Labor Market Frictions in the Czech Republic and Hungary

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Abstract. The goal of this paper is to investigate and compare the structural and dynamical characteristics of the Czech and Hungarian economy. The focus lies mainly on the examination of the development of key labor market variables. We also want to capture the changes that occurred due to the Great Recession in 2008. We estimate a DSGE model with search and matching frictions, price and wage rigidities and hiring costs. The monetary authority sets the nominal interest rates according to a Taylor-type rule. The wages setting mechanism and hours worked are the result of the Nash bargaining process. This model is estimated for the quarterly data of the Czech Republic and Hungary for the period 2001Q2 – 2014Q4. The results show that the reactions of variables to monetary shock are larger in the Czech Republic. This suggests that the monetary policy is less efficient in Hungary during the examined period. The bargaining power of workers is stronger in the Czech economy. This coefficient is smaller in Hungary, which is in line with the low trade union participation of workers. The model shows the preference, foreign and disutility from work shocks to be the main cause of the Great Recession in both countries.

Keywords: DSGE, small open economy, labor market, search and matching frictions, Great Recession

JEL classification: E32, J60
AMS classification: 91B40

1 Introduction

The aim of this paper is to examine the structural characteristics and dynamism of the Czech and Hungarian economy in the past 14 years. We focus mainly on the behavior of the labor market variables and the interactions between the labor market and the rest of the economy. The whole examined time period (2001Q2 – 2014Q4) is divided into two sections – *before* and *after* crisis. In total, we perform four separate estimations – two for each country – to investigate the differences between the economies and to identify the structural changes caused by the Great Recession. This paper is a follow up of our previous research [5], where we investigated the behavior of the Hungarian economy. Now we extend our field of interest also to the Czech Republic and provide a more detailed look at the impact of the Great Recession.

There are several other papers which examine the development of the labor market. Lubik [3], for example, estimates a model for the United States containing vacancy posting cost developed by Rotemberg [6]. This is one way to implement frictions to the model: the firms are less willing to hire and fire workers, because they cannot create vacancies for free. Lubik states, that most of the structural parameters of the model are not dependent on the model specification. However, specific parameters, like the search costs or worker benefit, can vary widely across specifications, and thus are likely not identified in either an econometric or economic sense.

Thomas [7] decided to examine the role of the monetary policy in models with labor market. He investigated the optimal monetary policy under different levels of wage rigidities. Under completely flexible wages, he finds the ideal inflation to be zero. However under wage frictions, the monetary

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authority should secure a positive inflation to decrease the volatility of unemployment. Therefore, the monetary policy holds a tool which can actively help in the labor market stabilization.

The role of monetary policy for labor market dynamics is discussed also by Christoffel et al. [2]. They use a DSGE model augmented with search and matching frictions and wage rigidities to determine the factors important for the monetary policy's effectiveness. They find flexible wages to increase the efficiency of the central bank. However, apart from the wage rigidities, other labor market characteristics have limited impact on the transmission of the monetary policy. They also suggest the bargaining power of workers to be an important information carrier for the monetary policy makers, and they emphasize the need for labor market modeling for the central banks.

1.1 Economic background of the Czech Republic and Hungary

The historical development of output is similar in both countries. It shows a relatively steady growth until the financial crisis, when there was a substantial drop in the GDP. On the other hand, the labor market variables show some significant differences between the two countries. The unemployment rate in the Czech Republic declined from 8% in 2001 to below 5% in 2008 with the average around 7%. During the same time period, the unemployment rate in Hungary had almost the same mean value (6.6%), but increased from 6% to 8%. The increase of this variable in Hungary to above 10% due to the recession was followed by a four-year period of high unemployment. After this, it decreased to its current level around 7.5%. The unemployment in the Czech Republic was also affected by the crisis and peaked temporarily at 7.8%. Its decrease to its current value (6.7%) was interrupted by a second decrease in the output in 2012. The movements in the vacancy rate are the opposite to the development of the unemployment rate in the Czech Republic. The vacancy rate reached its maximum value in 2008, when the unemployment was the lowest. This negative relationship also holds for the Hungarian economy, however not to such extent. The average working hours slightly increased during the whole examined time period in both countries. This increase was accompanied by rising real wages in the Czech Republic. On the other hand, the real wage shows a slight decrease in Hungary.

