



## LABOUR MARKET PERFORMANCE AND DECOMPOSITION OF UNEMPLOYMENT: THE CASE OF VISEGRAD GROUP COUNTRIES

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**Abstract.** Generally, economic performance declines and the unemployment rate rises during the economic crisis. This relationship was confirmed in the past several crises. Last crisis was during 2008 and 2009. The aim of the paper is to estimate output gap and to decompose the unemployment rate. We can decompose unemployment into several components – seasonal, cyclical and structural. We focused on Visegrad Group countries (Czech Republic, Hungary, Poland and Slovakia). Quarterly data from the Eurostat database in the period between 2000 and 2012 were applied. In order to estimate the trend of the unemployment rate's development was used Hodrick-Prescott filter. Data show that all observed economies recorded a low unemployment rate in a pre-crisis period and they had to face worsened labour market performance during and after the crisis. Our results suggest that structural component seems to be the most important component of unemployment. However, it has decreased in these countries, except Hungary.

**Keywords:** Hodrick-Prescott filter; labour market, NAIRU; output gap; regional disparities, structural unemployment, Visegrad group.

**JEL classification:** C82, J64.

### 1. Introduction

In labour economics, unemployment is seen as a phenomenon when there is a market surplus of supplied amount of labour in the market. In other words, unemployment occurs when a person who is actively searching for employment is unable to find a job. Unemployment is often used as a measure of health of the economy. The most often used measure of unemployment is the unemployment rate. This is usually the number of unemployed persons that are actively searching for employment divided by the number of people in the labour force.

However, the problem of unemployment is very complex because there are numerous ways how to decompose it (e. g. voluntary vs. involuntary; short-term vs. long-term). According to C. McConnell and S. M. Brue (2009) the overall rate of unemployment does not distinguish between the labour force who are experiencing short unemployment spells and those who are going through long periods of unemployment. In these boundaries, we have to look at this phenomenon as movements of the labour force between categories of labour force statute such as population not in the labour force, unemployed or employed labour force. There is a measurable

stock of people in each of these three categories. But these stocks are simultaneously being depleted and replenished by numerous flows into and out of each category. Changes in these rates of these flows can significantly affect the unemployment rate.

In the context of this paper, it is important to distinguish between three essential types of unemployment: (i) frictional unemployment; (ii) cyclical unemployment; and (iii) structural unemployment. The first one is related to situation that not all active job searchers will have yet found or accepted employment, and not all employers will have yet filled their job vacancies. This type of unemployment consists of search unemployment and wait unemployment. The second one is given by cyclical changes in economic performance. It contributes to decreasing in overall unemployment during the period of economic growth and to its increasing during the period of economic downturns. The last one is part of a national natural rate of unemployment which is associated with economic performance at the level of potential product; or in other words unemployment rate that persist regardless of the rate of inflation. Structural and frictional unemployment are usually considered among unpleasant and exogenous facts of economic life

about which little can be done. As demand and supply changes, employment must also shift.

As written above, there is no doubt that the business cycle influences unemployment. However, the impact of economic downturns on structural unemployment will depend on many factors. By weakening the labour market situation, economic downturns can lead to an increase in structural unemployment; through hysteresis effects whereby the path of actual unemployment influences structural unemployment (see Furceri and Mourougane, 2009). The level of structural unemployment reflects many different aspects, i.e. the wage bargaining system, the unemployment benefit system including eligibility and availability rules, tax rates, the scale and character of active labour market measures, hiring and firing rules, the educational composition of the labour force, the intensity of product market competition, etc.

The paper is structured as follows: (i) in the first part, the paper deals with theoretical-methodological background; (ii) the second part focused on empirical results - we estimate and compare output gaps and structural unemployment among the Visegrad group countries; and the last part concludes.

