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DEVELOPMENT OF THE ECONOMIC CYCLE ON LABOUR MARKET IN THE NATIONAL ECONOMY AND INDUSTRY OF THE CZECH REPUBLIC

Abstract:

This paper assesses phases of the economic cycle on labour market in whole national economy and in the industry of the Czech Republic. The set of methods and models used in this paper lowers the uncertainty of estimation of unobservable variables. Estimated phases of the economic cycle were further verified by development of indicators in the real economy. The analysis localized unstable time period in whole national economy and in the industry, which was assessed by signs of instability, pace and its duration. A great deal of attention related to this issue was given to the transformation of the economy in the last decade of previous century and to period of recession in the first decade of 21st century.

Keywords:

Phillips curve, NAIRU, HP filter, Kalman filter, Stochastic trend and unemployment gap on macro-economic and meso-economic level

JEL Classification: E24, E32, E37

Introduction

Information about development of GDP, inflation and unemployment are important economic indicators. Mutual relationship between them are described by theoretical concepts such as Phillips curve (PC), NAIRU (Non-Accelerating inflation rate of unemployment) and Okun's Law. There is another perspective in addition to macroeconomic point of view and that is mesoeconomics, which is mapping sectors, branches, regions and sections such as gender and age categories. Potential product and NAIRU are the unobservable variables that determine "balanced" or "expected" values. It is possible to find out by using various methods and models (**L. Boone, 2000**). This paper is especially concerned with using NAIRU to determine economic cycle on labour market.

Phases of economic cycle on labour market are verified by the development of real unemployment rate and by added value. The outcome is localization of unstable periods of time and their description by characteristics of their nature, pace, intensity and duration on labour market. The analysis can be divided into following parts. First part states the main representatives of theoretical framework of substitution between inflation and unemployment, and estimation by method NAIRU. Second part deals with empirical analysis of the economic cycle in whole national economy and industry of the Czech Republic. Last part summarizes results of the analysis.

1. Theoretical framework of substitution between inflation and unemployment, and estimation by method NAIRU

The origin of substitution between inflation and unemployment is associated with authors such as: Law, Thornton, Attwood, Mill, Fischer, Tinbergen, Kleina a Goldbergera, Brown, Sultan (**T. M. Humphrey, 1985**). **A. W. Phillips** (1958) is considered a founder of modern version of PC. Among his followers belong **A. P. Samuelson a M. R. Solow** (1960), **S. E. Phelps** (1967), **M. Friedman** (1968), **F. Modigliani a L. Papademos** (1975). This paper is based on the concept of NAIRU, whose pioneer was **J. Tobin** (1997). NAIRU is according to his work the outcome of macroeconomic balancing of pressure on inflation growth from markets with excessive demand and pressure on inflation decline from markets with excessive supply.

NAIRU and related economic cycle is unobserved variable and as such can only be estimated by using related statistical-econometric methods and models. (**P. Richardson, L. Boone, C. Giorno, M. Meacci, D. Rae a D. Turner, 2000**). This analysis is using **HP filter (Hodrick-Prescott filter)**. The method is purely statistical and uses only unemployment rate, which is further divided into trend part (NAIRU) and into a cyclic part. The analysis also works with **Kalman Filter**. Kalman Filter estimates NAIRU with using behavioral equation describing inflation (PC expanded with anticipation). Last method used in this paper is **Stochastic trend**. Stochastic trend uses tools to optimize credence of outcomes of NAIRU. Using these tools leads to independence of NAIRU on previous changes in inflation rate. (**S. Fabiani a R. Mestre, 2001**). Economic cycle will be detected in the analysis by deducting NAIRU values from the observed registered unemployment rate in whole national economy and from specific unemployment rate in industry.

