

COHERENCE OF TREND AND BUSINESS CYCLE IN THE DEVELOPMENT OF MAIN MACROECONOMIC INDICATORS

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Abstract

The long-term development of the economy of a country (trend¹) is usually characterized by the growth of the potential product and the cyclical development of main macroeconomic indicators (in economic literature known as the business cycle²) of the country and represented by the actual gross domestic product. These deserve attention not as issues analyzed separately but as mutually interdependent phenomena. The coherence of trend and business cycle becomes crucial in the forecasting of the economic growth of a country based on the extrapolation of the trend.

The objective of the paper is to show the limits of the application of statistical extrapolation methods used in forecasting the economic growth of a country. These limits arise from the choice of forecasting model as well as from the choice of time period length. The beginning and the end of the selected time period is strongly influenced by the phase of the business cycle. The extrapolation method used in this paper is applied to particular examples of GDP development in the Czech Republic in different time periods.

The analysis in this paper has two parts.

1. The effect of different business cycle amplitudes of fluctuations, together with different trends, on the economic growth measurement is shown graphically in model situations. The development of economic indicators is composed by the cycle and the trend (in case of a short time-series after seasonal adjustment). In the economy of two countries with the same amplitude of cyclical fluctuation the fast growing trend means only a slowing of growth in the recession phase, but a low rate of growth may show an absolute decline in production. The second option is the analysis of two countries with different amplitudes of cyclical fluctuation by the same trend of economic development. Deeper recessions mean an absolute decrease in the volume of production in comparison with slowing down economic growth in the case of mild recessions.

2. Examples show that time period choice influences the method of extrapolation as well as the resulting trend. The choice of forecasting model depends not only on the trend development of the analyzed macroeconomic indicator but also on the length of period chosen to build the model on. This is especially the case when, due to the cycle, high fluctuation due to the cycle appears, bringing with it the shortening or extension of the analyzed time period (by only one or two years even). This can crucially influence the results of the analysis.

Key words: *business cycle, extrapolation, forecasting, GDP, trend.*

¹ Under *trend* we understand a general tendency of a series of data to move in a certain direction over time.

² *Business cycles* are fluctuations which repeat regularly in the development of the economy of any country and consist of four phases (peak, recession, trough and recovery) but their lengths and amplitude of fluctuations are highly irregular.

1. Introduction

An analysis of macroeconomic indicators of any country always starts with a description of the growth of real gross domestic product. Economic growth expressed as the percentage year-over-year change of GDP is explained with the help of analysis of main macroeconomic indicators, including price level (inflation or deflation), labor market (mainly unemployment), money market and foreign exchange rates linked to the export and import of goods and services.

The liaison of the development of potential and actual products shows the deviation of one from the other defined as a recessionary or an expansionary gap (Frank, 2004). Government fiscal and monetary policy tools are directed towards closing these gaps.

Business cycle is an inherent phenomenon in the development of any market economy. Internal and external factors influence the length and volatility of individual cyclical fluctuations (Zarnowitz, 1992). Cyclical development is typical for all economic indicators in the macroeconomy and, hence, also in a microeconomic sphere.

2. The coherence of the long-term growth and cyclical development of an economy

In the long run, it is economic growth as the dominant indicator that is measured, which is represented by the year-over-year increase of Gross Domestic Product.

The endeavor of economic analysts in the short run is focused on forecasting the nearest turning point in cyclical development (the turn from recession to expansion and vice versa). The forecast of either of these two crucial phenomena, economic growth and the phase of the business cycle, should always be provided with respect to the latter or, better still, in their mutual interdependence.

2.1 The impact of the coherence of a business cycle and trend on the assessment of economic growth

It is needless to stress that the forecast of both indicators depends on many factors and facts that are found in the influence of internal economic forces in each country and in global economic development. Both are influenced by the macroeconomic policy of the country under analysis and the economic policies of other countries, namely trade and investment partners. Both long term economic growth and business cycle fluctuations develop to a high degree independently. Nevertheless, the macroeconomic situation in the country (and the situation of micro units especially) results from their mutual interdependence.

This fact can be demonstrated on model situations combining higher and lower rates of economic growth with larger and smaller amplitudes of cyclical fluctuations.

We start with a graph showing the model situation of a growing economy affected by recession. The recession is characterized as an absolute decrease of the volume of Gross Domestic Product in two successive quarters³. The negative growth of Gross Domestic Product is usually combined with an increasing unemployment rate, a growing number of

³There is no standard definition of **recession**. Generally, recession is a period of reduced economic activity. A quarter-on-quarter decrease in quarterly gross domestic product (GDP) in real terms at least in two successive quarters is called **technical recession**. A **wider definition of recession** says that recession is a period of reduced economic output and employment. (Czech statistical office. 2015. Recession, depression – Methodology)

company bankruptcies and the growing value of deficit and debt in government finance and so on.