## 2. Theoretical background

The concept of structural unemployment is related to the fact, that the rate of inflation can be high - and increasing - even though the rate of unemployment is relatively high. Structural unemployment might be defined as the level of unemployment compatible with stable inflation in a medium-term perspective. This definition implies that macroeconomic policy cannot permanently reduce unemployment below the structural level. This somewhat pragmatic definition of structural unemployment is not synonymous with the theoretical term NAIRU (non-accelerating inflation rate of unemployment), although closely related (Gersing, 1997). There is much confusion and disagreement among economists concerning the definitions of the natural rate of unemployment and the NAIRU. For some economists these two terms are interchangeable. However, recent studies indicated that the term NAIRU and natural rate of unemployment are not substitutable (Claar 2005).

The concept of the natural rate of unemployment (NRU) represents the hypothetical unemployment rate consistent with aggregate production being at the "long-run" level. This level is consistent with aggregate production in the absence of various temporary frictions such as incomplete price adjustment in labour and goods markets. The natural rate of unemployment there-

fore corresponds to the unemployment rate prevailing under a classical view of determination of activity. It is mainly determined by the economy's supply side, and hence production possibilities and economic institutions. If these institutional features involve permanent mismatches in the labour market or real wage rigidities, the natural rate of unemployment may feature involuntary unemployment.

Romer (2005) argues that the development of the theory of the natural rate of unemployment came in the 1960s where economists observed that the Phillips-curve relationship between inflation and unemployment began to break down. Until then, it was widely believed that a stable negative relation between inflation and unemployment existed. This belief had the policy implication that unemployment could be permanently reduced by expansive demand policy and thus higher inflation. Nevertheless, if we look at the original Friedman's paper (1968) we do not find a clear, well-defined characterization of this concept, but rather description of some features that it should have. This resulted in the hysteresis hypothesis, which states that cyclical fluctuations in the labour market might affect the unemployment rate permanently and might lead to a long-term persistence. This means that the unemployment should be an integrated process (see Gomes and Silva, 2009).

According to Weiner (1993) when the economy is at the natural rate of unemployment, inflation tends to be constant from one year to the next. Individuals come to expect this inflation rate and base their decisions on it. Any attempt to use monetary or fiscal policy to reduce unemployment below the natural rate of unemployment ultimately results in higher inflation. Under such a scenario, aggregate demand increases, prices rise, but wages initially lag behind. As a result, firms have an incentive to hire more workers to produce more output and the unemployment rate declines. The decline in unemployment is temporary, however, because workers eventually demand higher wages. The increase in inflation, in contrast, is permanent. The central bank can set the inflation or the economic cycle. If the central bank follows the inflation variability, the society must tolerate the output gap variability. On the other side central bank can set the economic cycle goal. It means the central bank minimises the output gap variability (for more detailed analysis see Kotlán, 2001).

The OECD distinguishes between a long-run structural rate of unemployment (NRU), corresponding to Friedman's original natural rate, determined by economic fundamentals, and the non-accelerating inflation rate of unemployment (NAIRU) as a short-run phenomenon. The latter

may differ from the NRU, when structural or demand shocks occur. In general, the NAIRU is considered an extension of Friedman's natural rate when labour markets are not competitive and most of the literature overlaps the two concepts (Chiarini and Piselli, 2001).

We understand structural unemployment something between pure short-run and long-run NAIRU depending on the changes in actual unemployment. Structural unemployment is a form of unemployment where, at a given wage, the quantity of labor supplied exceeds the quantity of labor demanded, because there is a fundamental mismatch between the number of people who want to work and the number of jobs that are available. According to Gersing (1997) if actual unemployment equals the structural rate and if unemployment has been constant for some time, inflation will be (approximately) constant, whereas a reduction in unemployment below the structural level will give rise to steadily increasing – or at least unsustainably high – inflation. According to Herz and Rens (2011) there are four sources of structural unemployment in the model. Each segment of the labour market is characterized by four variables: the job finding rate, which measures how hard it is for workers to find a job; the worker finding rate, which measures how hard it is for firms to find a worker; workers' surplus from having a job over being unemployed; and firms surplus of having filled position over a vacancy. In the absence of adjustment costs, worker mobility, job mobility and wage adjustment lead to equalization of labour market conditions across segments. Worker and job mobility costs, wage bargaining costs and heterogeneity in matching efficiency generate dispersion in labour market conditions and therefore structural unemployment.

