

COMPARISON OF THE ECONOMIC CYCLE ON LABOUR MARKET IN THE CONSTRUCTION INDUSTRY AND IN THE NATIONAL ECONOMY OF THE CZECHIA

Božena Kadeřábková¹, Emilie Jašová²

1. *Czech Technical University in Prague, Faculty of Civil Engineering, Department of Economics and Management, Thákurova 7, Prague 6, Czech Republic; kaderabb@fsv.cvut.cz*
2. *Charles University, Faculty of Social Sciences, Smetanovo nábřeží 6, Prague 1, 110 01, Czech Republic, ekonomka_2@hotmail.com*

ABSTRACT

This paper is focused on economic cycle on the labor market in the entire national economy of the Czech Republic and in particular in the construction industry of Czechia. Authors use indicators of price level development. Analysis applies methods of the Hodrick–Prescott filter, Kalman filter and Stochastic trend to improve the informative value and credibility of reached conclusions. Phases of economic cycle on the labor market can be verified by comparison with the actual development of unemployment and gross domestic product. Special attention is given to unstable periods on the labor market, and we focus on determining reasons for their existence, their duration and manifestation.

The analysis revealed negative gaps in the period of economic transformation but there were periods with positive unemployment gaps in the years 2007 and 2008 too.

We used the development in the last period to predict the development in the near future. This ad hoc estimate is compared with model estimate made on an extended time series up to the end of the year 2018.

KEYWORDS

NAIRU, HP filter, Kalman filter, Stochastic trend, Unemployment gap, Labor market

INTRODUCTION

Aim of this paper is to measure the economic cycle on the labor market with the use of price indicator an HP filter (Hodrick-Prescott filter), Kalman filter and Stochastic trend method. Phases of economic cycle reached by said methods are then verified in the paper by comparing them with the development of actual unemployment rate and added value with the delay being two or three quarters. Researched periods are the periods of economic transformation, period of significant positive unemployment gaps in the years 2007 and 2008, period of the last recession and the following period of boom. Ad hoc prediction was then compared with the model estimate, which was made on an extended time series up to the end of the year 2018. Paper is divided into several chapters. First part shows methods leading to the estimation of NAIRU. In the second part, an analysis of the predicted development of an economic cycle in the conditions of the entire national economy and in the construction, industry is made. This includes a prediction of said development in the near future. Last part of the paper offers a summary of the results of the analysis.

OVERVIEW OF METHODS

To examine the economic cycle, we used the NAIRU value defined by J. Tobin [1]. A. G. Akerlof, T.W. Dickens and L. G. Perry [2] also helped the spread of this concept. To estimate it, it is necessary to apply econometric models and methods, because it is an unobservable variable.

In this paper, we use the following methods:

HP filter - these methods divide the unemployment rate into a trend (NAIRU) and a cyclical part. The downside of this method is that is often based on random and in many cases improbable assumptions, mainly centered around the NAIRU smoothing value coefficient. Among other authors applying this method were also P. Richardson et al. [3] and M. Hájek and V. Bezděk [4].

Kalman filter a Stochastic trend estimate variable NAIRU in every moment of the studied period. In the case of **Kalman filter**, behavioural equations explaining inflation are used to properly estimate NAIRU. NAIRU is specified as a random walk in reaction to shocks. Main disadvantage of this method is its inability to identify basic structural relationships. This method was used by authors such as S. Fabiani and R. Mestre [5] and L. Boone [6].

Stochastic trend is a method used with the aim to improve the explanatory power and credibility of a NAIRU estimate. S. Fabiani a R. Mestre [7] claim, that NAIRU follows the process of a random walk, but extended by variable stochastic shift (so-called local linear trend).

We then compare our estimated NAIRU values with the actual development of an unemployment rate, by which we get positive or negative values of an unemployment gaps. These are used as an alternative way of determining the phases of the economic cycle, because quarterly changes of GDP are one of the main ways as how to measure a cycle.

