

ESTIMATING POTENTIAL OUTPUT AND THE NATURAL RATE ON UNEMPLOYMENT: THE CASE OF THE EUROPEAN UNION

Pavel Tuleja¹, Michal Tvrdoň²

Silesian University, School of Business Administration, Univerzitni nam. 1934/3, 73340 Karvina, Czech Republic
Email:¹tuleja@opf.slu.cz; ²tvrdon@opf.slu.cz

Abstract. This paper studies the selected European Union Member States (Czech Republic, Hungary, Poland and Slovak Republic), during and after the economic crisis. Consequences on the labour market, respectively on unemployment are also discussed in the paper. During the crisis, real gross domestic product decreased in almost all EU countries. Massive drop of gross domestic product led to increase in the unemployment rate. The purpose of this paper is to contribute to discussion about consequences of this crisis. The paper provides also an analysis of gross domestic product and its components. The empirical analysis also tried to answer the question if it is more a return to steady-state than the deterioration of economic performance in the case of selected European countries. In other words, it means that economic performance was above the level of potential output. We applied the Hodrick-Prescott filter for estimation potential output and the natural rate of unemployment. This method is quite frequently used to filter the trend and the cyclical time series. Research in this study is based on basic macroeconomic quarterly data between the years 1997 and 2011 which were published by Eurostat.

Keywords: economic crisis, gross domestic product, potential output, unemployment rate, natural rate of unemployment.

Jel classification: C80, J60, O40

1. Introduction

The economies of the Czech Republic, the Slovak Republic and Hungary are characterized as a small open economy strongly dependent on foreign demand, especially German one. It generally displays a high degree of synchronization with other EU Member States. In the pre-crisis period, these economies benefited from flourishing external demand shifting real GDP above its long-term potential. This dependence on foreign markets seems to be the main cause of macroeconomic vulnerability. On the other hand, high productivity and industrial competitiveness, high investment attractiveness and financial reliability, low government debt and low private debt or EU membership are the main strengths of the Czech Republic and the Slovak Republic. In addition, the Polish economy is among the largest economies within the European Union. Hence, dependence on foreign trade is not as great as in the case of the Czech Republic, Hungary and the Slovak Republic. If we look at economic performance, after the initial drop of economic performance during the transition period, all these countries recorded significant economic growth which was interrupted by the global financial and economic crisis.

It is well known that the financial crisis had its origins in the United States of America (U.S.). As the crisis unfolded in the U.S., a number of countries' real economies suffered from a decreased U.S. consumer demand, and credit problems arising from the U.S. mortgage sector rapidly have permeated across nations, ensnaring financial institutions worldwide (Fernández and Nikolsko-Rzhevskyy (2010)). In the following months, problems of the financial sector gradually spilled-over to the real economy and had dragged the world economy in the painful economic crisis. However, the influence of the world economic crisis on the convergence process is questionable (for more detailed analysis see Rozmahel (2011)). These dramatic changes in economic performance have been the subject of debate among renowned world and domestic economists. Although conclusions from this discussion are well known, there are also currently some areas without unambiguous conclusion, and the labour market is just one of those areas. It is widely accepted relationship between phases of the business cycle and the number of unemployed despite of ambiguous empirical findings (see Tvrdoň and Verner 2011) – if the economy achieves growth, the unemployment rate will decrease (with some delay). On the contrary, if the economy is hit by the recession, the unemployment rate tends to increase

sharply. Thus, our fundamental question is: Has led the decline of economic performance followed by the rise in the unemployment rate to significant deterioration of labour market performance or simply the labour market is going to return to a state that could be called as a long-term equilibrium or steady-state? We used Eurostat quarterly data for our estimates.

The aim of this paper is to estimate potential output and the natural rate of unemployment. We also try to examine factors of economic performance in these economies in the context of the global economic crisis and we also discuss its effects on the labour market.

The paper is structured as follows. The next part deals with the causes and evolution of the global economic crisis and its consequences on selected EU countries. Third part is focused on estimation of potential output and its development. Fourth part refers to the real unemployment rate and the natural rate of unemployment and its estimation and the last section concludes our analysis.

2. Causes and evolution of the global economic crisis and its consequences on selected EU countries

Figure 1 illustrates development of the financial crisis - the financial crisis began in August 2007, when subprime-related turmoil in other asset classes finally spilled over into the currency market. This initial phase of the crisis was manifested in a major carry trade sell-off. Then in November 2007, credit restrictions were associated with a major deleveraging in financial markets and many investment funds were forced to liquidate positions (Melvin and Taylor 2009). The crisis fully developed after the collapse of Lehman Brothers in September 2008.