We can find three basic estimation groups of methods how to estimate structural component of unemployment: (i) structural method; (ii) statistical method; (iii) the reduced-form method. The first group is based on modelling aggregate wage and price setting behaviour in structural form. However, according to Turner *et al.* (2001) the derived measure of equilibrium unemployment corresponds more closely to a measure of the long-run equilibrium rate of unemployment rather than the NAIRU which commonly appears in reduced-form Phillips curve specifications. Moreover, another problem which is associated with this method is considerable difficulty in quantifying many of the relevant institutional variables (employment protection legislation, unemployment benefits or the degree of unionisation). The second group involved purely statistical

methods that concentrate on the actual unemployment rate and its split into structural (NAIRU) and cyclical components. According to Turner *et al.* (2001) the assumption behind these approaches is that, since there is no long-term trade-off between inflation and unemployment. The third approach is based on the expectation-augmented Phillips curve. This approach has the major advantage of being directly related to the definition of the NAIRU.

One of the purely statistical methods is filtering using the Hodrick-Prescott filter. This method attempts to estimate the NAIRU using purely statistical technique to directly split the not seasonally adjusted unemployment rate into cyclical and trend components, with the latter identified as the NAIRU. To estimate structural component of unemployment, it is necessary to have just the time series of the unemployment rate – in our case the seasonally not adjusted unemployment rate. Quarterly data between the years 2000 and 2012 (52 observations) obtained from Eurostat database were applied. The standard ANOVA (analysis of variance) was carried out in order to determine the presence of quarterly seasonality in the unemployment rates series. Unemployment rates usually exhibit significant seasonality. There are several methods and techniques to adjust time series, e.g. Census X12 and TRAMO/SEATS. The first program is produced and widely used by the U.S. Census Bureau. TRAMO (Time series regression with ARIMA noise missing observations and outliers) and SEATS (Signal extraction in ARIMA time series), was developed by Gómez and Maravall (1996). For more details to seasonal adjustment and TRAMO/SEATS method see Gómez and Maravall (1998). TRAMO preadjust the series to be adjusted by SEATS Maravall and Sánchez (2000). Both of them are officially used by Eurostat and Czech statistical office. Hence this method was applied to seasonal adjustment.

We applied the Hodrick-Prescott filter (HP filter) for estimation structural component of unemployment. We used methodology which can be found in Němec (2008), Tasci (2012), Tvrdon, Tuleja and Verner (2012) and da Silvia Filho (2010). This method is quite frequently used to filter the trend and the cyclical time series. The only input parameter for the optimal filter, we have to specify, is an appropriate smoothing constant  $\lambda$ . It is defined as the ratio of dispersion of shock causing cyclical fluctuations and shocks affecting the growth trend Hlousek and Polanský (2007).

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

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

where:

U denotes the seasonally adjusted unemployment rate,

U\* is the trend component of unemployment,

$\lambda$  is a parameter determining the smoothness of the trend smoothing. For  $\lambda = 0$  the natural rate of unemployment is equal to the real unemployment rate, for  $\lambda \rightarrow \infty$  the trend will be a straight line.

When choosing a value of smoothing constant  $\lambda$ , we then drew on generally accepted recommendations – experts consider optimal value 14400 for monthly data, 1600 for quarterly data and 100 for annual data (Rozmahel (2011), Gerlach and Yiu (2004), Zimkova and Barochovský (2007) or Hájek and Bezděk (2001)).

When we had adjusted time series, we applied the Hodrick-Prescott filter to identification a trend component of unemployment. The difference between the estimated trend and the original seasonally adjusted time series represents the cyclical component of unemployment (when you turn the sign). Structural unemployment, we subsequently computed as part of the residual of the total rate after deducting seasonal and cyclical components. The disadvantage of this method of estimation using the HP filter represents, according to Hajek and Bezdek (2001), the fact that the results are mainly at the end of the series somewhat skewed. In other words, it means that they tend to be least reliable at the end of the sample. However, adding a few data of forecasts to the end of the data sample has become standard practice.