To estimate the development of the entire national economy we use consumer price index, and we use a construction work price index in the construction industry Time series of consumer price index and construction work price index are then transformed in a way to be able to formulate adaptive formation of expectations (annual change in time t – annual change in time $t-1$). For a description of a development on a labour market, we use registered unemployment rate given by Ministry of Labour and Social Affairs of CR and specific unemployment rate in a construction industry, which we had to calculate ourselves, because of lack of any officially published statistics [8]. Among other explanatory variables are annual changes of exchange rates and import prices. Unemployment rates for each season were cleaned by moving multiplicative average. All-time series used passed the ADF test [9], and their stationary was confirmed. Time series were also cleaned using Census X12 method [9]. To choose the best suited model to approximate the analysed data in a case of Kalman's filter and method of Stochastic trend, cleaned R^2 was used. For the testing of the normality of residues, the Jarque-Bera test was used [9]. For testing the auto correlation of residues, the Breusch-Godfrey test was used [9]. For testing the heteroscedasticity of residues, the Wald test was used [9]. For measuring the bearing capacity of multicollinearity, the Variable inflation factor was used [9]. Time series covered the period between 1st quarter of 1994 and 4th quarter of 2012. Due to frequency of used time series being quarterly, smoothing parameter with a value of 1600 was used during an analysis using a method of HP filter. This value of smoothing is internationally recognized.

COMPARATION OF ESTIMATE OF DEVELOPMENT OF ECONOMIC CYCLE ON THE LABOUR MARKET WITH THE ACTUAL DEVELOPMENT

Whole period is divided into a 1995 to 2012 subperiod and another subperiod after year 2012 to the end of the year 2018.

Comparison of model values and an actual development between the 1995 and 2012

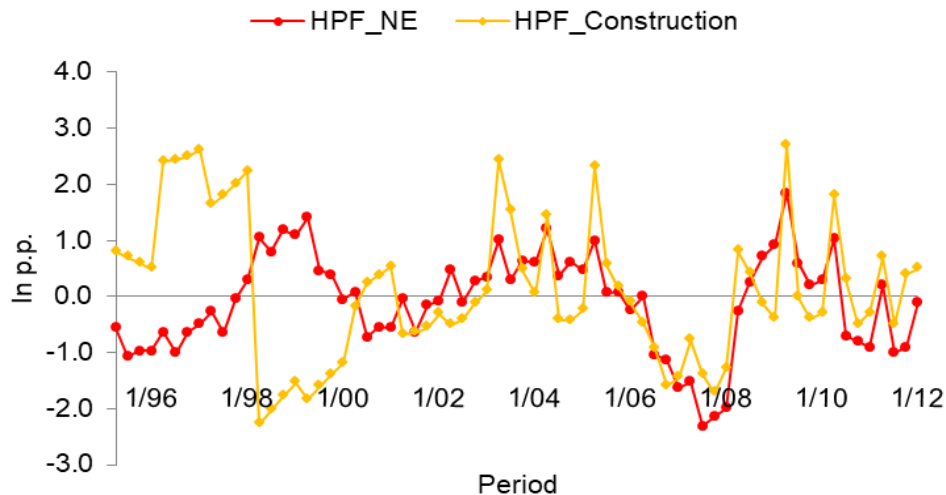


Fig. 1 - Development of unemployment gap in national economy according to HP filter and in the construction industry in Czechia (Source: Own calculations based on data by Ministry of Labour and Social Affairs and Czech Statistical Office)

Model phase of recession (4th quarter of 1998 to 1st quarter of 2001) on the labour market was consistent with the annual unemployment rate rise (+1,1 p.p.). **Positive gaps** (approx. 5,0 p.p., see Figure 1) were identified in the period from 4th quarter of 2006 to the 1st quarter of 2009. Model did not take into account the decline of situation on a labour market when showing NAIRU values. The phase of boom overlapped with the rise of GDP, which was on average 4,3 %. According to this method, effect of the last recession on labour market manifested itself in the period between 2nd quarter of 2009 and 1st quarter of 2011 and with the exception of the last two quarters was consistent with the actual development of national economy. In the period between 2nd and 4th quarter of 2011, a phase of boom with the positive unemployment gap of 0,2p.p. appeared. **Phase of recession** followed in the 1st quarter of 2012 (unemployment rate declined annually by 0,4 p.p. and GDP by only 0,1 %) and also in the 4th quarter of 2012 (GDP fell by 1,3 %). Gradual decline of positive unemployment gap in the last quarter of 2012 while maintaining the fall in GDP (-1,6 %) and rise in unemployment rate to 8,9 % indicates continuation of a phase of recession. In the construction industry, the start of transformation can be found in 1st quarter of 1996 (3 full quarters later than in the industry) and ends at same time as in the industry (4th quarter of 1998). Model development is consistent with the annual decline of added value (by 5,4 %) and with the acceleration of the specific unemployment rate to the value of 6,4 %. **Positive gaps** amounting to 1,0 p.p. were observed between the 4th quarter of 2006 and 4th quarter of 2008. Beginning of this period is one quarter behind the industry, the end of this period, however, overlaps. The model phase of boom on a labour market is consistent with the development of the actual economy (added value rose by 3,9 % and specific rate of unemployment fell annually by 0,9 p.p.). The effect for the last recession on a labour market manifested itself from the 1st quarter of 2009 to the 2nd quarter of 2011. The start was in the same quarter as it was in the industry, but the end of the recession was the full one quarter later than in the construction business. Specific unemployment rate in the observed period rose annually by 1,2 p.p. and added value rose only by 0,4 %. Phase of boom in the period between 3rd quarter of 2011 and 2nd quarter of 2012 is consistent with the one observed in the industry. Average positive gap amounting to 0,3 p.p. was consistent with the development of the specific unemployment rate (annual fall by 0,4 p.p.), but it wasn't consistent with the fall of the added value (annual fall by 5,0 %). Slight decrease of the