2. Development of the economic cycle on labour market in economy of the Czech Republic and its industry

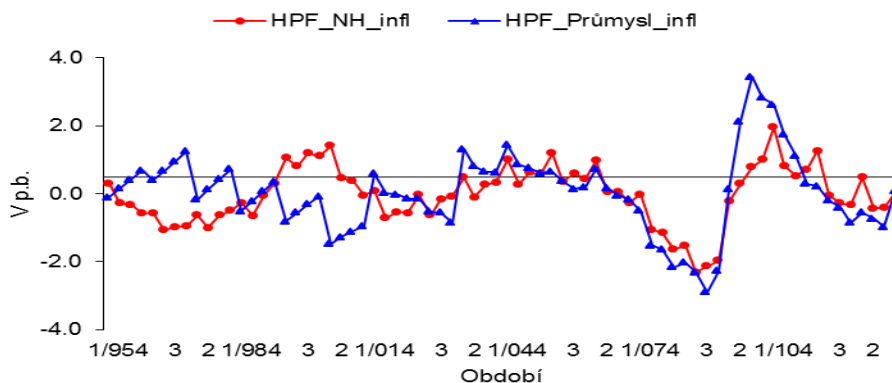
Scales of development of prices are applied in the analysis. Consumer price index is used for all national economy and producer price index is used for industry. Registered unemployment rate in % was copied from statistics of Ministry of Labour and Social Affairs. Specific unemployment rate in industry in % was calculated according to proposal of authors **B. Kadeřábková a E. Jašová** (2011) due to lack of official statistics. Estimated phases of the economic cycle on labour market are verified by chosen data from real economy published by Czech Statistical Office.

2.1 Economic cycle on labour market acquired by HP filter

Analysis is performed on quarterly data of registered unemployment rate for national economy and specific unemployment rate for a branch of industry. Index of registered unemployment rate and index of specific unemployment rate calculated from published data will be set up regarding their own prediction till the end of 2014. This will eliminate shortcomings of the beginning and the end of used time series. Both indexes of unemployment rate were interleaved with HP filter with smoothing parameter of 1600.

Graph 1

Development of unemployment gap in national economy and in industry according to HP filter



Source: Own calculation based on data from Ministry of Labour and Social Affairs and from Czech Statistical Office

There was recorded a longer and bigger negative unemployment gap (i.e. real unemployment rate was higher than NAIRU) in **whole national economy** in the period of time from 1st quarter of 1999 till 1st quarter of 2000, with still ongoing **transformation of czech economy**. Currently published unemployment rate increased year on year in this period by 2 p.p. This phase of recession on labour market was also consistent with development of GDP in constant prices of the previous period. Conversely, extensive **positive gap and phase of economic boom** (real unemployment rate was below NAIRU) was recorded in the period of time from 2nd quarter 2007 till 4th quarter of 2008. Unemployment rate decreased year on year in this period by 1,3 p.p and GDP in 2006 increased year on year by 7,1 % and in 2007 by 5,8 %. **Effect of recession** on labour market in the Czech Republic can be traced in 2nd quarter of 2009 and lasted until 1st quarter of 2011. Unemployment rate increased year on year in this period by 1,6 p.p and GDP decreased year on year in previous period (4th quarter of 2008 until 4th quarter of 2009) by 3,7 %. **In the last**

part of observed period (3rd quarter of 2011 until 3rd quarter of 2012) was detected a phase of shallow economic boom (positive gap was on average 0,2 p.p). Unemployment rate decreased year on year in this period by 0,3 p.p and GDP increased year on year in 2010 by 2,4 % and in 2011 by 1,9 %. In 4th quarter came transition into phases of stagnation, where unemployment rate increased year on year by 0,7 p.p and added value decreased by 0,1 %.