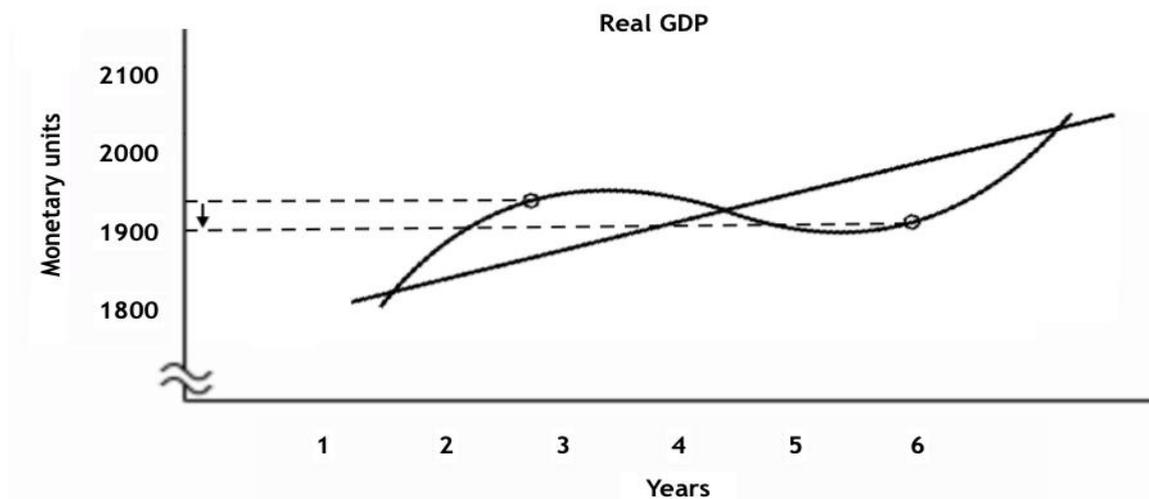


Figure 1. A model of recession resulting in an absolute decrease of the volume of Gross Domestic Product

In reality, two kinds of different combinations of the rate of growth of Gross Domestic Product and the impact of recession may occur. Both of them may strongly influence the economic situation of the respective country. We will show situations when both of them may mitigate the negative impact of the recession.

The first comparison is based on the different character of recession caused by a faster or a slower economic growth. The second comparison is based on the different influence of small or large amplitude of cyclical fluctuations.

a) Amplitude of cyclical fluctuations corresponding to Figure 1 is combined with rapid economic growth