### 3. Empirical results

Visegrad group economies (V-4) recorded relatively decent economic growth in the years 2000 to 2011. The slowest growing economy was Hungary with the average growth rate of 2.1% in the observed period. The Czech economy's average economic growth amounted to 3.3% per year. Polish economy grew on average by 4.0% per year and the most successful country in terms of real GDP growth posed Slovakia with the average growth rate of 4.4%. According to Vintrová (2008) this development can be explained by accession to the EU and cultivating institutional framework of the economy. These two factors helped to make these countries as an attractive destination for foreign capital. The massive inflow of foreign direct investments subsequently accelerated trade integration within the EU and among other things

economic growth driven by exports. Although these countries grew faster than the euro area countries, their level of real GDP per capita in purchase parity standards (PPS) still lagged behind.

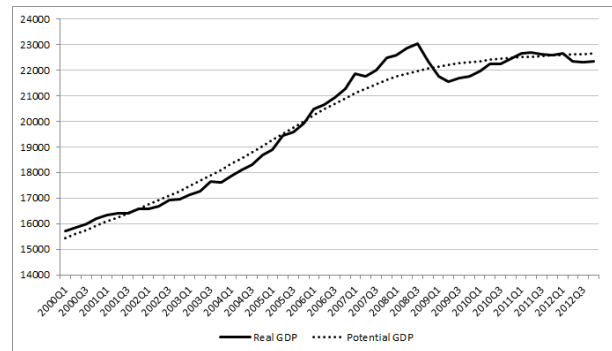


Fig. 1. Output gap: Czech Republic (source: Eurostat)

Based on our estimated values of the output gap, we conclude that before the outbreak of the economic crisis, the Czech economy was in a significant expansion, which peaked in 2008Q2. Therefore, we presumed that factors of production were used with too much intensity before the "spill-over" of the crisis into the Czech economy.

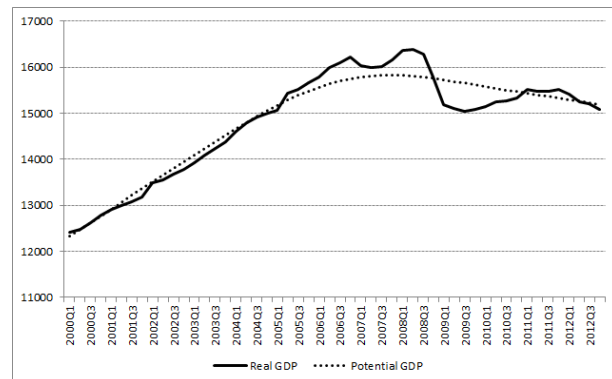


Fig. 2. Output gap: Hungary (source: Eurostat)

The real product of the Hungarian economy was below potential output for most of the period. It should be noted, however, that the negative output gap was not large. The growth rate of the Hungarian potential product was not as dynamic from mid-2000 as it was in previous years. In contrast, growth rate had accelerated in other countries, mainly due to different trends in investment and employment growth. Moreover, real GDP growth deteriorated in comparison with rest of Visegrad group. Divergence acquired its peak in 2006, when real GDP growth fell to 3.9% at a time when most countries in the EU has accelerated their economic performance. The Hungarian economy showed signs of overheating at the beginning of 2008 (see Fig. 2), which can prove the existence of a positive output gap (it amounted to 3.3% in 2008Q1). The

deep slump in economic performance as the impact of the economic recession in Western Europe also befell the Hungarian economy.

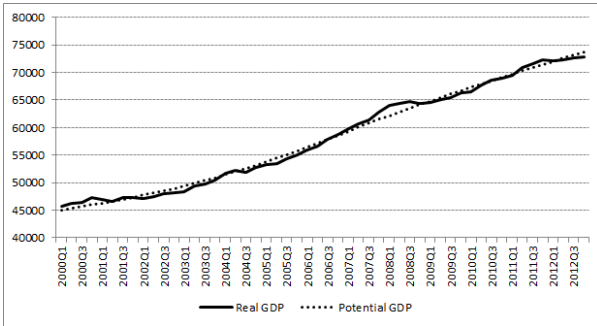


Fig. 3. Output gap: Poland (source: Eurostat)

Same as other selected economies, in the case of Polish economy, there were two periods when this economy found itself in a positive output gap. The main factors of significant economic growth were increasing labor productivity and better use of labour. Labour productivity growth was supported by strong investment, which was financed largely by capital that flowed into the country from abroad (see OECD 2008). Looking at the negative output gap, we can see that it did not reach such proportions compared to the remaining economies of the Visegrad group (Fig. 3). This can be mainly attributed to the size of the Polish economy, which is by far the largest of the countries and it is not so dependent on foreign demand, as other countries V-4.