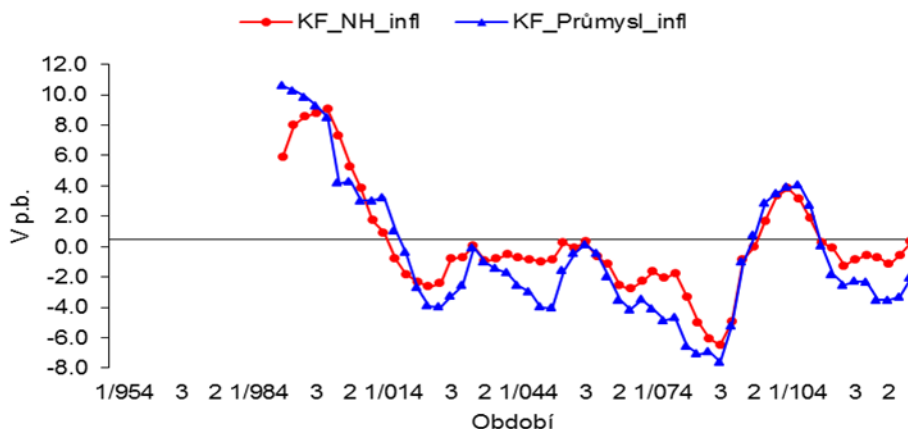
NAIRU was estimated by HP filter in **industry** in the interval from 6,1 % to 14,3 %. Fluctuation band of NAIRU around real specific unemployment rate extended a little compared to the development in the national economy. Influence of **Transformation of czech economy** is noticeable in this branch in the period of time from 2nd quarter of 1995 until 4th quarter of 1998. This industry was not influenced too hard. **Phase of economic boom** was noticed in the time period from 4th quarter of 2006 until 4th quarter of 2008. **Effect of recession** on labour market in industry worked during period from 1st quarter of 2009 until 1st quarter of 2011. This effect was accompanied by year on year decrease of unemployment rate and added value. In the time of **2nd quarter of 2011 until 3rd quarter 2012** a phase of shallow economic boom was monitored. Transition to stagnation was noticeable in **4th quarter of 2012**.

2.2 Economic cycle on labour market acquired by Kalman Filter

Kalman filtr uses consumer price index for all national economy and producer price index is used for industry to describe price development. These price indicators narrowed down quantity of included inflation factors, but on the other hand increased topicality of NAIRU estimations and derived economic cycle on labour market, because price indexes are published with one month delay in comparison with development of real economy.

Graph 2

Development of unemployment gap in national economy and in industry according to Kalman filter



Source: Own calculation based on data from Ministry of Labour and Social Affairs and from Czech Statistical Office

Phase of recession (4th quarter of 1998 until 4th quarter 2000) overlaps **on the level of economy** with development of real variables. **Positive gaps** (ca. 5,0 p.p., see Graf 4) were detected in time of 4th quarter of 2007 until 4th quarter of 2008. *The model did not project into NAIRU values last significant improvement of situation on labour market.* Phase of boom on labour market was also consistent with development of

GDP in previous period. **Influence of recession** on labour market according to this model is noticeable in period from 3rd quarter of 2009 until 4th quarter of 2010 and was consistent with development of real economy. In the period from 1st quarter of 2011 till 3rd quarter of 2012 came **phase of boom** with positive unemployment gap ca. 0,8 p.p. Gradual depletion of this gap resulted in a return of phase of recession on labour market in 4th quarter of 2012 (unemployment rate increased year on year by 0,7 p.p and GDP decreased in 1st quarter by 0,1 %).