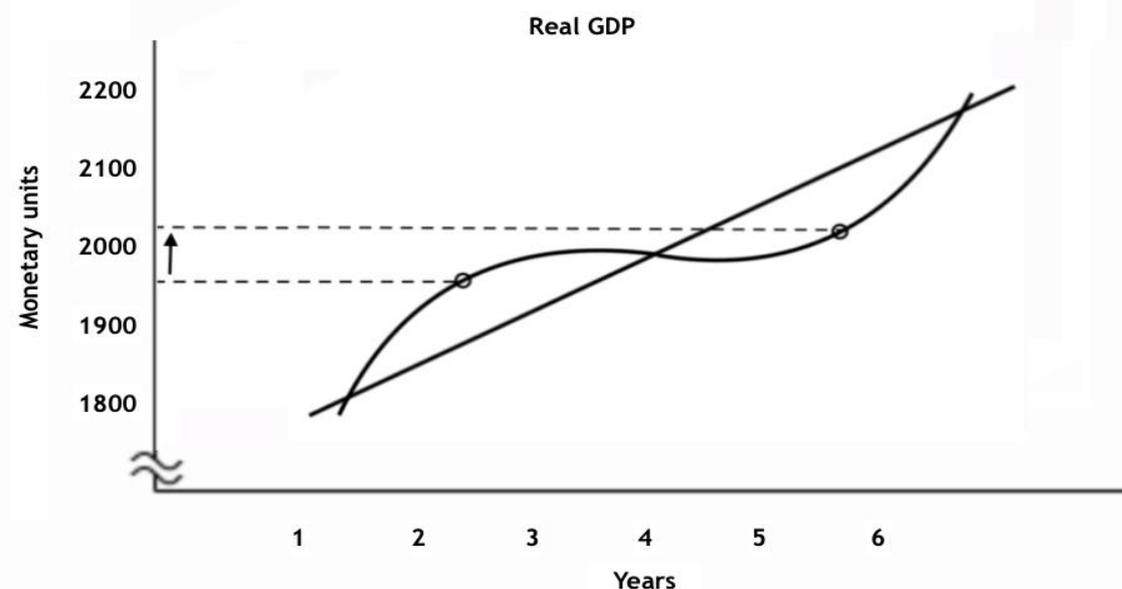


Figure 2. A model of recession in a country with rapid economic growth

The different impact of recession on the economic situation in countries with different rates of growth demonstrated by Figures 1 and 2 is obvious. The country with a high rate of economic growth (which is usually defined as “full-employment Gross Domestic Product”, (Blinder, 2011)) feels the recession as a slowing down of growth with positive rates (Figure 2).

b) Economic growth corresponding to Figure 1 is combined with a small amplitude of cyclical fluctuations

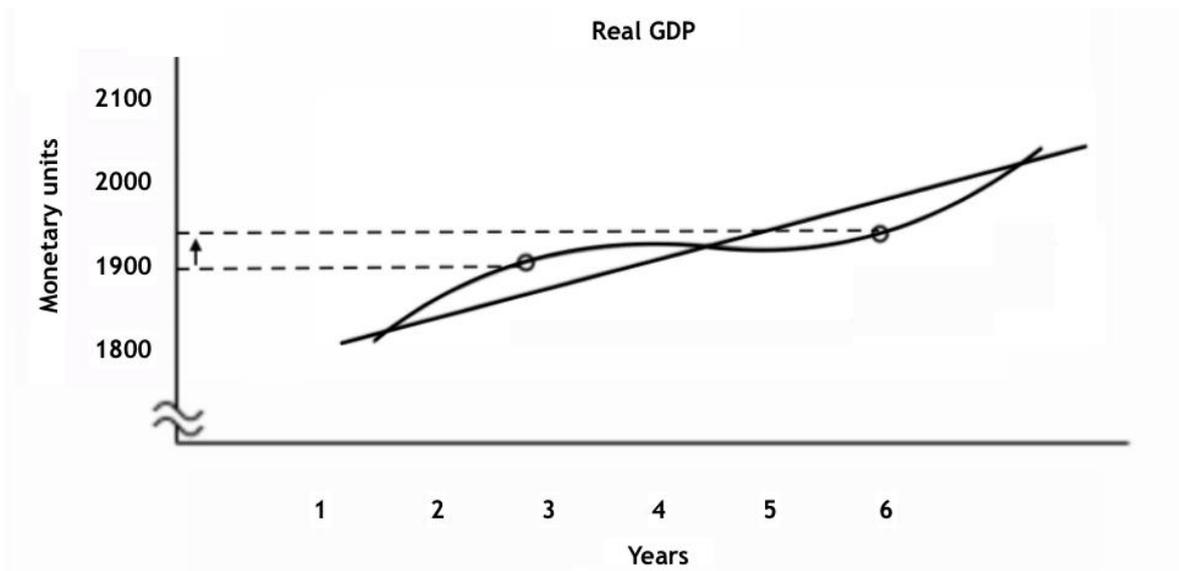


Figure 3. A model of recession in a country with small amplitude of fluctuations of the business cycle

Similarly, the different impact of recession on the economic situation in countries with different amplitudes of cyclical fluctuations as demonstrated by Figures 1 and 3 is also obvious. The country with a small amplitude of cyclical fluctuation (Figure 3) experiences recession as a slowing of growth with positive rates.

Ups and downs in time periods in many spheres of the economy and society are taken as normal and many fluctuations are considered to be natural, due to weather, life cycle, human health, etc. In macroeconomics most fluctuations exceeding very small amplitude are considered to have negative impact on economic development. The economy of the country prefers, in the long run, the steady growth of some indicators (e.g. gross domestic product) or steady decrease of other indicators (e.g. unemployment rate). For positive growth relatively smooth fluctuations around an optimal value are appreciated (moderate inflation, moderate changes in the exchange rate, moderate changes in exports and imports) until there is an urgent need for some change. Large fluctuations that include changes of indicators in a broad range of positive and negative values (not only changes in the rate of growth) have a negative impact on many spheres in the economy. To make up and come to the previous trend is, for the respective country, usually very costly (Fialová, 2014).

2.2 Trend extrapolation with regard to the impact of the coherence of business cycle and trend

The coherence of business cycle and trend causes many difficulties and presents barriers to trend extrapolation. It is the particular phase of the business cycle to be seen in the short-term that may crucially influence trend extrapolation methods and results.