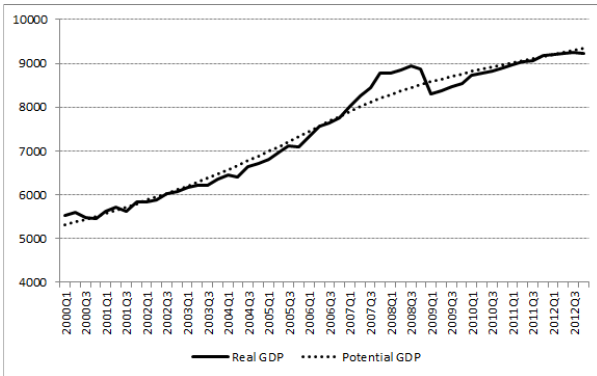


Fig. 4. Output gap: Slovakia (source: Eurostat)

Slovak economy recorded most distinct economic growth before the crisis of the real economy. Significant economic growth in this period can be explained by undertaken economic reforms that have attracted foreign direct investment and improved the functioning of the labor market. Horváth and Rusnak (2008) concluded that the variations in Slovak economic performance were mainly due to domestic factors that contributed to these fluctuations of approximately

70%. This may reflect the positive role of Slovak economic reforms, which aimed to increase the efficiency of the economy and labour market flexibility. According to Konuki (2008) estimations of output gap show a rapid shift of the economy to a positive output gap in 2006-2007. However, some signs of overheating were observed in this period.

Development of the Czech labour market shows Figure 5. The initial quarter (1Q2000) was characterized by the high unemployment rate and low level of unfilled jobs. The figure shows that the Czech labour market has undergone four cyclical changes during the observed period. The first positive cyclical influence on the total unemployment rate occurred between 2001Q1 and 2003Q1, the second one occurred from 2007Q1 to 2009Q1. The fundamental difference between these two cycles consisted of dynamics. While in the first cycle, shifts were minor, there were significant shifts during the second cycle (Fig. 2) Moreover, latter one was caused by significant economic growth during this period. Each cycle started by gradual improvement of labour market performance. This trend was reflected by reducing unemployment and raising the number of unfilled jobs. In the next phase, after reaching the summit, unemployment started to grow and the number of unfilled jobs started to decline as the consequences of the economic crisis. These phases of business cycle were seen during 2003Q3 and 2006Q3 and the second period lasted between 2009Q3 and 2010Q2. If we look at the estimated structural unemployment rate we can see that it was decreasing over time. However, this movement seems to be insignificant. If we look at the pre-crisis period, we can see that the main source of a decrease in total unemployment rate were changes in cyclical unemployment. In addition, the most important component of unemployment seems to be structural unemployment as seen from the Fig. 5.

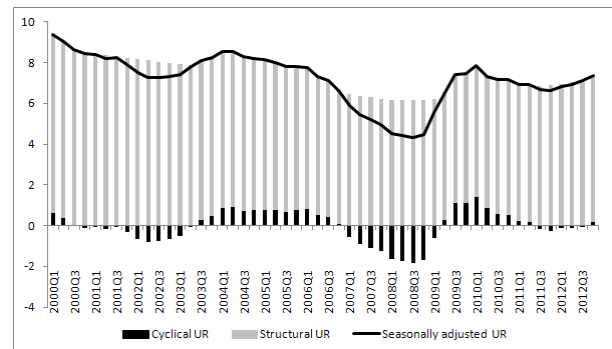


Fig. 5. Decomposition of unemployment: Czech Republic (source: Eurostat)