negative unemployment gap in the last quarter of 2012 (from +0,19 to +0,17) and a frequent changing of the phases since the 2nd quarter of 2011 showed a great probability of a positive gap in the 2nd half of 2013.

Comparison of model values and the actual development from 2012 to 2018

In this part, the development of the economic cycle in the national economy and in selected industries is observed in the period between the 1st quarter of 2013 and 4th quarter of 2018. For describing the development on the labour market, we are still using the registered unemployment rate provided by Ministry of Labour and Social Affairs. This time series can be used after 2013 only because the fact, that the data published for 2012 are using both the new and old methodology, which allows us to calculate a conversion coefficient. Additional estimate allowed us to confirm anticipated in our estimates after extending the time series with new observations. Furthermore, it allowed to verifying predictions, which we made from the trends in the development of data from the end of the 2012 for the near future, the year 2013. Development of the cycle to the 4th quarter of 2018 is also shown, including the prediction for a year 2019.

Tab. 1 - Impact of extending the time series on a prior estimate of NAIRU and gap in national economy and in chosen industries in Czechia - in p.p. (Source: Own calculation based on data provided by Ministry of Labour and Social Affairs and Czech Statistical Office)

Period	NAIRU_NE	NAIRU_Construction	Gap_NE	Gap_Construction
1/06	0,0	0,0	0,0	0,0
2	0,0	0,0	0,0	0,0
3	0,0	0,0	0,0	0,0
4	0,0	0,0	0,0	0,0
1/07	0,0	0,1	0,0	-0,1
2	0,0	0,1	0,0	-0,1
3	0,0	0,1	0,0	-0,1
4	0,0	0,1	0,0	-0,1
1/08	0,1	0,1	-0,1	-0,1
2	0,1	0,1	-0,1	-0,1
3	0,1	0,1	-0,1	-0,1
4	0,1	0,2	-0,1	-0,2
1/09	0,1	0,2	-0,1	-0,2
2	0,2	0,2	-0,2	-0,2
3	0,2	0,2	-0,2	-0,2
4	0,2	0,2	-0,2	-0,2
1/10	0,2	0,2	-0,2	-0,2
2	0,2	0,2	-0,2	-0,2
3	0,3	0,2	-0,3	-0,2
4	0,3	0,2	-0,3	-0,2
1/11	0,3	0,2	-0,3	-0,2
2	0,3	0,1	-0,3	-0,1
3	0,3	0,1	-0,3	-0,1
4	0,3	0,1	-0,3	-0,1
1/12	0,3	0,0	-0,3	0,0
2	0,3	-0,1	-0,3	0,1
3	0,3	-0,2	-0,3	0,2
4	0,3	-0,3	-0,3	0,3

From the comparison of estimate of NAIRU gained by using HP filter and an unemployment rate gap for the entire national economy we can see, that extending the time series by years 2013 to 2018 impacted the previously estimated values with the rising intensity of NAIRU in the national economy. While between the years 1994 and 2006 no changes in NAIRU and gap were mapped (see Table 1), in the period from 1st quarter of 2007 to the 3rd quarter of 2008, the difference ranges from 0,0 to 0,1 p.p., in the period from the 4th quarter of 2008 to the 3rd quarter of 2010, the differences are already ranging from 0,1 to 0,2 p.p, in the period from the 4th quarter of 2010 to the 2nd quarter of 2012, the interval is from the 0,0 to 0,3 p.p, in the 3rd quarter of 2012 the difference is between 0,2 and 0,4 and in the 4th quarter of 2012, the values were between 0,2 and 0,5 p.p.

