UNEMPLOYMENT AND GDP

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Abstract

Unemployment is one of very important and closely monitored macroeconomic indicators. Unemployment rate gives indication what proportion of workforce is currently without job. In many cases prediction of unemployment would help to plan fiscal policy, programs of active employment policy and other tools of social politics. Importance of reliable prediction was proved during crisis period. Such that, modelling of labour market – employment and unemployment – may have benefits for many institutions.

Various indicators have been analyzed in correlation analysis in order to build macroeconomic model (with unemployment as dependent variable) and estimate its parameters, for example GDP, household consumption, government consumption, investments, inflation, wages, rate of employment and participation rate. It is widely accepted that GDP is one of the strongest predictor for forecasting of unemployment trend but with some delay because labour market reacts later as legislation rules are strict. In the paper relation between GDP and unemployment rate for the case of the Czech Republic is introduced considering time delay. Importance of GDP and GDP growth rate was not approved based on real data analysis. Moreover, one regression model is proposed and estimated. Forecasts of number of unemployed people based on this model capture trend but are lower than real numbers.

Key words: unemployment, GDP, investments, regression analysis, OLS

JEL Code: J24, J64, C20

Introduction

Unemployment is very important macroeconomic indicator that helps politicians and economists manage efficiency of economy and businesses and in maintaining social and political stability as well. Unemployment rate gives indication what proportion of workforce is currently without job but job actively seeks (condition of activity, i.e. involuntariness) and are able to start a new job immediately (i.e. availability). Employment rate presents complement, what proportion of workforce works. Participation rate shows what proportion of people aged 15 years or more are economically active, which means either employed or unemployed.

Continuing economical crisis at the end of 2008 demonstrated close relation between performance of economy measured by GDP and labour market. Unemployment increased after financial indicators' fall and restrictions on financial markets with some delay. Statistical dependency among selected macroeconomic indicators in the Czech Republic including delayed indicators is analyzed in this paper. It is expected that labour market's reaction is delayed by one to two quarters.

Forecasting of unemployment would help in many cases to institutions in planning fiscal policy and active employment programs. Nevertheless, predicting unemployment is very difficult and statistical models often do not have correct and usable results. Regression model introduced in the second part of the article shows quality of forecasted versus real values.

1 Data

Data for analysis come from Czech Statistical Office (CZSO): GDP, consumption and investments in constant prices & seasonally adjusted, employment and unemployment from quarterly organized Labour Force Sample Survey (LFSS), inflation rate as an increase in average annual CPI indicating percentage change in last 12-month average over preceding 12-month average, wages as average monthly gross wage. Both annual data (1996-2010, 15 observations) and quarterly data (Q1/1996-Q1/2011, 61 observations) are used here.

Level of dependency is measured by Pearson's correlation coefficient. This coefficient measures linear type of relation. Statistical test for statistical significance of correlation coefficient is calculated on significance level $\alpha = 0.05$; it is very sensitive and for high number of observations gives positive result even for low test values.

2 Trend of GDP, Investment, Employment and Unemployment

GDP, consumption and investments show seasonal oscillations, therefore seasonally adjusted time series were used in analysis.

GDP in constant prices shows clear slowdown since 2008, which is exactly the period when economic crisis was detected. Final consumption growth decelerates as well. Investments in constant prices even decreased from 247 bn CZK in Q4/2008 to 182 bn CZK in Q4/2009. Currently (in Q1/2011) GDP is formed from final household consumption (49%), government consumption (22%), investments (22%) and net export (7%). Wages are represented by nominal value which shows seasonal fluctuations.

Number of unemployed people according to LFSS reached its maximal value in Q1/2000 (494 thousands people) and minimum in Q1/2008. Number of unemployed people increased after favourable period till the middle of 2008 with local maximum in Q4/2009. Impact of economic crisis is very well recognizable in the period 2009-2010 and according to last trends in economy this unfavourable situation continues.

Fig. 1: Trend of GDP, Investments, Consumption, Wages and Unemployment (Q1/1996– Q1/2011)
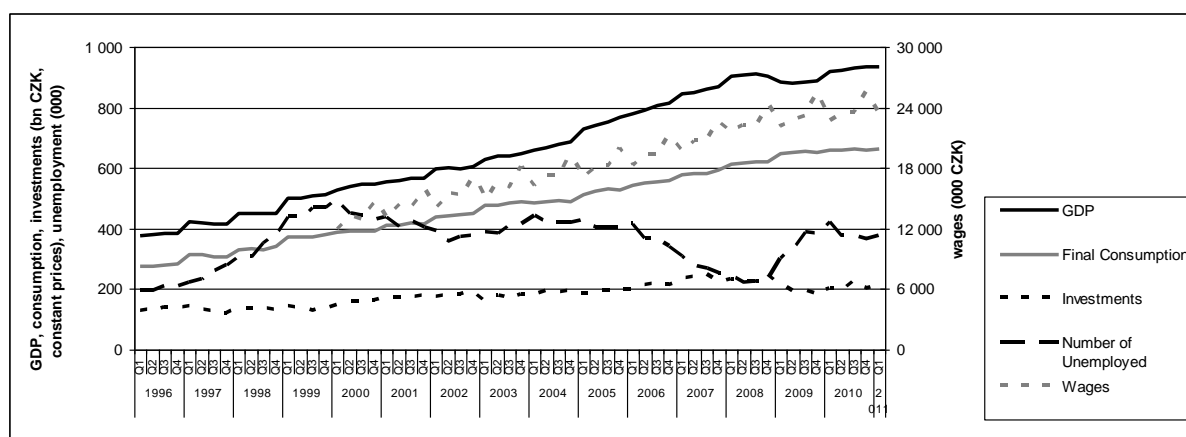
Source: Czech Statistical Office