2 Model characteristics and structure

The selected model was introduced by Albertini et al. [1]. They used it to estimate the behavior of the New Zealand economy. This small open economy model consists of a monetary authority and homogenous firms and households. The monetary authority is present in the form of a Taylor rule. The sole input in the production function is the labor and there is no government sector present in the model. The model incorporates a detailed description of the movements on the non-Walrasian labor market. These movements are captured by varying hours worked (intensive margin) and also choosing whether or not the members of the households want to participate in the labor market at all (extensive margin). The Nash bargaining process sets the hours worked and wages and determines the allocation of the surplus from the production between the firms and workers based on their negotiating power. The model includes a matching function, initially introduced by Mortensen and Pissarides [4]. To capture the behavior of a real economy, four kinds of frictions are implemented into the models structure. First, due to the matching function, a certain part of the unemployed population fails to get paired with a vacant job position. Second, creating this vacant job position increases the firm's costs, therefore the firms cannot increase the employment freely. Next, the firms face a price adjustment cost, so they might be reluctant to change their prices. Finally, the change in the wage of the employees also increases the firms costs.

The most important element of the model is the labor market. This is the place, where the unemployed search for vacant job positions and firms seek to fill their vacancies. However, searching for workers and job positions is a costly and time consuming process. Being unemployed or vacant is a unproductive state. Only employees combined with filled vacancies create output. The number of these matches is the result of the following Cobb-Douglas matching function

$$M_t = \varepsilon_t^m S_t^\nu V_t^{1-\nu}.$$

This function gives us the amount of seeker-vacancy pairs that were created in each time period. On the other hand, there are several jobs that are destroyed each period at an exogenous and constant job destruction rate. Thus, the number of employed in each time period is given by the number of those,

who kept their job and those, who managed to find a new one. This model assumes constant labor force over time and differentiates between the number of unemployed and job seekers. Everyone is looking for jobs except those, who kept their job from the previous period. The number of unemployed in period t is given by the whole labor force without the number of employed in this period t. This setting allows workers who lost their job in one period to find a new one in the same time period.

The examined model consists of the foreign sector and three domestic agents: households, firms and monetary authority. Furthermore, there are three kinds of firms in the model: domestic producers and retailers, and foreign good importers. The foreign sector (output, inflation and interest rate) is exogenous and is represented by independent autoregressive processes – AR(1).

The representative household maximizes its expected intertemporal utility function. This function depends positively on the difference of consumption and consumption habit, and negatively on the supplied labor:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \varepsilon_t^c \left[\log(C_t - \vartheta \bar{C}_{t-1}) - N_t \kappa_t^h \frac{h_t^{1+\phi_h}}{1+\phi_h} \right].$$

Because there is no capital in the model, the income of the household – wage from work and interests from bonds and assets – are spent solely on the consumption and domestic and foreign assets. The consumption consist of bundles of domestic and foreign goods.

The domestic intermediate good producers are the only type of firms which hire workers and set their wages. These firms maximize their intertemporal profit function

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t}{\lambda_0} \left[mc_t Y_t - \frac{W_t}{P_{H,t}} h_t N_t - \Gamma(V_t) - \Upsilon(W_t) N_t \right], \tag{1}$$

while facing hiring ($\Gamma(V_t)$) and quadratic wage adjustment ($\Upsilon(W_t)$) costs as in Rotemberg [6]. The good producers negotiate the wages and the worked hours by a Nash bargaining process. They sell their products on a perfectly competitive market to the second kind of firms, the domestic retailers. The retailers combine the differentiated intermediate goods to a final good and sell it to the representative household on a monopolistically competitive market. This gives them the opportunity to adjust their prices. However, each price change induces a increase of costs. The retailers have to choose whether to change their prices despite the increased costs or keep them at their old levels. The last kind of firms, the importers function similarly as the retailers. They import goods and set their domestic prices on a monopolistically competitive market. The importers also face price adjustment costs together with the fluctuations of the exchange rates.

The final agent in the model is the monetary authority, which is modeled using the following Taylor-rule

$$i_t = i_{t-1}^{\rho_r} \left[\frac{1}{\beta} \left(\frac{E_t \pi_{t+1}}{\pi} \right)^{\rho_\pi} \left(\frac{Y_t}{Y} \right)^{\rho_Y} \left(\frac{Y_t}{Y_{t-1}} \right)^{\rho_{\Delta Y}} \left(\frac{e_t}{e_{t-1}} \right)^{\rho_e} \right]^{1-\rho_r} \varepsilon_t^m.$$

The central bank sets the current nominal interest rate based on its previous value, deviation of inflation from its target, output from its steady state and the differences of output and exchange rate from their previous values.

