0083; 0.0232)	(0.0208; 0.0489)
σ_A	0.0081	0.0163	0.0087	0.0082
	(0.0068; 0.0093)	(0.0138; 0.0186)	(0.0074; 0.0100)	(0.0070; 0.0095)
σ_μ	0.0308	0.0348	0.0246	0.0333
	(0.0162; 0.0428)	(0.0145; 0.0503)	(0.0124; 0.0378)	(0.0132; 0.0560)
σ_ω	0.5021	0.4451	0.2511	0.2401
	(0.2975; 0.7164)	(0.2349; 0.6589)	(0.1145; 0.4209)	(0.1165; 0.3584)
σ_ρ	0.0367	0.0491	0.0618	0.0715
	(0.0146; 0.0579)	(0.0138; 0.0853)	(0.0376; 0.0846)	(0.0397; 0.0991)

Table 2 Posterior means and the 90% HPDIs

The main focus of this contribution is to evaluate the labour market flexibilities in V4 countries. Surprisingly, the bargaining power of the workers is almost zero in the Czech and Slovak Republic. The worker in Hungary and Poland are stronger but their power does not overweight the one of firms. From this point of view, all the labour markets might be assessed as relatively flexible because the wages are not set in contradiction with the productivity. Costs of vacancy posting are one of many signs of lower labour market flexibility. Estimated parameters ψ are greater than one in case of Czech, Slovak and Polish labour markets. These values mean increasing vacancy posting costs. Hungary may seem to have constant costs implying good conditions in vacancy posting. Some kind of dispersion might be seen in the case of parameter ξ. Higher values in Slovakia and Hungary indicate higher sensitivity of successful matching process considering the changes in unemployment. The case of Poland shows relatively similar weight of unemployment and vacancies in the match pairing process.