The causes of overheating of the U.S. credit market and a consequent global housing bubble, which peaked in the U.S. in 2006, are (Tomšík 2010): (i) excessive risk taking by private entities; (ii) new complicated financial products (securities); (iii) poor regulation and lax supervision of financial markets; (iv) government support for ownership housing for low-income population; (v) excess liquidity and very low FED interest rates. All these factors combined with fall in prices on the real estate market have led to expansion into to other segments of the financial sector and it was followed by nationalisations and takeovers of banks and insurance companies (Northern Rock, Fannie Mae and Freddie Mac, Merrill Lynch, Washington Mutual, Wachovia, and AIG). The financial crisis then spilled over into the real economy.

Consequences of the global economic crisis would be characterized as follows (Tomšík 2010): (i) sharp deterioration in the expectations of firms and households; (ii) increase of problems related to funding of business, production or investment; (iii) fall in production and foreign trade; (iv) firing employees; (v) reduction in consumption and investment.

The global recession was triggered by a severe financial crisis in key advanced economies that coincided with the freezing of global financial markets and the collapse in global trade flows. The intensification of the financial crisis in September 2008 caused an abrupt increase in uncertainty and led to a downward reassessment of wealth and income prospects (IMF 2009). The crisis had four features in common with other crises: 1) asset price increases that turned out to be unsustainable; 2) credit booms that led to excessive debt burdens; 3) build-up of marginal loans and systemic risk; and 4) the failure of regulation and supervision to keep up with and get ahead of the crisis when it erupted (Claessens et al. 2010).

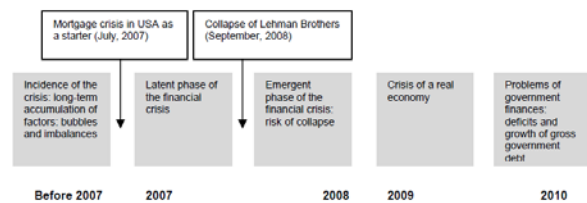


Fig.1. Phases of the crisis in advanced economies (Source: Singer 2010)

Some authors have even compared the contemporary global recession with the Great Depression: Eichengreen and O'Rourke (2009) found out that the decline in world industrial production in the first nine months was at least severe as in the nine months following the 1929 peak. Moreover, global stock markets and world trade were falling even faster now than in the Great Depression. Helbling (2009) stressed the need to distinguish between setting, initial conditions, transmission, and policy responses:

- U.S. as the epicentre of both crises;
- Both episodes were preceded by rapid credit expansion and financial innovation that led to high leverage. However, while the 1920s credit boom was largely US-specific, the 2004-2007 boom was global.
- Liquidity and funding problems have played a key role in the financial sector transmission in both episodes.
- Unlike in the Great Depression, when countercyclical policy responses were virtually absent, there has been a strong, swift recourse to

macroeconomic and financial sector policy support in the current crisis.

- Despite the stunning contraction of industrial production and trade across the globe in the second half of 2008, the global economy is still a far cry away from the calamities of the Great Depression.

While the crisis quickly resulted in deep recessions in a number of advanced economies, the emerging market and developing economies were also seriously affected but the impact varied across regions and countries (Claessens, Kose and Terrones 2010). Economic development is determined both by domestic (e.g. aggregate demand shocks and budgetary policy) and international factors (external demand and international prices of traded goods). In open economies, the latter are playing an increasingly important role and often determine also domestic policies, which are aimed at insulating the economy from adverse external economic shocks (Fidrmuc and Korhonen 2009). According to World Bank's Report (2010) governments face the challenges to secure the recovery, bring about fiscal consolidation, raise productivity, and generate jobs.

Looking at performance of the Visegrad group countries for the past fourteen years these economies kept relatively good pace of growth between the years 1997–2010 (Fig. 2). Hungarian economy grew at the slowest rate in the observed period; the average real GDP growth reached 2.5 %. The Hungarian economy was followed by the Czech economy with average real GDP growth rate of 2.8 %. Much faster growing economies were Poland and Slovakia with the average of 4.3 %, 4.2 % respectively. As the result, e.g. the volume of the Czech GDP increased by one third. According to Vintrová (2008) the main reasons of this development can be seen in accession into the EU and cultivation of the institutional framework which made these countries more attractive for foreign capital. Massive inflows of foreign direct investment have accelerated trade integration within the EU and promoted export-oriented economic growth.

