Decomposition of Unemployment: The Case of the Visegrad group countries

Michal Tvrdoň

Working Papers in Interdisciplinary Economics and Business Research

Abstract

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Generally, economic performance declines and the unemployment rate rises during the economic crisis. This relationship was confirmed in the past several crises. Moreover, we can decompose unemployment into several components – seasonal, cyclical and structural. The aim of the paper is to decompose unemployment and we try to estimate the rate of structural unemployment. 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. Moreover, it has decreased in these countries, except Hungary. We also compared our method with OECD estimations and we can state that these approaches lead to analogous results.

Key words

Hodrick-Prescott filter, Kalman filter, NAIRU, structural unemployment

JEL: C82, J64

Contacts

Michal Tvrdoň, Departament of Economics and Public Administration, School of Business Administration, Silesian University, Univerzitní nám. 1934/3, 733 40 Karviná, Czechia, e-mail: tvrdon@opf.slu.cz.

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 McConnell and 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 compute and compare two main structural unemployment´s estimating methods; and the last part concludes.

1. 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).

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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 therefore 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 Da 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 of 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 (see Chiarini and Piselli, 2001).

We understand structural unemployment something between pure short-run and long-run NAIRU depending on the changes in actual unemployment. 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 van 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) statitistical 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.

As seen above 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), Tvrdoň, 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 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):

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

where U denotes the seasonally adjusted unemployment rate, U* is the trend component of unemployment, λ is a parameter determining the smoothness of the trend smoothing. For λ = 0 the natural rate of unemployment is equal to the real unemployment rate, for λ → ∞ 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 14400 for monthly data, 1600 for quarterly data and 100 for annual data - see Rozmahel (2011), Gerlach and Yiu (2004), Zimková 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 Hájek and Bezděk (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.

If we look at last group of methods, state-space models with Kalman filter techniques have been widely used in the recent literature to estimate the NAIRU. In this framework, the estimated NAIRU is time varying and treated as an unobserved stochastic variable: it is derived

from its ability to explain inflationary developments, subject to various constraints on its evolution over time (Gianella et al., 2008). The simplest theoretical framework incorporating the NAIRU concept in a transparent fashion is the expectation-augmented Phillips curve, which captures a disequilibrium adjustment mechanism: inflation depends on its past values, on the tightness of the labour market and other factors potentially affecting its response to demand pressures (Fabiani and Mestre, 2000):

$$\Delta\pi_t = \alpha(L)\Delta\pi_{t-1} - \beta(u_t - u_t^*) - \theta(L)\Delta u_t + \gamma(L)z_t + e_t$$

(2)

where Δ is the first difference operator, π is inflation, u is the observed unemployment rate, u^* is the NAIRU, z is a vector of temporary supply shock variables, $\alpha(L)$, $\theta(L)$ and $\gamma(L)$ are polynomials in the lag operator and e is a serially uncorrelated error term with zero mean and variance $\sigma 2$.

For the Kalman filter, the Phillips curve is used directly as the only measurement equation (Boone, 2000). The state space form comprises two equations: a measurement equation and a transition equation. First, we write the Phillips curve (measurement equation) in a matrix format (according to Turner et al. 2001):

$$y_t = ZX_t + RD_t + e_t$$

(3)

where Z and R are vectors of parametres, X is a vector of unobserved variables (the NAIRU), while D is a vector of observed exogenous variables (lagged inflation, temporary supply shocks).

Secondly, we write a transition equation (in matrix format) that specifies the time-series process generating the unobservable state variables and is given by:

$$X_t = TX_{t-1} + \varepsilon_t$$

(4)

where et and εt are iid, normally distributed with mean zero and variances Ht = σ2 and qt = σ2. The ratio qt/Ht = Q is called the signal-to-noise ratio. T is a vector of parameters.

The Kalman filter is made up of two stages: (i) the filtering procedure builds up the estimates as new information about the observed variable becomes available. If at is the optimal estimate of the state variable Xt (the NAIRU) and Pt its variance/covariance matrix, then, given at-1 and Pt-1, the Kalman filter may be written:

$$a_{t+1|t} = (T - K_t Z)a_{t|t-1} + K_t(y_t - d_t)$$

(5)

with $K_t = TP_{t|t-1}Z'F_t^{-1}$ and $F_t = ZP_{t|t-1}Z + H$

(6)

and $P_{t+1|t} = T(P_{t|t-1} - P_{t|t-1}Z'F_t^{-1}ZP_{t|t-1})T' + Q$

(7)

These equations permit the computation of the prediction errors vt for period t as:

$$v_t = y_t - Za_{t|t-1} - RD_t$$

(8)

to go into the likelihood function:

$$l_t = -\frac{1}{2}\log 2\pi - \frac{1}{2}\log|F_t| - \frac{1}{2}v_t F_t^{-1} v_t$$

(9)

The series {at} that maximises this function gives an optimal estimate of the one-sided NAIRU.