As well as others Visegrad group countries Hungary was remarkably affected by the global crisis, although the development was different due to problems of internal nature. The Hungarian labour market can be described as rigid, though some shifts occurred during the observed period. In the first half of the observed period (until 2004), the unemployment rate was quite stable and stayed at a relatively low level. Since 2004, however, the rate of unemployment has increased and the rate of unfilled jobs has decline. Unlike other V-4 countries the subsequent development of the labour market was affected by the problems with which the economy struggled. As shown in Fig. 6, the unemployment rate has increased continuously since 2008Q1, even labour market performance significantly improved in the other V-4 countries. This insufficient labour market development was influenced by bad economic situation in the country which 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. Unlike other Visegrad group countries estimated structural unemployment rate increased during observed period (see Fig. 6). Moreover, cyclical component of unemployment did not have so significant effect on total unemployment.

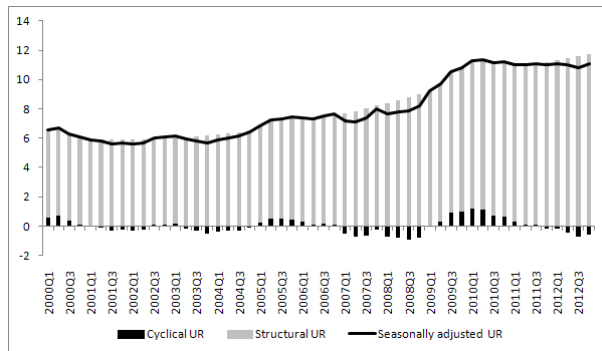


Fig. 6. Decomposition of unemployment: Hungary (source: Eurostat)

Polish labour market performance was worsening by increasing the unemployment rate to beyond 20% accompanied by the low rate of unfilled jobs in the first four years (see Fig. 7). It has started to improve since 2004 - the unemployment rate gradually declined to a historically low rate of 7% before the economic crisis. Poland has had the highest real GDP growth since 2007 among the Visegrad group and even the whole EU. According to OECD (2012) this strong performance can be explained by substantial inflows

of EU funds (which have contributed to modernising transport infrastructure), stimulus from domestic macroeconomic policies (through 2010), exchange-rate depreciation and effective prudential regulation of the comparatively solid financial system. Certain signs of overheating were recorded in 2008 - this is in line with the empirical evidence that the actual unemployment rate fell below the structural unemployment rate (Fig. 7). Though, like the rest of V-4 countries or other EU countries the unemployment rate started to increase again since the second half of 2008.

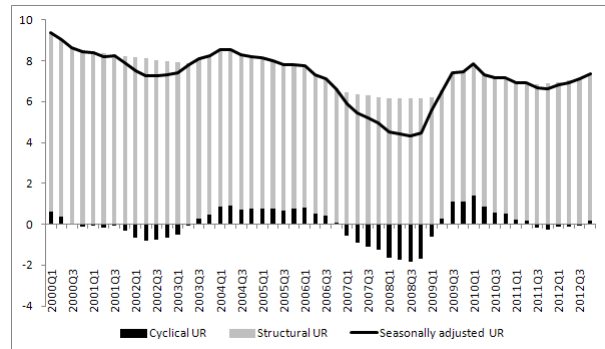
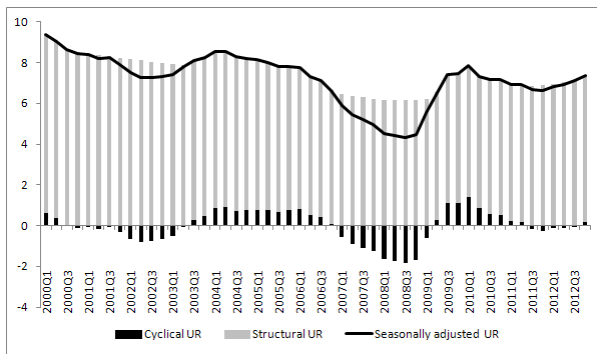


Fig. 7. Decomposition of unemployment: Poland (source: Eurostat)