3   Statistical analysis

Correlation coefficients presented in following tables and denoted by * are statistically significant on significance level $\alpha = 0.05$.

3.1   Correlation for Annual Data

Tab. 1: Pearson's correlation coefficient (1996-2010)

	Unemployment rate	Employment rate	Participation rate
GDP seasonally adjusted – growth rate y/y	0.123	-0.222	-0.203
GDP seasonally adjusted – growth rate y/y (y−1)	-0.421	0.118	-0.256
GDP seasonally adjusted – growth rate y/y (y−2)	-0.893*	0.215	-0.643*
GDP seasonally adjusted – growth rate y/y (y−3)	-0.630*	0.024	-0.665*
Inflation rate	-0.600*	0.841*	0.624*
Investments seasonally adjusted – growth rate y/y	0.298	-0.144	0.110
Investments seasonally adjusted – growth rate y/y (y-1)	-0.206	0.314	0.108
Investments seasonally adjusted – growth rate y/y (y-2)	-0.321	0.164	-0.226
Investments seasonally adjusted – growth rate y/y (y-3)	0.008	-0.497	-0.454

Source: own calculation

Annual view revealed statistically significant linear relation between unemployment rate and GDP growth rate delayed by 2 years and 3 years (with negative relation) and unemployment rate and inflation rate. Employment rate is statistically significantly correlated with inflation rate (in positive way). Participation rate is correlated with GDP growth rate delayed by 2 and 3 years and with inflation. Investments are not correlated with selected characteristics of labour market.

It was confirmed that higher GDP growth rate determines lower unemployment rate after 2 and 3 years (negative correlation coefficient) and surprisingly also lower participation rate after 2 and 3 years. For participation rate was not expected negative result because economic boom and investment should motivate people to work and should attract more people to join economic active part of population. Easy explanation would be that society is rich and people do not need to work so intensively. This indicator is probably determined by other influences including demographic characteristics of population. In case of investment growth rate it was expected that more investments means lower unemployment rate next year or year after that. Higher inflation rate means lower unemployment and higher employment and participation rate. This is caused by overall performance of economy – expanding or booming economy 'warms up', inflation grows and, simultaneously, labour demand increases.

3.2 Correlation for Quarter Data

Tab. 2: Pearson's correlation coefficient (Q1/1996-Q1/2011)

	Unemployment rate seasonally adjusted	Employment rate seasonally adjusted	Participation rate seasonally adjusted
GDP seasonally adjusted – growth rate q/q	0.076	0.083	0.193
GDP seasonally adjusted – growth rate q/q (q–1)	0.048	0.092	0.173
GDP seasonally adjusted – growth rate q/q (q–2)	0.025	0.101	0.157
GDP seasonally adjusted – growth rate q/q (q–3)	0.021	0.122	0.174
Inflation rate	-0.431*	0.639*	0.048
Investments seasonally adjusted – growth rate q/q	0.107	-0.038	0.053
Investments seasonally adjusted – growth rate q/q (q-1)	0.058	-0.005	0.051
Investments seasonally adjusted – growth rate q/q (q-2)	0.013	-0.004	0.008
Investments seasonally adjusted – growth rate q/q (q-3)	-0.009	0.060	0.067

Source: own calculation

Quarterly distributed data confirmed statistically significant correlation between inflation rate and rate of unemployment and employment. No significant relation was

confirmed among GDP growth rates and labour market characteristics or investments growth rates and labour market characteristics, which relations are very weak.

Tab. 3: Pearson's correlation coefficient (Q1/2007-Q1/2011)

	Unemployment rate seasonally adjusted	Employment rate seasonally adjusted	Participation rate seasonally adjusted
GDP seasonally adjusted – growth rate q/q	0.017	0.029	0.220
GDP seasonally adjusted – growth rate q/q (q–1)	-0.210	0.191	-0.063
GDP seasonally adjusted – growth rate q/q (q–2)	-0.423	0.379	-0.155
GDP seasonally adjusted – growth rate q/q (q–3)	-0.552*	0.501*	-0.167
Inflation rate	-0.765*	0.717*	-0.115
Investments seasonally adjusted – growth rate q/q	0.020	-0.060	-0.197
Investments seasonally adjusted – growth rate q/q (q-1)	-0.072	0.065	-0.027
Investments seasonally adjusted – growth rate q/q (q-2)	-0.062	0.060	-0.006
Investments seasonally adjusted – growth rate q/q (q-3)	-0.205	0.246	0.231

Source: own calculation

Using shorter period of time it can be seen that unemployment rate is statistically significantly correlated with GDP growth rate delayed by 3 quarters and with inflation rate. Employment rate is statistically significantly correlated also with GDP growth rate delayed by 3 quarters but with positive correlation and with inflation. This means that increasing GDP growth rate causes with delay of 3 quarters decreasing unemployment rate and increasing employment rate, i.e. higher proportion of workforce works compared to those who seek job.