3 Data and calibration

The time period is selected to cover the whole inflation targeting era in Hungary, 2001Q2 – 2014Q4. The first quarter of 2009 is selected as the dividing point for the *before* and *after* crisis periods. Eleven time series are selected for the estimation, eight for the domestic economy, three for the foreign sector represented by the Euro area. Output (Y_t) is calculated as the real gross domestic product divided by the active labor market population. Inflation (π_t) is defined as a quarterly percentage change in the domestic CPI. The 3 month interbank rate is selected for the estimation as interest rate (i_t). The exchange rate (q_t) is defined as the real effective exchange rate between the domestic economy and the Euro area. Harmonized unemployment rate (U_t) is selected as a measure of the unemployment. The vacancies (V_t) are calculated as the number of vacancies divided by the active labor market population. The wages (w_t) are represented by the real unit labor costs. Finally, the hours worked (h_t) are defined as the average work time per worker. The three variables of the foreign sector are the output (Y_t^*), inflation (π_t^*) and interest

rates (i_t^*). The time series of the exchange rates are acquired from the EuroStat database. The hours worked are obtained from the official statistical databases of the examined countries. The rest of the data is selected from the OECD database. The data series are seasonally adjusted. Before the estimation the data series are stationarised using demeaning for the inflations and interest rates and Hodrick-Prescott filter with the standard smoothing parameter $\lambda = 1600$ for the other variables. The model is estimated using Bayesian techniques. The computations are carried out in the Dynare toolbox (version 4.4.3) for Matlab. Two chains of Metropolis-Hastings algorithm are generated for each estimation. Each chain contains 600.000 draws of which the initial 33% is dropped.

Several of the variables are calibrated according to the relevant literature and are the same for each four estimations. The discount factor is set to 0.99. The elasticity of labor in the production function is set to 0.667. The debt elasticity of risk premium is set to 0.001 as in Albertini et al. [1]. The scale parameter in the vacancy creation function is set to 0.05, as in Lubik [3]. Other parameters are derived from the data and are set to different values to provide more data related information for the estimations. The steady state value of unemployment is calculated as the sample mean of the unemployment rate. For the Czech economy, it is set to 0.07 *before* and 0.067 *after* crisis and for Hungary to 0.066 and 0.101 respectively. The import share of GDP is set to 0.333 and 0.4 for the Czech Republic, and to 0.4 and 0.467 for Hungary. The job separation parameter is calculated to get the sample mean of the vacancy rate and set to values between 0.3 and 0.4 for the four estimations.

4 Estimation results

Table 1 shows the parameter estimation results for both economies and both time periods. This table also contains the prior densities used for the estimations. These values are the same for each estimation to get the differences between the estimations based solely on the differences between the input data and not the model setting. The habit parameter ϑ is higher for the Czech Republic, which suggests a less smoothed consumption in Hungary. The estimates of this parameter for Hungary are similar to our previous paper [5] – 0.4621. Although the changes in the mean are noticeable, the standard deviations suggest statistical insignificance. The firms bargaining power ξ is estimated to be lower in the Czech economy. This parameter increased *after* the crisis in both countries, possibly due to the increase in the unemployment and decrease of vacancies. This shift on the labor market makes the vacancies more rare

		Czech Republic				Hungary			
		Posterior before		Posterior after		Posterior before		Posterior after	
Params	Prior density	Mean	*Stdev*	Mean	*Stdev*	Mean	*Stdev*	Mean	*Stdev*
Other parameters									
ϑ	$\beta(0.5, 0.15)$	0.5899	*0.0808*	0.5658	*0.1175*	0.4714	*0.0923*	0.4121	*0.1170*
ξ	$\beta(0.5, 0.2)$	0.2720	*0.1179*	0.3456	*0.1392*	0.3860	*0.1454*	0.4613	*0.1609*
ν	$\beta(0.5, 0.2)$	0.3868	*0.2030*	0.5342	*0.2165*	0.5193	*0.2147*	0.4805	*0.2178*
e	$\Gamma(1, 0.5)$	7.0881	*0.6502*	6.6384	*0.8388*	7.1303	*0.6189*	6.5596	*0.8702*
Price and wage setting									
γ_H	$\beta(0.75, 0.1)$	0.5916	*0.1317*	0.5507	*0.1200*	0.6410	*0.1168*	0.6739	*0.1092*
γ_F	$\beta(0.75, 0.1)$	0.7824	*0.0926*	0.7671	*0.0937*	0.7646	*0.0961*	0.7366	*0.1020*
γ_W	$\beta(0.75, 0.1)$	0.6103	*0.1222*	0.5512	*0.1275*	0.5406	*0.1262*	0.5920	*0.1265*
ψ_H	$\Gamma(50, 15)$	56.1169	*14.6623*	33.1562	*10.8325*	28.6902	*8.9787*	28.8904	*8.7966*
ψ_F	$\Gamma(50, 15)$	57.0627	*14.9510*	44.5975	*12.7647*	55.4398	*14.1978*	48.6207	*13.3753*
ψ_W	$\Gamma(50, 15)$	6.3773	*1.6856*	11.3269	*2.6489*	8.7053	*1.9456*	9.8835	*2.5985*
Monetary policy									
ρ_r	$\beta(0.5, 0.15)$	0.7337	*0.0563*	0.6916	*0.0597*	0.4337	*0.0881*	0.4539	*0.0951*
ρ_π	$\Gamma(1.5, 0.5)$	1.9257	*0.4433*	1.3039	*0.2879*	2.3758	*0.4979*	2.5195	*0.5536*
ρ_Y	$\mathcal{N}(0.25, 0.1)$	0.2929	*0.1003*	0.3225	*0.0927*	0.2902	*0.0984*	0.3308	*0.0983*
$\rho_{\Delta Y}$	$\mathcal{N}(0.25, 0.1)$	0.2830	*0.0988*	0.2778	*0.0928*	0.2927	*0.0986*	0.2678	*0.0987*
ρ_e	$\mathcal{N}(0.25, 0.1)$	0.2820	*0.0849*	0.0977	*0.0659*	0.3030	*0.0803*	0.2023	*0.0754*