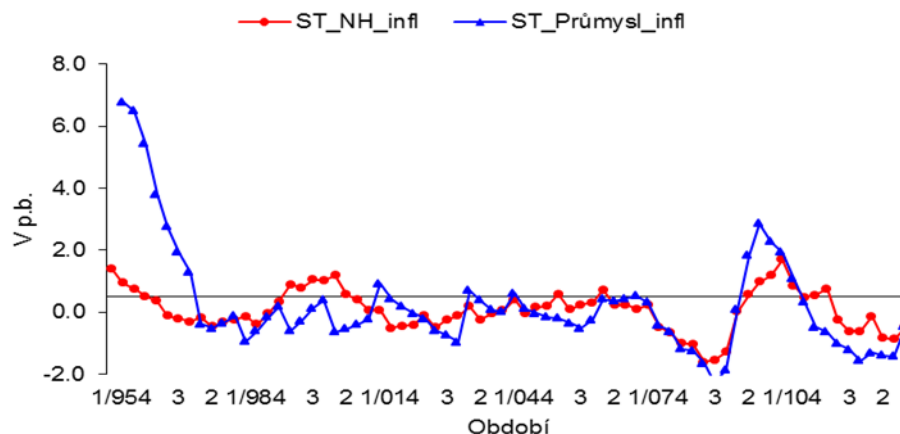
NAIRU values in **industry**, acquired with higher smoothing than usual, were around real unemployment rate in interval from -1,3 to +11,7 %. Negative values of NAIRU were detected in the period from 4th quarter of 1998 until 3rd quarter of 1999. In 4th quarter of 2000 were values already positive, but they remained inconsistent with development of real specific unemployment rate. **Phase of recession** (from 4th quarter of 1998 to 2nd quarter 2001), that was estimated by this model, corresponded with slight year on year decrease in specific employment rate in this whole period and with growth of added value. **Extensive positive gaps** (ca. 5,0 p.p.) were noticed in the period of time from 1st quarter of 2006 until 1st quarter of 2009. *Even here the model did not reflect last significant improvement on labour market into NAIRU values.* **Influence of recession** was noticed in the period of time from 2nd quarter of 2009 to 4th quarter of 2010. In the period from 1st quarter of 2011 to 4th quarter of 2012 was localized **phase of boom** with average positive gap 2,7 p.p.

2.3 Economic cycle on labour market acquired by Kalman Stochastic trend

This method in its basic form sets consumer price index and producer price index manufacturing industry (year on year changes in %). Explanatory variables are annual changes of consumer price index on the level of the national economy and producer price index manufacturing industry with different time delays in %, unemployment rates with different time delays in % and year on year changes in exchange rates with delays (except whole national economy).

Graph 3

Development of unemployment gap in national economy and in industry according to Stochastic trend



Source: Own calculation based on data from Ministry of Labour and Social Affairs and from Czech Statistical Office

On the level of national economy this model confirmed conclusions of Kalman filter, when it places the **period of transformation of czech economy** consistent with data

from real economy into the time period from 4th quarter of 1998 to 1st quarter of 2001. According to the HP filter it is important to consider as its beginning the 1st quarter of 1999 and its end 1st quarter of 2000. We can imply from comparison of the results of all 3 methods with real data, that *in the Czech Republic we can accept conclusion of these authors (S. Fabiani a R. Mestre, 2001) about using local linear trend to increase credence of NAIRU estimaton*. Stochastic trend method reflects actual development of the economy and labour market as well as Kalman filter and much more accurate than HP filter. Estimation **of positive gap and phase of boom** in the period from 2nd quarter of 2007 to 4th quarter of 2008. With the help of stochastic trend it also overlaps with estimation of HP filter (in case of Kalman filter it was between 4th quarter of 2007 and 4th quarter of 2008), which corresponded with development of unemployment rate and GDP. *Consensus of estimations of Stochastic trend with real data supports appropriatness of adjustment called random walk within the meaning of the proposal of authors S. Fabiani a R. Mestre (2001)*. Method Stochastic trend was reflecting real economy and labour market as well as HP filter (Kalman filter informed about beginning of this phase with delay). **Influence of recession** on labour market of the Czech Republic can be traced in correspondence with data as in the case of HP filter from 2nd quarter of 2009 to 1st quarter of 2011 (There was delayed start and truncated end by 1 quarter at Kalman filter). *Again, compliance of estimation given by Stochastic trend and real data indicates correctness of adjustments random walk*. Stochastic trend corresponded to the actual development of labour market the same as HP filter. In case of Kalman filter was the reaction delayed of one quarter and the end came about one quarter earlier. **Development in the final section of observed period** (2nd quarter of 2011 to 4th quarter of 2012) was specific by the fact that throughout this period was the labour market in boom phase. According to Kalman filter and HP filter phase of boom lasted only until 3rd quarter 2012 and in the next quarter was the labour market again in recession. *Because of the fact that comparison of acquired estimation with real data confirmed recession on labour market in the last quarter, we can not consider extension called random walk in case of Stochastic trend as positive*. Kalman filter and HP filter are for analysis of the final section much more appropriate than Stochastic trend.