As already written above, remarkable slower economic growth was reached in Hungary. This development was caused by unstable finances, large fiscal imbalances and high government debt. Given the size of fiscal imbalances, government had to raise state budget's revenues, e.g. hikes in employee social contributions, value-added tax and business taxation. The resulting squeeze on households' disposable incomes and businesses was damping demand (OECD 2007).

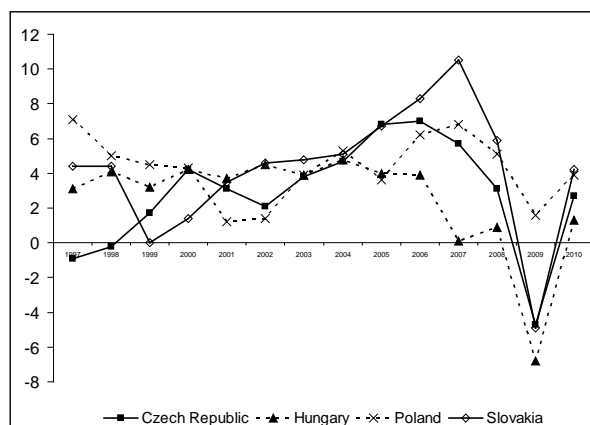


Fig.2. Real GDP growth rate (Source: Eurostat)

According to OECD (2008) main factors of significant economic growth in Poland were labour productivity and labour resource utilization. Labour market productivity has been underpinned by strong investment growth, financed in large part by foreign capital inflows.

Although these countries have made progress in closing the income gap and its GDP per capita relative to the EU-27 average, the difference with EU income levels remains wide.

3. Estimating potential output

We applied the Hodrick-Prescott filter (HP filter) for estimation potential GDP. This method is quite frequently used to filter the trend and the cyclical time series. To estimate potential output, it is necessary to have just the time series of real GDP (we applied Eurostat quarterly data of 1997-2011 time period). The only input parameter for the optimal filter, we have to specify, is an appropriate smoothing constant λ . It is defined as the ratio of dispersion of shock causing cyclical fluctuations and shocks affecting the growth trend (Hloušek and Polanský (2007)).

The filter is characterized by this formula (Hájek and Bezděk (2001)):

$$\text{Min} \left\{ \sum_{t=1}^T (\ln Y_t - \ln Y_t^*)^2 + \lambda \sum_{t=2}^{T-1} [(\ln Y_{t+1}^* - \ln Y_t^*) - (\ln Y_t^* - \ln Y_{t-1}^*)]^2 \right\} \quad (1)$$

where Y denotes the real output, Y^* is potential output, λ is a parameter determining the smoothness of the trend smoothing. For $\lambda = 0$ potential output is equal to real GDP, for $\lambda \rightarrow \infty$ the trend will be a straight line.

When choosing a value of smoothing constant λ , we then drew on generally accepted recommendations – experts consider optimal value 1600 for quarterly data and 100 for annual data (Rozmahel (2011), Gerlach and Yiu (2004), Zimková and Barochovský (2007) or Hájek and Bezděk (2001)).

As is evident from the data captured in before the crisis of the real economy, the Czech economy was in a relatively strong inflation gap (Fig. 3). According to Hájek and Mihola (2009) the decisive factor in the acceleration of economic growth was the total factor productivity. Total factor productivity is one of the important indicators of economic performance. At the macroeconomic level, it can be measured as the ratio between real GDP and aggregate input, which includes labour and capital (or other inputs). Its growth is the result of qualitative, i.e. the intensive factors of growth.

According to estimated data values of real output exceeded values of potential output, which clearly shows that the Czech economy used production factors with too much intensity during this period. It was untenable from the long-run view (Tuleja and Tvrdoň, 2011).