Table 1 Estimation results (parameters)

so the firms have better conditions in the negotiating process. However, even the highest value of the bargaining power parameter is far below our previous estimate for Hungary (0.9252). This is given mainly because of the different setting of the prior values. The parameter of elasticity of the matching function with respect to the job seekers ν increased in the Czech Republic and reached the level of Hungary, where it remained relatively stable. In both countries, the vacancy creation elasticity e decreased *after* the crisis. This decrease could be due to the firms effort to lower costs during the recession. However, the values are still far above our prior and suggest an increasing cost of creating an additional vacant job position. The backward looking price and wage parameters γ are more stable than the price and wage adjustment costs ψ. The backward looking domestic price γ_H is higher in Hungary and the backward looking wage parameter γ_W is lower. The backward looking foreign price γ_F is around the same value for the four estimations. This is given by the same foreign sector for both countries and the similar development of the exchange rates. There are significant differences in the adjustment parameters ψ in the Czech Republic between the two periods. The domestic ψ_H and foreign ψ_F price adjustment costs were almost the same *before* the crisis, while the wage setting cost ψ_W was much smaller. *After* the crisis, the price parameters decreased – the domestic more than the foreign – and the wage parameter increased. On the other hand, these parameters are unaffected by the crisis in the Hungarian economy, while the domestic price adjustment cost is much smaller in Hungary and the wage parameter is larger *before* and smaller *after* the recession than in the Czech Republic. The Taylor-rule parameters ρ imply relatively low volatility of the interest rates in the Czech Republic (interest rate smoothing parameter $\rho_r = 0.7$) and considerably higher fluctuations in Hungary, where $\rho_r = 0.4$. However, the weight of the inflation ρ_π in the monetary authority's decision making is relatively higher in Hungary.

Next, we focus on the shock decomposition of outputs presented in Figure 1 for the Czech economy and Figure 2 for Hungary. These two figures show, that in the period directly *before* the crisis, there were huge productivity shocks that pushed the product upwards. These shocks were also accompanied by high preference shocks, and foreign and labor market shocks (mainly the shock of disutility form work). Figure 1 shows the main cause in the output drop in 2008-09 in the Czech Republic to be the high negative foreign and preference shocks. This proves that the recession came to the Czech Republic from outside (in our case from the Euro area). The decrease of the product in 2012 is also caused mainly by the foreign shocks. On the other hand, the decline of Hungarian output in 2008-09 was caused by a combination of three shocks – shock of disutility form work, preference shock and foreign shocks. A positive shock of disutility form work caused the population to be less willing to work. This increased the unemployment and thus, reduced the output. This figure also shows an attempt of the monetary authority in the last eight quarters of the observed period to boost the output.