NAIRU values in **industry** were according to this method between 3,9 and 14,2 %. NAIRU circulated around real specific unemployment rate with less tightness than by using HP filter and with higher tightness than by using Kalman filter. It was not possible to localize the **period of trasformation of the Czech economy** by using Stochastic trend, because of low values of unemployment gap, but also because of frequent changes in plus/minus signs, which prevented unambiguous assignment of phase type. **Begginig of positive gap and phase of boom** is set by this method into the period of 2nd quarter of 2007 (Kalmans filter puts it into 1st quarter and HP filter into 4th quarter of 2006). The end of this period falls into 4th quarter of 2008 the same as by using HP filter (It was in 1st quarter of 2009 using Kalman filter). The outlined development according to the model is correspondent with data from real economy. *Because of the fact that Stochastic trend revealed phase of boom with delay in comparison with HP filter and Kalman filter, it can not be positively decided, if it is suitable to expand random walk hypothesis*. **Influence of recession** in this branch begins to display in 1st quarter of 2009 and lasts until 3rd quarter of 2010. Beginning of this phenomenon was captured by HP filter the fastest together with Stochastic trend (1st quarter 2009) followed by Kalman filter (2nd quarter 2009). According to Stochastic trend this phase continued to 3rd quarter of 2010, according to Kalman filter to 4th quarter of 2010 and

according to HP filter to 1st quarter of 2011. *The recession was placed according to Stochastic trend with correspondenc with development of real data.* **Phase of boom** (average positive gap 1,0 p. p.) was detected in the period from 4th quarter of 2010 to 4th quarter of 2012. According to Kalman filter this phase started in 1st quarter of 2011 and according to HP filter in 2nd quarter of 2011. Last mentioned method localized phase of stagnation in the last quarter of 2012.

Conclusion

Intention of this paper was to map the economic cycle on labour market in economy and in industry of the Czech Republic. Consumer price index and producer price index of manufacturing industry were used to describe development of prices. Using these indexes gave us more typical view on development of NAIRU and derived the economic cycle on labour market. Further there was calculated specific unemployment rate for branch of industry, that even Czech Statistical Office or Ministry of Labour and Social Affairs does not provide within their published statistics. Contribution of this paper is the comparison of outcomes from 3 different methods, which lowers uncertainty connected to our estimation of analysed unobserved variables. Robustness and thus reliance was increased by verification of data from real economy. The main goal of the analysis was localization of major unstable periods of time in national economy and in industry. Those periods were assessed by signs of their instability, pace, intensity and duration on macroeconomic and mesoeconomic level. Major significance was attached to the period of transformation of the czech economy and industry in the last decade of previous century and the period of recession in the first decade of 21st century. The analysis also mapped and quantified the advance in development of estimation by one method compared to the other methods in whole national economy and in chosen branch. „Leading indicator“ among methods, which can help to build a short-term prediction of development on labour market in whole national economy and in industry, was determined by this.

NAIRU values according to Stochastic trend in **national economy** copied more closely the real unemployment rate than in case of HP filter and Kalman filter. In **industry** was NAIRU moving around real specific unemployment rate with lower tightness than by using HP filter and with higher tightness than by using Kalman filter. According to Stochastic trend were NAIRU values in **national economy** in the interval from 1,5 to 9,3 % and in **industry** in the interval from 3,9 to 14,2 %.