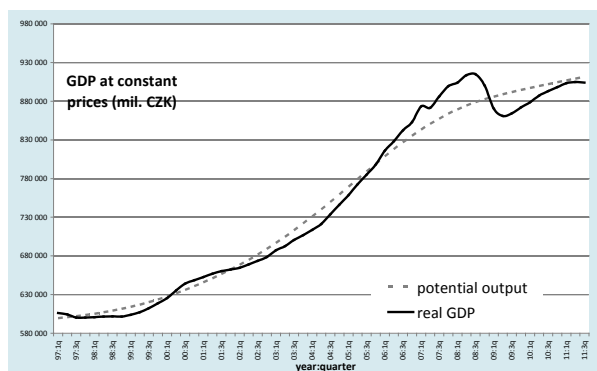


Fig.3. Potential and real output – Czech R. (Source: Eurostat)

Real GDP of the Hungarian economy remained below the level of potential GDP during the observed period. According to IMF (2011) potential growth declined in Hungary since mid-2000, while it accelerated in the other countries due to markedly different underlying trends in investment and employment growth. As an early reformer, Hungary benefited from strong productivity and capital stock growth in the pre-2000 period. Then, despite a temporary uptick in FDI inflows around EU accession in 2004, investment growth declined. Real GDP growth deteriorated relative to the rest of Europe starting early 2005. The divergence was accentuated in 2006, when GDP growth declined to 3.9 % just when much of Europe accelerated.

Similarly as in the case of the Czech economy, Hungarian economy started to show symptoms of overheating during 2007. After the economic recession during 2008-2010, Hungarian economy got closer to its potential (Fig. 4).

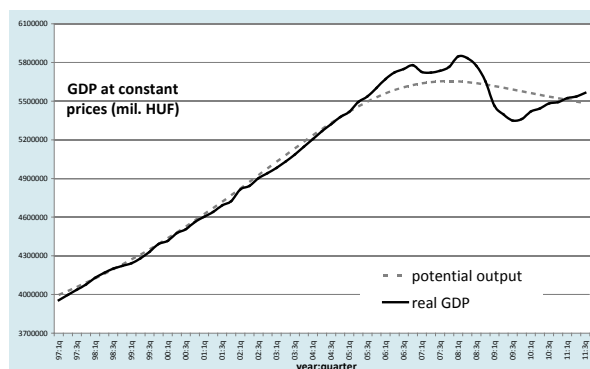


Fig.4. Potential and real output- Hungary (Source: Eurostat)

During the boom years preceding the recent financial crisis, Poland was growing above its potential (Fig. 5). Moreover, by disaggregating the contributions to potential growth, Epstein and Macchiarelli (2010) found that the pre-crisis decline in total factor productivity coincided with the deceleration in the growth of potential output. At the same time, the contribution of capital was steadily rising, suggesting that the rapid investment-led output expansion during that period was unsustainable.

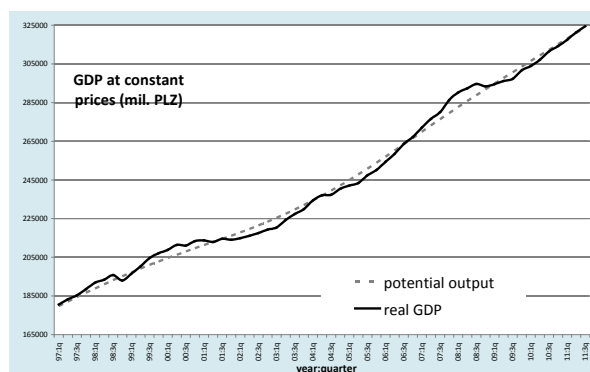


Fig.5. Potential and real output - Poland (Source: Eurostat)

The Slovak economy experienced a dynamic economic growth before the economic crisis. Massive growth was a result of economic reforms that attracted foreign direct investment and improved the functioning of the labor market. Horvath and Rusnak (2008) conclude that the fluctuations in Slovak output are mainly due to domestic factors and contribute to about 70% in the variation. This may reflect the positive role that Slovak economic reforms, which aimed to increase product and labor market flexibility, played for domestic economic growth. According to Konuki (2008) output gaps estimated by conventional methods show a large positive swing during 2006-2007. However, few signs of economic overheating have been observed yet.

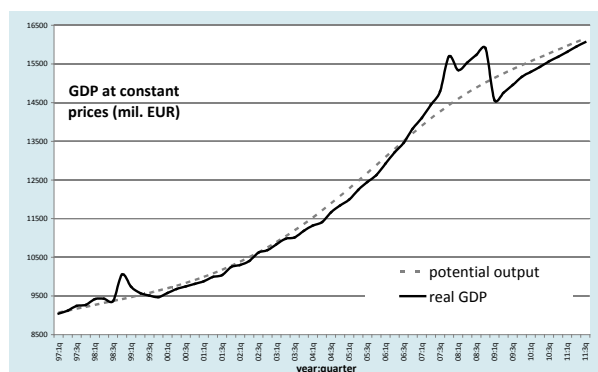


Fig.6. Potential and real output – Slovak R. (Source: Eurostat)

As seen from figures, all observed economies were hit by the economic crisis which led to drop potential outputs. Development was somewhat different in Poland, where the decline of potential output was not as big as in the other economies.