Quality of ad hoc prediction for year 2013 from the alternative methods (such as Kalman filter and Stochastic trend), which allows us more complex assessment of phases of economic cycle can be seen in Table 2.

Tab. 2 - Comparison of ad hoc unemployment gap prediction for the year 2013 and its development after time series extension to the year 2018 - in p.p. (Source: Own calculation based on data provided by Ministry of Labour and Social Affairs and Czech Statistical Office and Czech National Bank)

Estimation method	Period	NE_Gap	Construction_Gap
Estimating from tendencies towards the end of 2012 using the HP filter method	1/13	Continuation and further deepening of the recession phase but also a variant with its exhaustion in the second half of the year.	The probability of turning into a positive gap in the second half of 2013.
Estimating from tendencies towards the end of 2012 using the the Kalman filter method	1/13	Continuation and further deepening of the recession phase but also a variant with its exhaustion in the second half of the year.	The continuation and further deepening of the positive gap, but also the variant with its exhaustion in the first half of the year.
Estimating from tendencies towards the end of 2012 using the the Stochastic trend method	1/13	The continuation of the positive gap only in Q1 2013, the possible recession phase could cover the remaining part of the year.	Sustaining the recession phase in the early part of 2013 and the boom phase in the second half of the year.
Estimation after prolongation of the HP filter method	1/13	1,13 2 0,47 3 0,54 4 0,93	2,86 1,04 -0,22 -0,66

In case of comparing ad hoc prediction of the unemployment gaps in the entire national economy for the year 2013 using all methods and the estimate of HP filter, we can see the correct placement of the phase of recession, while the former HP filter and Kalman filter results indicated a certain degree of doubts about said recession being present for the entire year 2013. Slightly more optimistic were ad hoc predictions for the year 2013 using the methods of HP filter and Kalman filter. The most conformity between the extrapolated data from 2012 and results obtained by using HP filters after extending time series to the year 2018 can be seen in the construction industry. Interestingly, in the industry, trends resulting from the application of models on the data all the way to the year 2012 were the most reliable in predicting the correct development using the method of Stochastic trend.

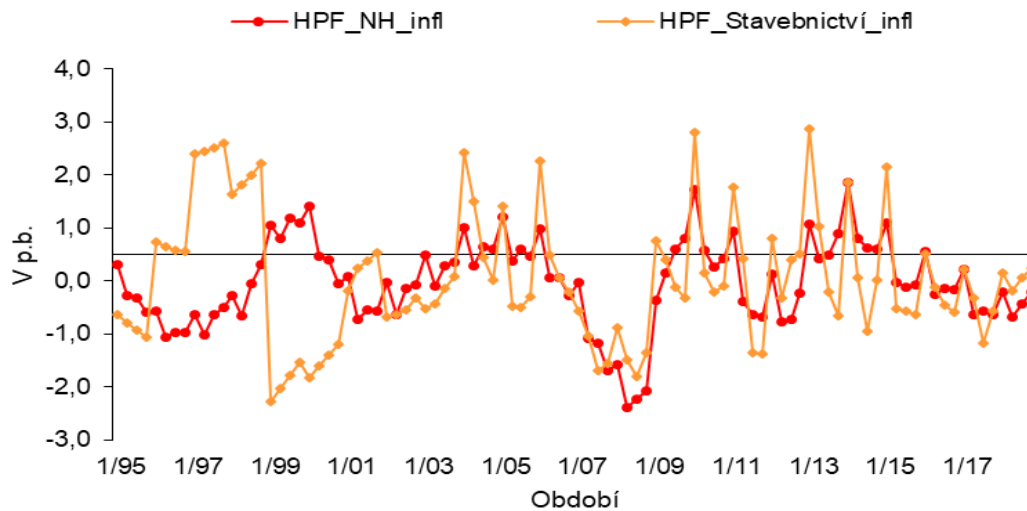


Fig. 2 - Development of unemployment gap in national economy according to HP filter and in the construction industry after extending the time series all the way to the 4th quarter of 2018 (Source: Own calculations based on data by Ministry of Labour and Social Affairs and Czech Statistical Office)