Figure 8 shows labour market development in the Slovak Republic. The initial characteristics of the Slovakia labour market were similar to the Polish labour market – the high unemployment rate and a small number of unfilled job vacancies. An improvement of business environment, restructuring in banking sector and structural reforms (tax, social and labour market reforms) attracted new greenfield FDIs, which boosted the potential growth of the economy as of 2004 (Sramkova 2010). The unemployment rate was decreasing significantly during the pre-crisis period. As in the Czech Republic and Poland we can see that negative cyclical unemployment was the main source of this development. Estimates in Tvrdon, Tuleja and Verner (2012) suggest that there was an overheating in 2008. This is in line with the empirical evidence that the actual unemployment rate fell below the structural unemployment rate (see Fig. 8). However, the Slovak labour market was influenced by the economic recession - the unemployment rate increased remarkably and this increase was among the EU countries with the highest shift. According to Fidrmuc *et al.* (2013) euro adoption changed the composition of drivers of growth dramatically. Disinflation, enforced by the large output gap and increased unemployment, contributed to wage moderation and imposed a cap on job-rich domestic demand growth.



**Fig. 8.** Decomposition of unemployment: Slovakia (source: Eurostat)

#### 4. Conclusions

The aim of the paper was to perform decomposition of unemployment in Visegrad group countries. We applied Hodrick-Prescott filter to estimate output gap and a trend component of unemployment. Looking at economic performance in the years 2000-2011, measured by the growth rate of real gross domestic product, it is clear that the economies of Visegrad group significantly were growing during most of the period. Growth was disrupted by the economic crisis of 2008-2009, which caused a noticeable decline in real gross domestic product. This development was also reflected in the labour market – labour market performance measured by the unemployment rate deteriorated after 2008. The most important component of unemployment seems to be structural unemployment. It tends to be high although we can see remarkable differences among observed countries. The rate of structural unemployment has decreased in the case of Czech Republic, Poland and Slovakia. On the other hand, it has increased in the case of Hungary. This mainly due to internal economic problems associated with public finances and government debt.

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#### References

- Boone, L. 2000. *Comparing Semi-Structural Methods to Estimate Unobserved Variables: The HPMV and Kalman Filters Approaches*. OECD Economics Department Working Papers, No. 240. Paris. OECD Publishing.
- Claar, V. 2005. A Kalman-Filter Approach to Estimating the Natural Rate of Unemployment, in *Proceedings of Rijeka School of Economics: Journal of Economics and Business* 23: 1–24.
- Chiarini, B.; Piselli, P. 2001. Identification and Dimension of the NAIRU, *Economic Modelling* 18(4): 585–611. [http://dx.doi.org/10.1016/S0264-9993\(00\)00054-7](http://dx.doi.org/10.1016/S0264-9993(00)00054-7)
- Fabiani, S.; Mestre R. 2000. *Alternative Measures of the NAIRU in the Euro Area: Estimates and Assessment*. ECB Working Paper No.17. Frankfurt. European Central Bank.
- Fidrmuc, J.; Klein, C.; Price, R.; Wörgötter, A. 2013. *Slovakia: A Catching Up Euro Area Member In and Out of the Crisis*, OECD Economics Department Working Papers, No. 1019, OECD Publishing, 28 p.
- Friedman, M. 1968. The Role of Monetary Policy, *American Economic Review* 58(1): 1–17.
- Furceri, D.; Mourougane, A. 2009. *How do Institutions Affect Structural Unemployment in Times of Crises?* OECD Economics Department Working Papers, No. 730. Paris. OECD Publishing. <http://dx.doi.org/10.1787/220734255421>
- Gerlach, S.; Yiun, M. 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)
- Gersing, A. 1997. *Structural Unemployment in Denmark*, OECD Economics Department Working Papers, No. 183. Paris. OECD Publishing.
- Gianella, C.; Koske, I.; Rusticelli, E.; Chatal, O. 2008. *What Drives the NAIRU: Evidence from a Panel of OECD Countries*. OECD Department Working Paper No. 649. Paris. OECD Publishing.
- Gomes, F. A. R.; Silva, C. G. 2009. Hysteresis versus NAIRU and convergence versus divergence: The behavior of regional unemployment rates in Brazil, *The Quarterly Review of Economics and Finance* 49: 308–322. <http://dx.doi.org/10.1016/j.qref.2007.03.009>
- Gómez, V.; Maravall, A. 1996. *Programs TRAMO (Time Series Regression with Arima noise, Missing observations, and Outliers) and SEATS (Signal Extraction in Arima Time Series)*. Instruction for the User. Working paper No. 9628. Madrid. Banco de España.
- Gómez, V.; Maravall, A. 1998. *Seasonal Adjustment and Signal Extraction in Economic Time Series*. Working paper No. 9809. Madrid. Banco de España.
- Hajek, M.; Bezdek, V. 2001. Odhad potencionálního produktu a produkční mezery v České republice, *Politická ekonomie* 50(4): 473–491.
- Herz, B.; van Rens, T. 2011. *Structural Unemployment*. Universitat Pompeu Fabra Economics Working Paper No. 1276. 44 p.
- Hlousek, M.; Polanský, J. 2007. Produkční přístup k odhadu potenciálního produktu – aplikace pro ČR, *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. Chiarini, B. and P. Piselli 2001. Identification and Dimension of the NAIRU, *Economic Modelling* 18(4): 585–611.