According to Šrámková (2010) three variants of the future development are possible:

- After a decrease of the potential output, its growth rate will recover in the medium-term. As a consequence, the loss on the potential output gradually evaporates.
- Potential output records a permanent short-fall, but the impact on the growth rate is only temporary. That said, it will follow with its past growth rates after some time. In this case, an impact of the crisis is measured as the cumulative loss on the potential output, which stabilizes in the long-term.
- The crisis has a permanent negative effect both on the level and the growth rate of the potential output. Hence, the cumulative loss on the potential output does not stabilize even in the long-term.

4. Estimating the natural rate of unemployment

The unemployment rate fluctuates consistent with phases of the business cycle in the most countries. In addition Abraham and Shimer (2001) mention that at the most of proceeded economic cycles it was proved rather strong correlation between the unemployment level and average duration of unemployment. Besides, there is an interesting fact that the persistence of unemployment did not decrease after the economic recession in such intensity as in the case of a decrease of the unemployment rate. OECD study (1993) even declares that long-term unemployment tends to grow for a year or two since the beginning of decreasing of unemployment and afterwards it starts to decline slowly. The fundamental question than is, which factors cause a delayed reaction of long-term unemployment (in the

sense of its decreasing) after subsiding of a shock. The study explains this phenomenon through the dynamics of the labour market, which is a function of speed recovery of the market, a degree of structural changes taking place in the economy. In addition it could be the setting of various government programmes assisting unemployed people and finally it is also the amount of previous short-term unemployed finding a new job.

In this context it should be noted that duration of unemployment may have a negative impact on a restoring macroeconomic equilibrium. Pissarides (1992) assumes existence of a negative shock which could have effect on employment – firms will be wary, based on uncertain expectations about future, and they will hire fewer workers. This will also prolong the duration of unemployment. If the long-term unemployed lose their knowledge and skills and thus they become less attractive for their potential employers, the results of this phenomenon will be that there will be created fewer jobs and the labour market becomes “tight” for the reason of a lower human capital brought by the labour force as the whole. With the number of offered jobs, which is lower than usually, it also increases duration of unemployment of the new group of unemployed above a trend level. This is the reason why the labour market remains tight in the future and even if all the labour force, which had been in the previous period (before the shock) unemployed, would have attained a job. The tight labour market leads to a greater lack of work, which causes maintenance of the tightness of the labour market. Thus the effects of a negative shock persist and if the externality is strong enough, than the economy can “get stuck” on the lower macroeconomic equilibrium level.

According to Blanchard and Katz (1996) the natural rate of unemployment is typically interpreted as the rate of unemployment consistent with constant (non-accelerating) inflation. Then the difference between the estimated natural rate of unemployment and the unemployment rate is unemployment gap. Any decline in aggregate demand will increase the actual rate of unemployment, while an expansion of aggregate demand will lower the actual rate of unemployment. However, in the long run, unemployment returns to the natural rate of unemployment (Snowdon and Vane 2005), in other words it means that the labour market is in steady-state. We again performed calculation using the HP filter on seasonally adjusted quarterly data as it was performed in da Silva Filho (2010).

Our calculations, which are captured in the following Figures 7, 8, 9 and 10 show that changes

of unemployment were determined by phases of the business cycle. We can find periods where the real unemployment rate was higher than the natural rate of unemployment and vice versa. In other words, it means that economy was in the recession gap when the real unemployment rate was higher than the natural one and vice versa. We can also see that development of both unemployment rates was synchronous with the development of real GDP and potential output. Figure 7 shows the development of the real and natural rate of unemployment in the Czech Republic. We can see two periods when the real unemployment was below the natural rate of unemployment. Moreover, this development was in accordance with the development of the real and potential output.