Phase of recession estimated for the entire national economy in the year 2013 and continuing all the way up to the 1st quarter of 2015 was consistent with the annual growth of unemployment rate (+0,3 p.p.). It was also consistent with the development of GDP, which shows the beginnings of this phase as early as in the 2nd quarter of 2012. Positive gaps amounting to roughly 0,2 p.p. (see Figure 2) were found in the period from the 2nd quarter of 2015 to the 4th quarter of 2018. Observed phase of boom overlapped with the decrease in the unemployment rate by 1,4 p.p. and was also accompanied by growth of (by 3,7 %). In the construction industry, negative gaps were observed as early as in the 3rd quarter of 2012 to the 1st quarter of 2015, with added value growing only by 0,5 % and specific unemployment rate growing by 0,1 p.p. Positive gaps in the period directly following and lasting all the way to the 2nd quarter of 2018 was in average roughly 0,3 p.p. and was in accordance with the annual growth of the added value and with the decrease in the specific unemployment rate (by 1,2 p.p.). Negative gap was then observed in the second half of 2018 being roughly 0,2 p.p., and added value growing only by 0,9 % with specific unemployment rate stagnating and being same as at the same time last year.

CONCLUSION

From the analysis of the ability of individual methods to correctly depict the influence of the transformation of the economy on the labor market consistent with the development of the actual real economy, it can be concluded, that, in Czechia, we can accept the conclusions made by authors [7]. These conclusions were about using local linear trend to improve the credibility of the estimate of NAIRU. Method of Stochastic trend reacted to the actual development of the economy nearly the same as the Kalman filter and substantially more accurately than the HP filter.

In the construction industry, the period of transformation of the economy and phases of the economic cycle was predicted correctly by used methods and was consistent with the actual development of the economy. Even though Stochastic trend was consistent with the actual development of the economy, results gained by this method did not cover the entire observed period and it is therefore impossible to agree with the authors [7] about their proposed extension of random walk. It needs to be added, that the Kalman filter with the smoothing factor of 0,6 reacted to the process of transformation in the Czech economy and in the construction industry by giving

negative or unrealistically low positive NAIRU values. Another reason for unrealistically great gaps in this period can be seen in the fluctuations in oil prices, exchange rates, import prices and in regulated prices, which disturbed the substitution relation between unemployment and the deflation of household consumption.

Another extraordinary incident that was recorded by all three methods was the period of extensive positive unemployment gaps. The consistency of estimation made using Stochastic trend with the actual data supports the proposal of modifying the random walk, as made by the authors S. Fabiani and R. Mestre [7]. Method of the Stochastic trend reflected actual economy equally the HP filter did (while the Kalman filter reported the beginning of the said phase with a delay). Positive gaps consistent with the actual development of the economy were also observed in the construction industry. Reason for such high positive gaps both in the national economy and construction industry while using Kalman filter can be explained by said model being unable to reflect the last significant improvement of the situation on the labor market in the NAIRU value.

All methods reacted to the emerging recession. Using the method of Stochastic trend, the effect of the last recession on the labor market in the national economy was consistent with the actual data. Specifically, it was the period from the 2nd quarter of 2009 to the 1st quarter of 2011, which was consistent with the results provided by HP filter and one quarter earlier than the prediction provided by Kalman filter. Start of the latest recession in the construction industry was determined very differently by individual methods. All the methods, with the exception of the Kalman filter (estimates the phase of boom contrary to the actual economic data) agree with and place the end of the phase of the recession at the end of the year 2012. Stochastic trend reflected the transition between the phases of boom and recession with the significant delay. It needs to be pointed out that the disadvantage of too tightly copying estimated NAIRU values and the development of the actual specific unemployment rate. *The problem was that beside low values of the calculated unemployment gap, there was also frequent changing of the phases of the cycle. (Negative and positive states of the calculated unemployment gaps.)*

The evaluation of the national economy until the end of year 2012 with methods used is inconclusive. Using Stochastic trend, development of the national economy in the period between 2nd quarter of 2011 and 4th quarter of 2012 was meant to be characteristic by the fact, that the labor market was in the phase of boom. Using the Kalman filter as well as HP filter, we got the phase of the boom ending by the end of the 3rd quarter of the year 2012 and in the following year the labor market once again entered the phase of recession. Both the Kalman filter and the HP filter turned out to be much better suited for the analysis of the latest period than the Stochastic trend.