The period of transformation of the czech economy was placed by Stochastic trend in correspondence with estimation done by Kalman filter and with development of real data into time period from 4th quarter of 1998 to 1st quarter of 2001. HP filter considers as its beginning 1st quarter of 199 and its end falls already into 1st quarter of 2000. *Comparison of estimation of all three methods with real data implies, that in the Czech Republic we can accept conclusion of authors (Fabiani a R. Mestre, 2001) about using local linear trend to increase credibility of NAIRU estimation.* Method Stochastic trend reflected the real development of the economy and of the labour market as well as Kalman filter did and much more accurate than HP filter did. In **industry** was not possible to map this period with Stochastic trend at all. The reasons were low values of unemployment gaps and frequent changes in plus/minus signs, which made impossible to unambiguously assign the type of phase. *This points out, that expanding with random walk according to Fabiani , Mestre (2001) does not necessarily need to be appropriate.*

Estimation of **positive gap and phase of boom on national economy level** by Stochastic trend in the interval from 2nd quarter of 2007 to 4th quarter of 2008 overlaps with estimation by HP filter. This phase according to Kalman filter started in 4th quarter of that year. *Correspondence of estimation by Stochastic trend with real data supports appropriateness of random walk adjustment within the meaning of authors S. Fabiani a R. Mestre (2001).* Stochastic trend method reflected the real economy and labour market as well as HP filter did (Kalman filter informed us about beginning of this phase with delay). In **industry** is the beginning of this phase placed by Stochastic trend into 2nd quarter of 2007 (Kalman filter into 1st quarter and HP filter into 4th quarter of 2006). End of this phase was found in 4th quarter of 2008 the same as by HP filter (Kalman filter placed the end into 1st quarter of 2009). Development implied by the model was supported by data from real economy. With regard to the fact, that *Stochastic trend method estimated the boom phase delayed behind HP filter and Kalman filter, it is not possible to positively decide whether it is appropriate or not to expand random walk hypothesis.*

According to Stochastic trend it is possible to trace the **influence of recession in national economy** on labour market in correspondence with data as with using HP filter in the interval from 2nd quarter 2009 to 1st quarter 2011, i.e. one quarter of the year ahead of Kalman filter. *Again compliance of estimations of Stochastic trend with real data implies correctness of random walk adjustment.* Stochastic trend corresponded with the real development on labour market as well as HP filter did. In case of Kalman filter was this phenomenon delayed by 1 quarter of the year and the end came 1 quarter sooner. The Great Recession in **industry** influenced the labour market from 1st quarter of 2009 until 3rd quarter of 2010. First symptoms were captured by HP filter together with Stochastic trend (1st quarter of 2009), followed by Kalman filter (2nd quarter of 2009). Stochastic trend set the end of the phase to 3rd quarter of 2010, Kalman filter to 4th quarter of 2010 and HP filter to 1st quarter of 2011. *Even though the recession was placed by Stochastic trend in correspondence with data from real economy, it is not possible to assume random walk adjustment as beneficial, because there was not captured the whole length of the effect.*

Development in the **period from 2nd quarter of 2011 to 4th quarter of 2012 in national economy** according to Stochastic trend was characteristic by labour market in boom phase. Boom phase according to Kalman filter and HP filter lasted only until 3rd quarter of 2012 and transitioned into phase of recession the next quarter. *Because the comparison of estimations with real data confirmed presence of recession on labour market in the last quarter, it is not possible to consider random walk adjustment as positive in case of Stochastic trend.* Kalman filter and HP filter were this time much more appropriate for the analysis than Stochastic trend. There was detected phase of boom in branch of **industry** (with average positive gap of 1,0 p. p.) in the period from 4th quarter of 2010 till 4th quarter of 2012. Kalman filter localized the beginning of this phase in 1st quarter of 2011 and HP filter in 2nd quarter of 2011. Phase of stagnation was localized in the last quarter of 2012 by Kalman filter. *Because this method captured full strength of influence of recession, we consider random walk adjustment suggested by (S. Fabiani a R. Mestre, 2001) as useful.*

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