Difficulties and problems related to the trend extrapolation of any economic indicator are described and analyzed in many economic works and articles. Statisticians have developed a range of methods in this field and give a variety of advice on how to work with extrapolation and how to avoid misleading conclusions, e.g. (Hindls, 2007). This article will focus on only one point, namely the importance of the length of period taken as the base for the extrapolation with regard to business cycle phases. As an example, the seasonally adjusted quarterly GDP of the Czech Republic will be taken in order to keep the theme of this article.

We are aware that the simple extrapolation we are going to demonstrate is only one of the methods used for forecasting, but the aim of this exercise is to highlight and stress the importance of the period choice. Also, GDP is officially forecasted by the Ministry of finance, but as mentioned above this indicator is merely used to highlight the problems that can arise when forecasting.

The development of the GDP of the Czech Republic in the period 1996 – 2013 is an excellent example of a variety of possible methods to illustrate a trend that may characterize the development of the indicator under analysis over the whole period. There are also a variety of possible approaches to extrapolation for future development depending on the weight we match to the business cycle phase.

By choosing periods of different length, we will demonstrate our conclusion regarding the influence of the respective business cycle phases on the whole process of finding the trend and making the extrapolation on the selection and comparison of data concerning the growth of GDP in the Czech Republic.

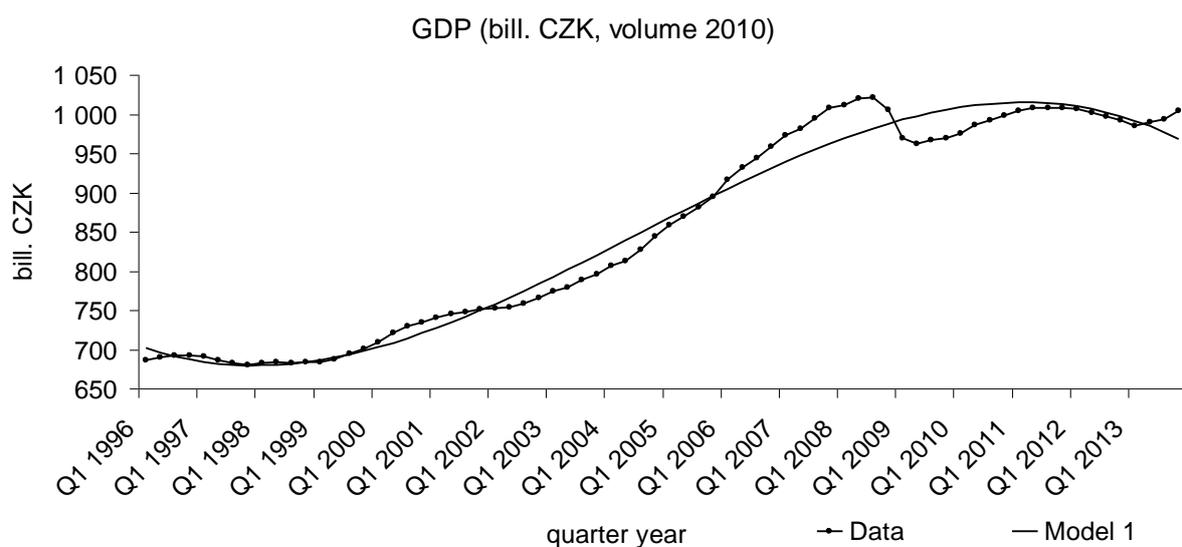


Figure 4. Seasonally adjusted quarterly GDP of the Czech Republic in the period 1996 – 2013 with the fitted line (bill. of CZK, volumes of 2010)

Data source: Czech Statistical Office, own calculations

For the purpose of this discussion we have taken four different periods of GDP in the Czech Republic in order to show the diverse results obtained. Model 1 takes all available periods between 1996 – 2013 into account. In Model 2 we cut the 4 oldest years and in Model 3 use only data up until the year 2007 as if this was the last available year. For Model 4 we took the most interesting period starting with GDP growth and ending at its peak (1999 – 2007).

The method of ordinary least squares⁴ was used and various regression models were tested. The results can be found in the following table, where the best three models for each period from the coefficient of determination (R^2 adjusted) perspective are shown. All models are statistically significant on the 5% level of significance as well as their parameters.

Table 1. Model comparison for different periods

R^2 adjusted	1996 - 2013	2000 - 2013	1996 - 2007	1999 - 2007
Cubic	0,976	0,954	0,993	0,992
Exponential	0,913	0,847	0,907	0,964
Quadratic	0,913	0,930	0,994	0,994

Source: Own calculations.