2. Empirical Results

Development of the Czech labour market shows Figure 1. 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 (see figure) 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 figure.

Fig. 1: Decomposition of unemployment (quarterly data) – Czech Republic
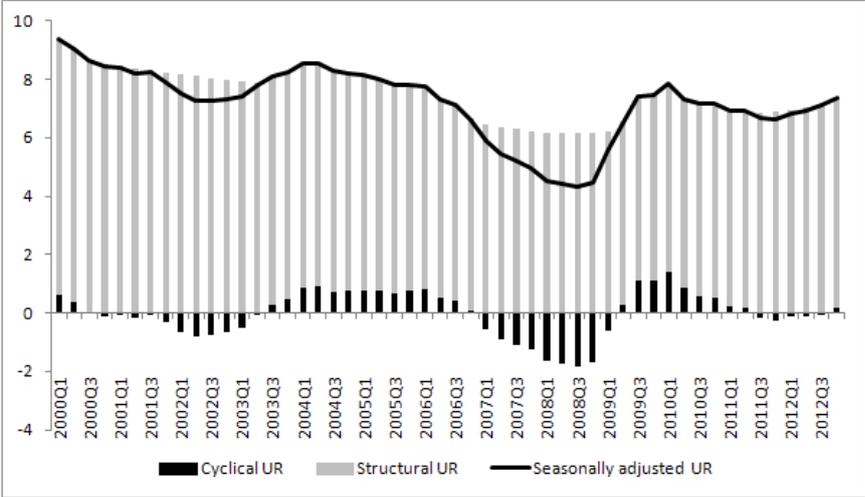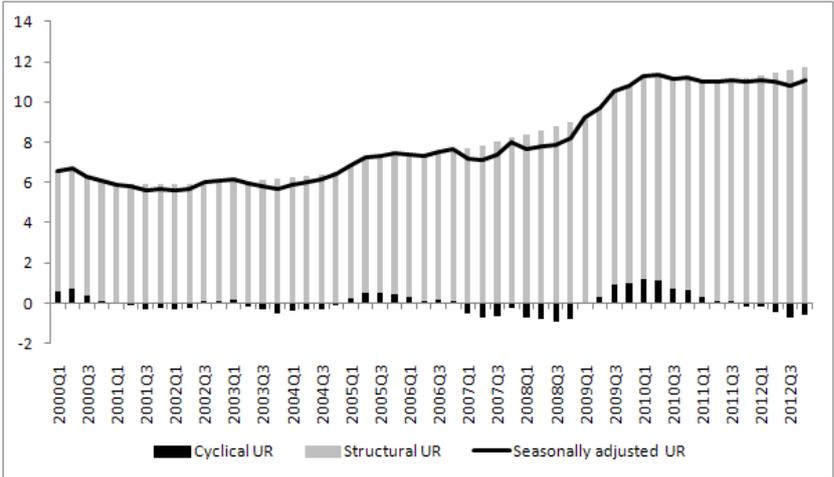

Source: Eurostat; own calculation

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 Figure 2, 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 figure 2). Moreover, cyclical component of unemployment did not have so significant effect on total unemployment.

Fig. 2: Decomposition of unemployment (quarterly data) – Hungary

Source: Eurostat; own calculation

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 Figure 3). 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 (see Figure 3). 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.
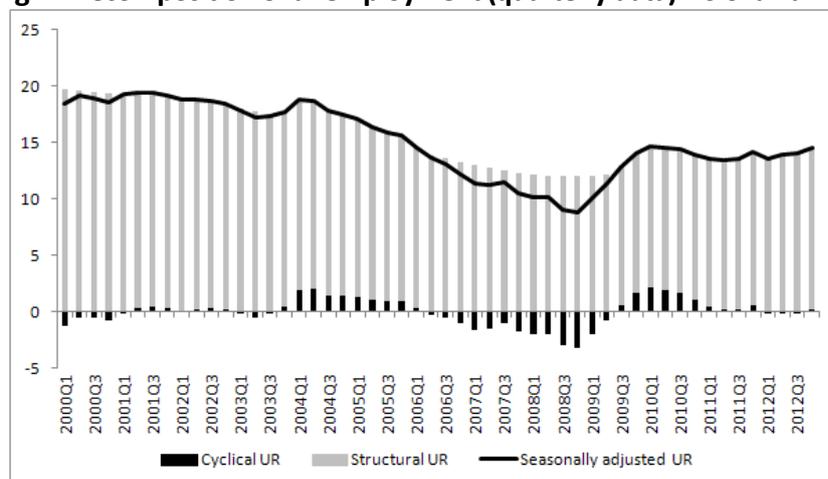
Fig. 3: Decomposition of unemployment (quarterly data) – Poland
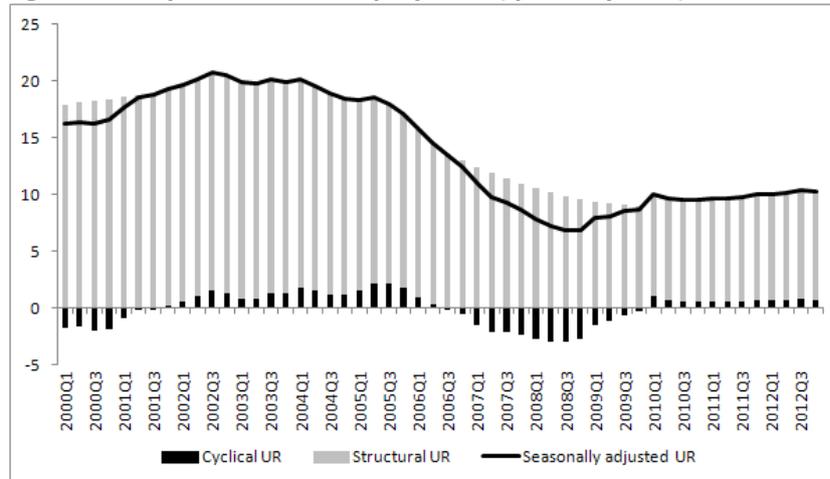
Source: Eurostat; own calculation