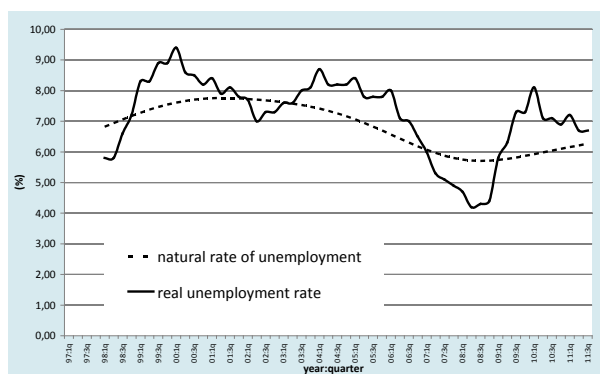


Fig.7. Real and natural rate of unemployment – Czech R. (Source: Eurostat)

Hungary is the only economy with the diverse development. Both the natural rate of unemployment and the unemployment rate remarkable rose from 2003 (Fig. 8). This was due to internal economic problems of Hungary rather than the global economic crisis.

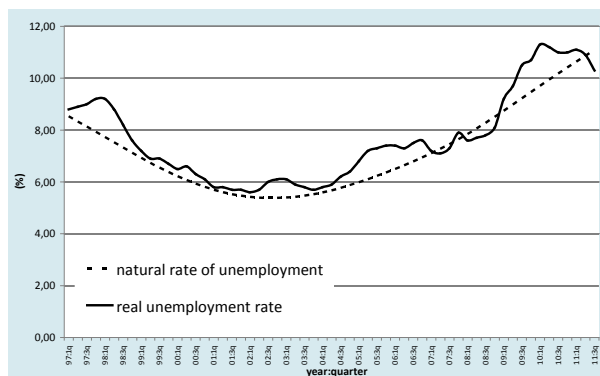


Fig.8. Real and natural rate of unemployment – Hungary (Source: Eurostat)

As seen from the Figures 9 and 10. The highest rates of unemployments were reached in Poland and the Slovak Republic. In addition, both the real and natural rate of unemployment were significantly decreasing before the economic crisis.

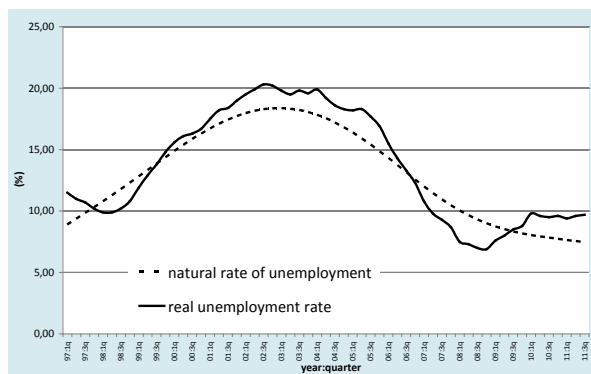


Fig.9. Real and natural rate of unemployment – Poland (Source: Eurostat)

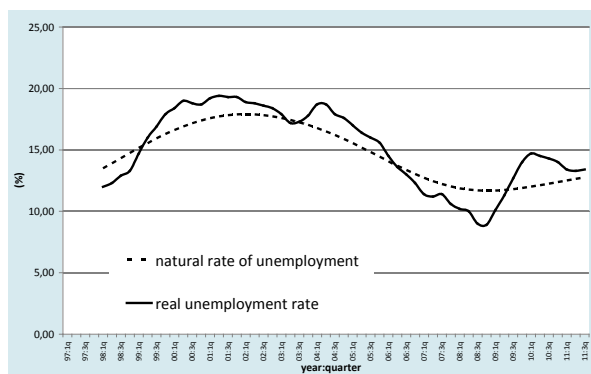


Fig.10. Real and natural rate of unemployment – Slovak R. (Source: Eurostat)

5. Conclusions

The aim of this paper was to estimate potential output and the natural rate of unemployment and their comparison with real indicators in the selected EU economies. We also tried to examine the global economic crisis and its effects on the labour market during the period 1997–2011. We also tried to contribute to discussion about consequences of this crisis. The paper provides also an analysis of gross domestic product and its components. The empirical analysis also tried to answer the question if it is more a return to steady-state than the deterioration of economic performance in the case of these countries. In other words, it means that economic performance of the Czech, Hungarian, Polish and Slovakian economies was above the level of potential output. We applied the Hodrick-Prescott filter (HP filter) for estimation potential GDP as well as the natural rate of unemployment. This method is quite frequently used to filter the trend and the cyclical time series.