- Kiszova, Z.; Nevima, J. 2012. Usage of analytic hierarchy process for evaluating of regional competitiveness in case of the Czech Republic, in *Proceedings of 30th International Conference Mathematical Methods in Economics*, Karviná. SU OPF, 402–407.
- Konuki, T. 2008. *Estimating Potential Output and the Output Gap in Slovakia*. IMF Working Paper 08/275. 22 p.
- Kotlan, I. 2001. Alternativy stabilizační politiky, *Politická ekonomie* 50(4): 514–523.
- Maravall, A.; Sánchez, F. J. 2000. *An Application of TRAMO-SEATS: Model Selection and Out-of-Sample Performance: the Swiss CPI Series*. Madrid. Banco de España. Working paper No. 14.
- McConnell, C.; Brue, S. M. 2009. *Contemporary Labour Economics*. Columbus. McGraw Hill.
- Nemec, D. 2008. *Kvantitativní analýza mezery nezaměstnanosti a výstupu v České republice*. Working Paper No. 22/2008. Brno. ESF MU, Centrum výzkumu konkurenční schopnosti české ekonomiky.
- OECD. 2008. *OECD Economic Surveys: Poland*. Paris: OECD. 166 p.
- 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.
- Romer, D. 2005. *Advanced Macroeconomics*. Boston, MA. McGraw Hill.
- Silva Filho 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. 45 p.
- Tasci, M. 2012. *The Ins and Outs of Unemployment in the Long Run: Unemployment Flows and the Natural Rate*. Federal Reserve Bank of Cleveland Working Paper No. 12-24.
- Turner, D.; Boone, L.; Giorno, C.; Meacci, M.; Rae, D.; Richardson, P. 2001. Estimating the Structural rate of unemployment for the OECD Countries, *OECD Economic Studies* 2001(2): 171–216.
- Tvrdoň, M.; Tuleja, P.; Verner, T. 2012. Economic Performance and the Labour Market in the Context of the Economic Crisis: Experience from the Visegrad Four Countries, *E+M Ekonomie a Management* 15(3): 16–31.
- Tvrdoň, M.; Verner, T. 2011. Examining the Relationship between Economic Performance and Unemployment: the Case of Visegrad Countries, in *Proceedings of the 29<sup>th</sup> International Conference on Mathematical Methods in Economics 2*: 733–738. Prague: University of Economics
- Vintrová, R. 2008. Česká a slovenská ekonomika 15 let po rozdělení (Czech and Slovak economies 15 years after separation), *Politická ekonomie* 56(4): 449–466.
- Weiner, S. E. 1993. New Estimates of the Natural Rate of Unemployment, *Federal Reserve Bank of Kansas City Economic Review* (4): 53–69.
- Zimkova, E.; Barochovský, J. 2007. Odhad potenciálního produktu a produkční mezery v slovenských podmienkach, *Politická ekonomie* 55(4): 473–489.