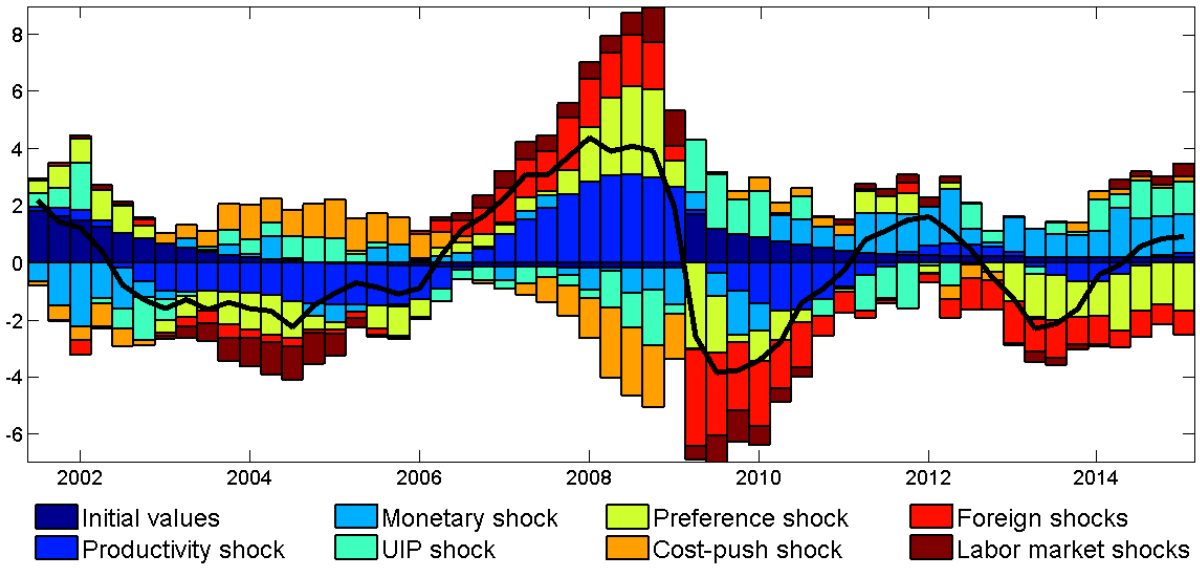

Figure 1 Shock decomposition of output for Czech Republic

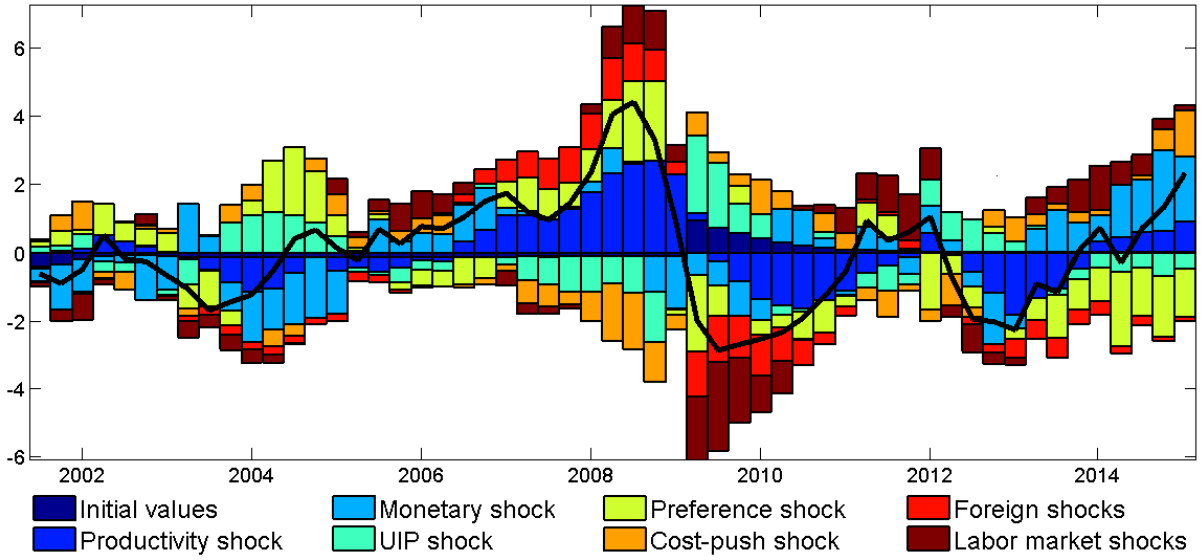

Figure 2 Shock decomposition of output for Hungary

5 Conclusion

In this paper we presented the estimation results of a small open economy DSGE model using the data of the Czech Republic and Hungary. The parameter estimates suggest that the structure of the Hungarian economy was affected less by the Great Recession than the Czech Republic. Also, we found significant rigidities present in both countries. The model provides a reasonable explanation to the causes of the output drop in both countries – in the Czech Republic it was caused mainly by the foreign and preference shocks, in the Hungarian economy by the disutility from work and preference shock.

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