Figure 4 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 (Šrámková, 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 Tvrdoň, 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 Figure 4). 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.
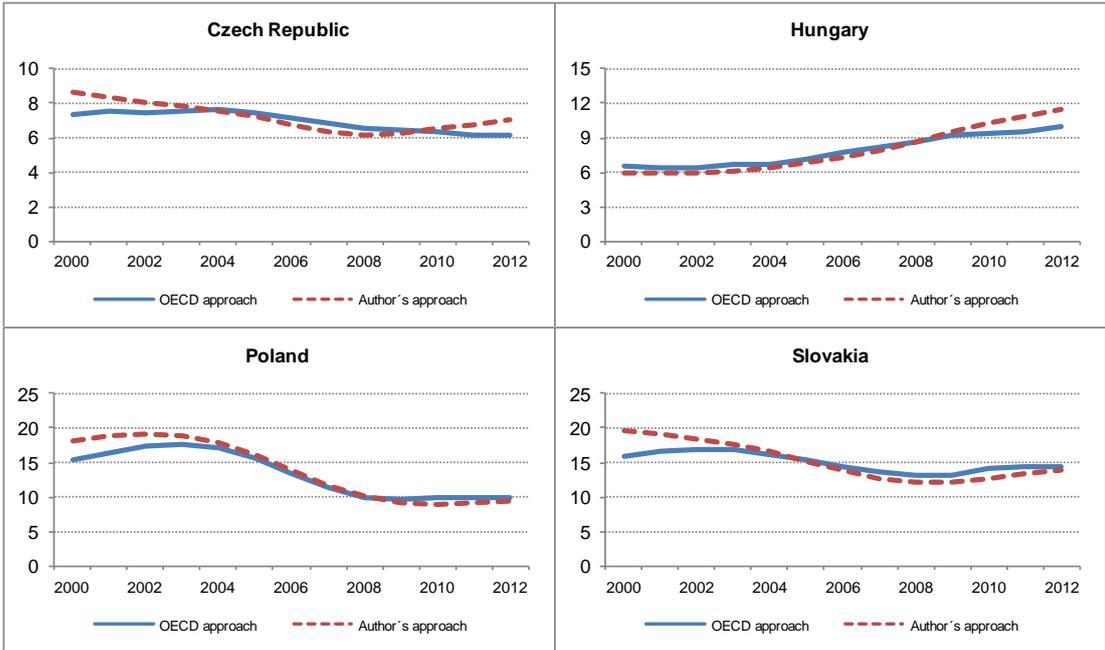
Fig. 4: Decomposition of unemployment (quarterly data) – Slovakia

Source: Eurostat; own calculation

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Figure 5 shows the comparison of two different approaches to estimate the structural component of unemployment - OECD approach (Kalman filter) and the author's approach. Although these are two different approaches, it can be seen from the figure that it has been achieved similar results. In other words – it was recorded the same trend of development of structural unemployment. First, the structural unemployment rate declined due to the significant economic growth and subsequently it increased due to the economic crisis. This trend was typical for Czech Republic, Poland and Slovakia. For Hungary, it was found distinct development (mentioned above) based on these two approaches.

Fig. 5: Comparison of OECD and Author´s approach (annual data)

Source: Eurostat and OECD; own calculation

Conclusion

The aim of the paper was to perform decomposition of unemloyment in Visegrad group countries. We applied Hodrick-Prescott filter to estimate 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. We also compared our approach with approach that is applied by OECD. Results suggest that both methods lead to analogous estimations.

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