Research in this study is based on basic macroeconomic quarterly data between the years 1997 and 2011 which were published by Eurostat. As is evident from the data captured in before the crisis of the real economy, all economies were in a relatively strong inflation gap. We argue that the de-

cline of economic performance directed labour markets in these economies on the road to return to a state of long-term equilibrium. This argumentation may seem at least controversial, but if we look at the situation before the outbreak of the economic crisis, then we can see that these economies were in a relatively strong expansion and it was found in the inflation gap (real GDP exceeded potential output). This resulted in usage the production factors (especially labour) with the too much intensity, and it was untenable in the long-run view. We found out the difference between the estimated natural rate of unemployment and the unemployment rate which is called an unemployment gap. During the last period, it has begun to show a significant discrepancy between quantity of labour supply and labour demand, which consequently resulted in a relatively sharp rise in the unemployment rate in these countries.

Acknowledgement

The research behind this paper was supported by the Czech Science Foundation within the project GAČR 402/09/P142 “Institutional labor market framework in the context of economic convergence and adopting single currency (application on Visegrad group countries)”.

References

- Abraham, K. G.; Shimer, R. 2001. *Changes in Unemployment Duration and Labor Force Attachment*. NBER Working Paper No. 8513. [online] [cit. 2011-01-19] Available from <http://www.nber.org/papers/w8513>
- Blanchard, O.; Katz, L. F. 1996. *What we know and do not know about the natural rate of unemployment*. NBER Working Paper No. 5822 [online] [cit.2011-04-20] Available from <http://www.nber.org/papers/w5822>
- Claessens, S.; Kose, A.,M.; Terrones, M.E. 2010. The global financial crisis: How similar? How different? How costly? *Journal of Asian Economics* 21(3): 247-264. <http://dx.doi.org/10.1016/j.asieco.2010.02.002>
- Claessens, S.; Dell’Ariccia, G.; Igan, D.; Laeven, L. 2010. *Lessons and Policy Implications from the Global Financial Crisis*. IMF Working paper WP/10/44 [online][cit. 2010/06/17] Available from <http://www.imf.org/external/pubs/ft/wp/2010/wp1044.pdf>
- Crotty, J. 2009. Structural causes of the global financial crisis: a critical assessment of the ‘new financial architecture’, *Cambridge Journal of Economics* 33(4): 563-580. <http://dx.doi.org/10.1093/cje/bep023>
- Eichengreen, B.; O’Rourke, K., H. 2009. *A tale of Two Depressions*. *Advisor Perspectives*. [online][cit. 2010/03/20] Available from http://www.advisorperspectives.com/newsletters09/pdfs/A_Tale_of_Two_Depressions.pdf
- Epstein, N.; Macchiarelli, C. 2010. Estimating Poland’s Potential Output: A Production Function Approach. IMF Working Paper 10/15.
- Fernandez, A.,Z.; Nikolsko-Rzhevskyy, A. 2010. The changing nature of the U.S. economic influence in the World, *Journal of Policy Modeling* 32(2): 196-209. <http://dx.doi.org/10.1016/j.jpolmod.2010.02.002>
- Fidrmuc, J.; Korhonen, I. 2010. The impact of the global financial crisis on business cycles in Asian emerging economies, *Journal of Asian Economics* 21(3): 293-303. <http://dx.doi.org/10.1016/j.asieco.2009.07.007>
- Gerlach, S.; Yiun, M., S., 2004. Estimating output gaps in Asia: A cross-country study. *Journal of Japanese and International Economics* 18(1): 115-136. [http://dx.doi.org/10.1016/S0889-1583\(03\)00033-9](http://dx.doi.org/10.1016/S0889-1583(03)00033-9)
- Guichard, S.; Rusticelli, E. 2010. *Assessing the Impact of the Financial Crisis on Structural Unemployment in OECD Countries*. OECD Economics Department Working Papers, No. 767, 22 p.
- Hájek, M.; Mihola, J. 2009. Analýza vlivu souhrnné produktivity faktorů na ekonomický růst České ekonomiky (Analysis of total factor productivity contribution to economic growth of the Czech Republic, *Politická ekonomie* 57(6): 740-753.
- Hájek, M.; Bezděk, V., 2001. Odhad potenciálního produktu a produkční mezery v České republice (Estimate of potential output and output gap in the Czech Republic), *Politická ekonomie* 50(4): 473–491.
- Helbling, T. 2009. *How similar is the current crisis to the Great Depression?* [online] [cit. 2010/05/20] Available from <http://www.voxeu.org/index.php?q=node/3514>
- Hloušek, M.; Polanský, J., 2007. Produkční přístup k odhadu potenciálního produktu – aplikace pro ČR (Production approach to estimation of potential output – application on the Czech Republic), *Národohospodářský obzor* 7(4): 3–12.
- Horvath, R.; Rusnák, M. 2008. *How Important are Foreign Shocks in Small Open Economy? The Case of Slovakia*. William Davidson Institute Working Papers, WP 933. 15p.
- IMF. 2011. Hungary: Staff Report for the 2010 Article IV Consultation and Proposal for Post-Program Monitoring. 46 p.
- IMF. 2010. Czech Republic: Staff Report for the 2010 Article IV Consultation. IMF Country Report No. 10/60. [online] [cit. 2010/05/14] Available from <http://www.imf.org/external/pubs/ft/scr/2010/cr1060.pdf>
- Konuki, T. 2008. Estimating Potential Output and the Output Gap in Slovakia. IMF Working Paper 08/275. 22 p. <http://dx.doi.org/10.1016/j.jimonfin.2009.08.006>