Statistical significance between investments growth rates and employment or unemployment rates were not approved.

3.3 Regression Model

Using regression for analysis of GDP is always very problematic. Here is an example of quite simple linear regression model and its ability to forecast unemployment. Proposed model:

$$y_t = \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + u_t , \qquad (1)$$

where

y	number of unemployed individuals [000]	Source: LFSS
x_1	unit vector	
x_2	inflation rate [%]	Source. CZSO
x_3	average gross monthly wage - full time equivalent [000 CZK]	Source. CZSO
x_4	GDP growth rate (q/q) based on constant prices, seasonally adj. [%]	Source: CZSO

This model was estimated using OLS method based on quarter data 2004–2010:

$$y_t = 657.22 - 27.256 x_{2t} - 11.471 x_{3t} + 4.604 x_{4t} . \qquad (2)$$

Economic interpretation is obvious: if inflation grows by 1 percentage point, number of unemployed decreases by 27,256 individuals. Assumption for effect of inflation (negative correlation) is confirmed. If average monthly wage increases by 1 thousand CZK, number of unemployed decreases by 11,471 individuals, which meets also assumption regarding relation between unemployment and wage. If GDP growth rate increases by 1 percentage point, number of unemployed increases by 4,604 individuals. Expectation would be that GDP growth rate influences decrease of unemployment.

Statistical verification shows that constant, inflation rate and wages are statistically significant, whereas GDP growth rate is not. Coefficient of determination is $R^2 = 68.98\%$. Result of Durbin-Watson test for autocorrelation of residuals DW = 0.606 suggests that some delayed variable (by 1 quarter) should by included into the model. MSE = 1,512.9.

Prediction calculated from the model shows that number of unemployed individuals should decrease in 2011. Real information from Q1/2011 is 376,175 unemployed compared with forecasted value 344,099 and for Q2/2011: 354,591 (real number) compared with forecast 336,127. Thus, trend is captured but real labour market is higher regarding number of unemployed people.

Fig. 2: Estimated values and prediction of number of unemployed
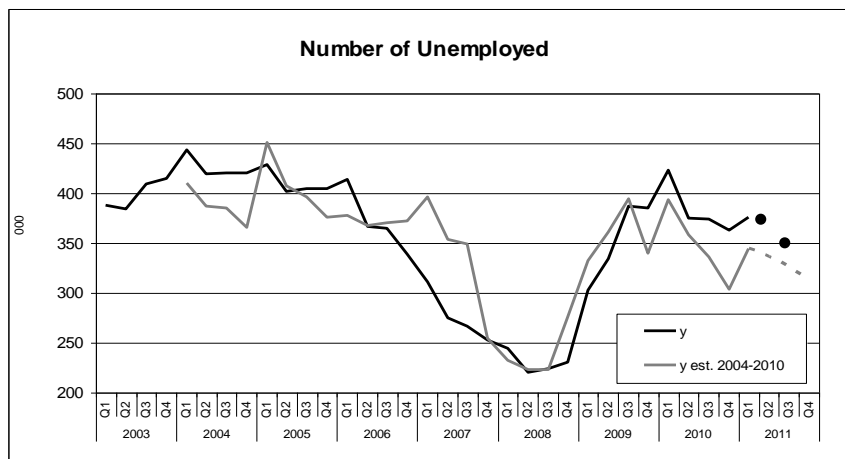
Source: own calculation

Conclusion

It was expected that unemployment rate is influenced by business cycle and economic development that is represented mainly by GDP and GDP growth. It was also expected that

labour market and employment and unemployment react with some delay, approximately 1–2 quarters.

These expectations were not statistically confirmed on quarterly distributed data for Q1/2007-Q1/2011 when crisis attacked the Czech Republic and Czech economy. It was proved that GDP growth affects unemployment and employment rate with the delay of 3 quarters, which is longer than expected. Statistical significance of investments was not confirmed as well. In the annual view there is significant relation between unemployment rate and GDP delayed by 3 years, which could be hardly justified by economic arguments. In most cases correlation coefficient between unemployment and GDP growth rate was negative, which confirms economic assumption (GDP grows and unemployment decreases afterwards).

Forecasts based on estimated regression model calculated from quarter data Q1/2004-Q4/2010 were compared with real data from first two quarters of 2011. It shows that such models could be used with caution. This model captured trend of decreasing number of unemployed people but was positioned lower than reality.

Acknowledgment

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