Consistency of the extrapolation of the development in the year 2013 from the estimates provided by the individual methods using the data until the end of the year 2012 with the results given by using HP filter after extending time series as the way to the end of the year 2018 confirmed the correct placement of the recession phase in the entire national economy. The most consistent was the estimation in the industry made by using the HP filters for the year 2013 and the extrapolation made on the results until the end of the year 2012 using the Stochastic trend method. Little more optimistic were former estimates concerning the year 2013 with these using the methods HP filter and the Kalman filter. The most consistency with the results that were obtained by extrapolation of the data from the year 2012 and the estimation made by using the HP filter from extended time series was found in the construction industry.

Estimations made by using HP filter on the most recent data confirmed two more phases of the economic cycle in the national industry in the period after the year 2012 and three more phases in our chosen industry. Phase of the recession estimated for the entire national economy started in the 1st quarter of the year 2013 but in the construction industry it

already started by the 3rd quarter of 2012. In both said cases, these model estimates were verified by annual unemployment rate growth (in the national economy and in the construction industry). The phase of the recession ends by the 1st quarter of the year 2015. Start of the positive gaps both in the national economy and in the construction was located to the 2nd quarter of the year 2015. While in the entire national economy this positive period lasted until the end of the year 2018, in the construction industry, this period only lasted until the 2nd quarter of 2018. The observed phase of boom was on all levels consistent with the annual decline in unemployment rate and with the growth of the added value. The following period can be characterized by very shallow recession in the construction industry in the two last quarters of 2018, specifically the 3rd and the 4th quarters of 2018. Specific unemployment rate in the construction industry was the same as it was in the 2017, while in the industry, it saw an annual decrease of 0,3 p.p. Both in the construction industry and in the industry as a whole, a rise in the negative unemployment gaps can be registered, which makes continuation of this phase into 2019 very probable. In the entire national economy, a decreasing intensity of positive gap can be registered since the 3rd quarter of 2018 and it can signal slow end of the phase of the boom, which could then change into a shallow recession in the second half of 2019.

REFERENCES

- [1] Tobin, J. (1997): *Supply Constraints on Employment and Output: NAIRU versus Natural Rate*. Cowles Foundation Paper 1150. Yale University, New Haven. 1 s.
- [2] Akerlof, G. A.; Dickens, W. T.; Perry, G. L. (1996): *The Macroeconomics of Low Inflation*. Brookings Papers on Economic Activity, Brookings Institution. Washington, D.C.
- [3] Richardson, P., Boone, L., Giorno, C., Meacci, M., Rae, D., Turner, D. (2000): *The concept, policy use and measurement of structural unemployment: estimating a time varying NAIRU across 21 OECD countries*. OECD WP. 38 s.
- [4] Hájek, M., Bezděk, V. (2000): *Estimation of potential product and production gap in the Czech Republic*. Working Paper, 2000, č. 16, Czech National Bank. 21 s. (in Czech)
- [5] Fabiani, S.; Mestre, R. (2000): *Alternative measures of the NAIRU in the euro area: estimates and assessment*. ECB WP.
- [6] Boone, L. (2000): *Comparing Semi-Structural Methods to Estimate Unobserved Variables. The HPMV and Kalman filter Approaches* OECD. Economics Department Working Papers No. 240.
- [7] Fabiani, S., Mestre, R. (May 2001): *A system approach for measuring the euro area NAIRU*. ECB WP. 65 s.
- [8] Kadeřábková, B., Jašová, E. (2011): *Analysis of the NAIRU indicator at the sectoral level*. Political Economy, University of the Economics, Prague, 4, ISSN 0032-3233. (in Czech)
- [9] Eviews. 2013. EViews Version 7.2 Help Topics.

Czech Statistical Office

Consumer price index, <http://www.czso.cz/csu/csu.nsf/kalendar/aktual-isc>
 Manufacturing price index, <http://www.czso.cz/csu/csu.nsf/kalendar/aktual-ipc>
 Construction price index, <http://www.czso.cz/csu/csu.nsf/kalendar/aktual-ipc>
 Import price index, http://www.czso.cz/csu/redakce.nsf/i/ceny_vd_ekon

Czech National Bank

http://www.cnb.cz/cs/financni_trhy/devizovy_trh/kurzy_devizoveho_trhu/denni_kurz.jsp

Ministry of Labour and Social Affairs

Registered unemployment rate, <http://www.mpsv.cz/cs/869>