- Melvin, M.; Taylor, M. P. 2009. The crisis in the foreign exchange market. *Journal of International Money and Finance* 28(8): 1317-1330.
- OECD. 1993. OECD Employment Outlook 1993. 214 p.
- OECD. 2007. OECD Economic Surveys: Hungary. Paris: OECD. 127 p.
- OECD. 2008. OECD Economic Surveys: Poland. Paris: OECD. 166 p.
- Pissarides, Ch.A. 1992. Loss of Skills During Unemployment and the Persistence of Employment Shocks, *The Quarterly Journal of Economics* 107(4): 1371-1391.
<http://dx.doi.org/10.2307/2118392>
- Rozmahel, P., 2011. Measuring the business cycles similarity and convergence trends in the Central and Eastern European Countries towards the Eurozone with respect to some unclear methodological aspects, *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* 59(2): 237-250.
- SilvaFilho da, T., N., T., 2010. *The Natural Rate of Unemployment in Brazil, Chile, Colombia and Venezuela: some results and challenges*. Banco Central do Brasil Working Paper Series No.212. [online] [cit.2011/04/12] Available from <http://www.bcb.gov.br/pec/wps/ingl/wps212.pdf>
- Singer, M. 2010. Hospodářská krize a česká ekonomika (Economic Crisis and the Czech Economy). [online] [cit.2010/06/22] Available from http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/verejnost/pro_media/konference_projevy/vystoupeni_projevy/download/singer_20100614_vse.pdf
- Snowdon, B.; Vane, H. R. 2005. *Modern Macroeconomics*. Cheltenham: Edward Elgar.
- Šrámková, L. 2010. Output gap and NAIRU Estimates within State-Space Framework: An Application to Slovakia. Ministry of Finance of the Slovak Republic, Economic Analysis 16.31 p.
- Tomšík, V. 2010. *Reakce měnové politiky ČNB na hospodářskou krizi*. [online] [cit.2010/06/20] Available from http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/verejnost/pro_media/konference_projevy/vystoupeni_projevy/download/tomsik_20100612_dod.pdf
- Tuleja, P.; Tvrdoň, M. 2011. The Czech Labour Market after the Crisis of a Real Economy: Negative Development or Return to Steady-State? *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* 59(7): 477-488.
- Tvrdoň, M.; Verner, T. 2011. Examining the Relationship between Economic Performance and Unemployment: the Case of Visegrad Countries. In Proceedings of the 29th International Conference on Mathematical Methods in Economics. Vol. II, Pp. 733-738. Prague: University of Economics.
- Vintrová, R., 2008. Česká a slovenská ekonomika 15 let porozdělení (Czech and Slovak economies 15 years after separation). *Politická ekonomie*, 56 (4): 449-466.
- World Bank. 2009. EU10 Regular Economic Report: From Stabilization to Recovery. [online] [cit. 2010/06/10] Available from http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/11/04/000333038_20091104015559/Rendered/PDF/514240NEWS0v1010Box342028B01PUBLIC1.pdf
- Zimková, E.; Barochovský, J. 2007. Odhad potenciálního produktu a produkčnej medzery v slovenských podmienkach (Estimation of potential product and output gap in Slovak condition). *Politická ekonomie* 55(4): 473-489.