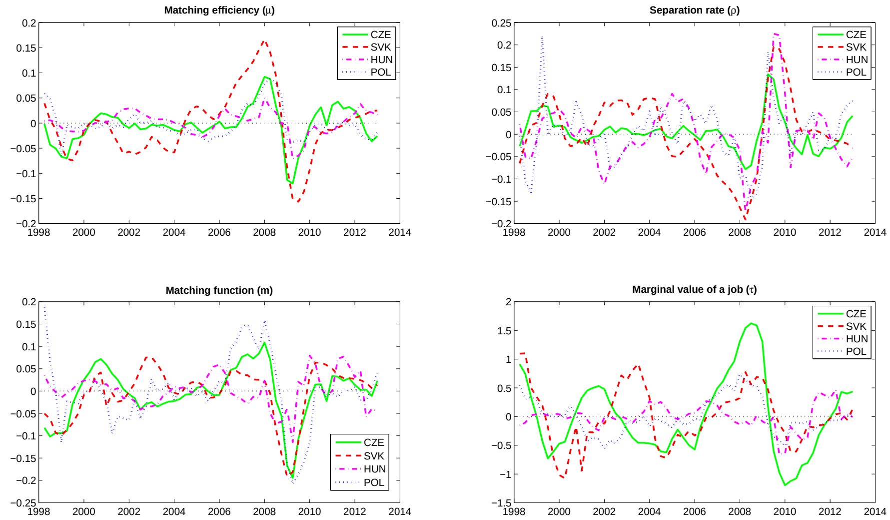

Figure 1 Trajectories of selected (smoothed) variables

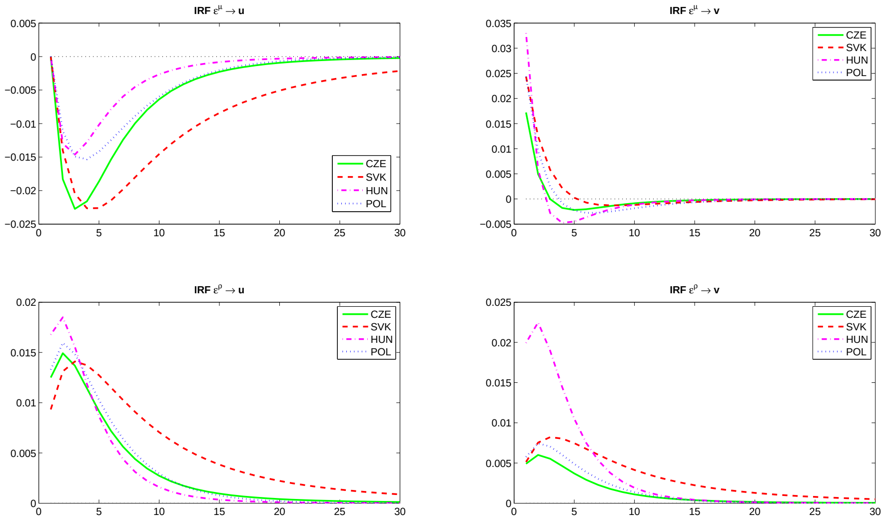

Figure 2 Selected impulse-response functions (IRFs)

Figure 1 shows historical development of selected smoothed variables. In particular, we can see the trajectories of the match efficiency, μ, of the separation rate, ρ, of the matching function, m, and of the marginal value of the jobs, τ. Separation rate as a time-varying parameter is an important feature in all economies and does not seem to be constant within the analysed period. Its variability plays a role in the labour market dynamics because its adjustment helps the economy to recover from the disequilibrium states caused by exogenous shocks. Czech labour market may be thus viewed as less flexible due the lower variability in separation rate. As for the matching efficiency, there were only little positive changes in the Czech Republic and Poland in the period from 2000 to 2007. Negative development in Slovakia in the period 2001-2004 may be connected with unfavourable labour market policies in this period. It should be noted, that the high negative correlation between μ and ρ (Czech Republic -0.87, Slovakia -0.84) is not a general feature of the model. We have found correlation of -0.71 in Hungary and -0.57 in Poland. High negative correlations support the evidence that the low match efficiency (i.e. a lower ability of the labour market to pair the vacancies with unemployed persons) on the labour market is accompanied by higher separation rate that increase the flows from employment to unemployment. The V4 economies are similar in their reactions in matching function in the period of economic slowdown starting in 2008. But, this pattern is not so convincing in case of Hungary. Stability in marginal value of job in Hungary illustrates the institutional quality of Hungarian labour market. The rest of V4 countries suffered from the uncertainty with evaluation of workers and their contribution to the firms. This characteristic discourages the employees from new jobs creation and labour market flexibility is undermined. Figure 2 allows us to evaluate labour market flexibility as the ability of the economy to absorb exogenous shocks. We focus on match efficiency shock and the separation rate shock and their influence on unemployment gap and gap in vacancies. With regard to the amplitude and the speed of adjustment we could conclude that the short lasting responses are typical for the Hungary. Slovakia seems to be the least flexible. Moreover, the strong response of vacancies creation to the separation rate shock in Hungary indicates high ability of this economy to create new jobs as a result of increasing unemployment. The flows from one to another job are thus very flexible. Polish and Czech labour markets are very similar in their shock response dynamics.

4 Conclusion

All examined economies are similar to the extent of the low wage bargaining power of the workers and increasing vacancy posting cost (excluding the constant vacancy post in Hungary). As Lubik [5] pointed out in U.S. labour market, the lower bargaining power is accompanied by the increasing vacancy costs preventing excessive vacancy creation. But, our results show that this is not a general feature of the model. With respect to our results we are able to observe low bargaining power and constant vacancy costs (see estimates for Hungary). Although only a part of the results has been presented, it appears that the labour market in Hungary is the most flexible and the expected recovery of the economy may be accompanied by a quick return of the unemployment to its pre-crisis level. On the other hand, the Slovak labour market seems to be more rigid and the future development may be not too much positive. The estimated model provides a satisfactory description of employment flows in both economies, and is able to replicate observed data and some of its basic properties. Extending our analysis to the other CEE countries and the rest of EU countries will be further step of our research. We hope that this approach may offer a new way to compare and classify European labour markets. As stated in Němec [7], knowledge of the degree of labour market flexibility is important for considering the intended extents of future labour market reforms and for the evaluation of the reforms up to now.

Acknowledgements

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