In the above table the complications of the trend extrapolation can clearly be seen. When every available period is taken, including the period 2000 – 2013, the best model is cubic. Conversely, for the two periods ending in the year 2007 the quadratic⁵ model shows the best results.

The following table specifies the estimates of parameters for each of the studied periods that are used for the calculation of the fitted or model data. Comparison can be made only between the same models and it is obvious that they differ considerably, both cubic and quadratic models.

Table 2. Parameters' estimates for different periods

Period	1996 – 2013	2000 – 2013	1996 – 2007	1999 – 2007
	1	2	3	4
Model	Cubic	Cubic	Quadratic	Quadratic
b_0	707 957,79	739 389,62	694 553,40	713 253,90
b_1	-7 073,94	-9 612,54	-2 648,40	-3 855,01
b_2	476,18	537,28	192,61	210,62
b_3	-4,55	-5,00	NA	NA

Source: Own calculations.

⁴One of the forecasting methods, e.g. in HEBÁK, P. a kolektiv. 2013.

⁵A type of the general polynomial regression model: $y = \beta^0 + \beta^1x + \beta^2x^2 + \dots + \beta^nx^n$, where $n = 2$; the cubic model holds $n = 3$

Despite the differences in parameter estimates, the predicted values for the period 1996 – 2013 and 2000 – 2013 are similar, as pictured in Figure 6. However, forecasts for the following year (2014) start to vary. Moreover, both models estimate GDP decline in the following years that is in contradiction of the general outlook and atmosphere in the Czech economy.

Case 1. Period 2000 – 2013

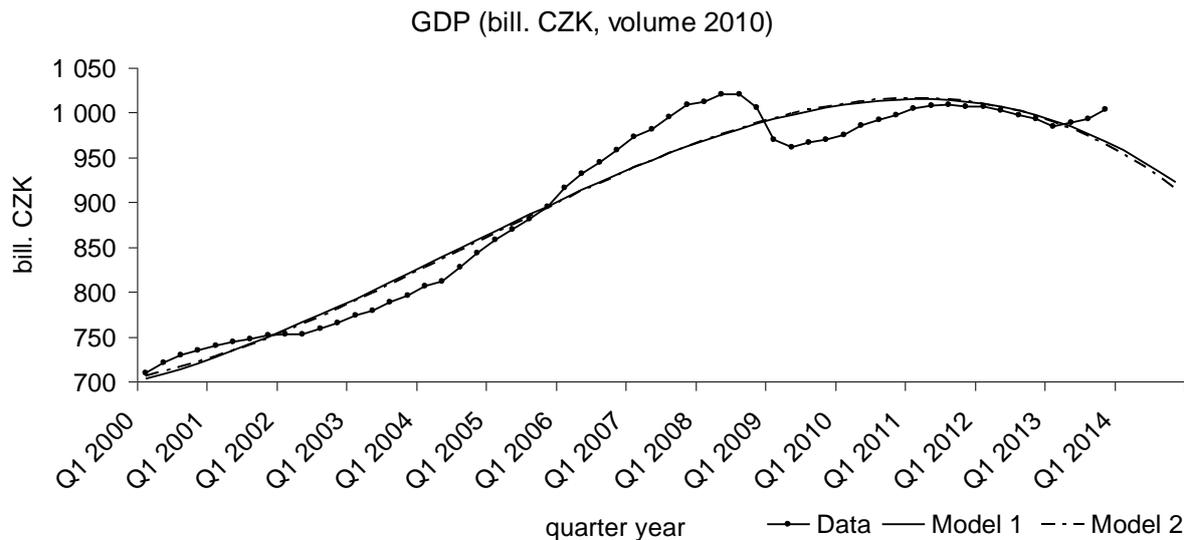


Figure 5. Seasonally adjusted quarterly GDP of the Czech Republic in 2000 – 2013, fitted lines of Models 1 and 2 with forecasts for 2014 (bill. of CZK, volumes of 2010)

Data source: Czech Statistical Office, own calculations

Based on business cycle analysis, at the beginning of the 21st century the economy of the Czech Republic showed all features of “overheating”. The rapid growth of GDP combined with other macroeconomic indicators was a signal of a coming slowdown. The recession that started in the USA and EU countries had to be imported to the Czech Republic without any doubt. (The openness of the Czech economy measured as the share of imported and exported goods and services in GDP is one of highest in the world). The period after 2007 was the crucial indicator for the forecast in nearest future.

Case 2. Periods 1996 – 2007 and 1999 – 2007

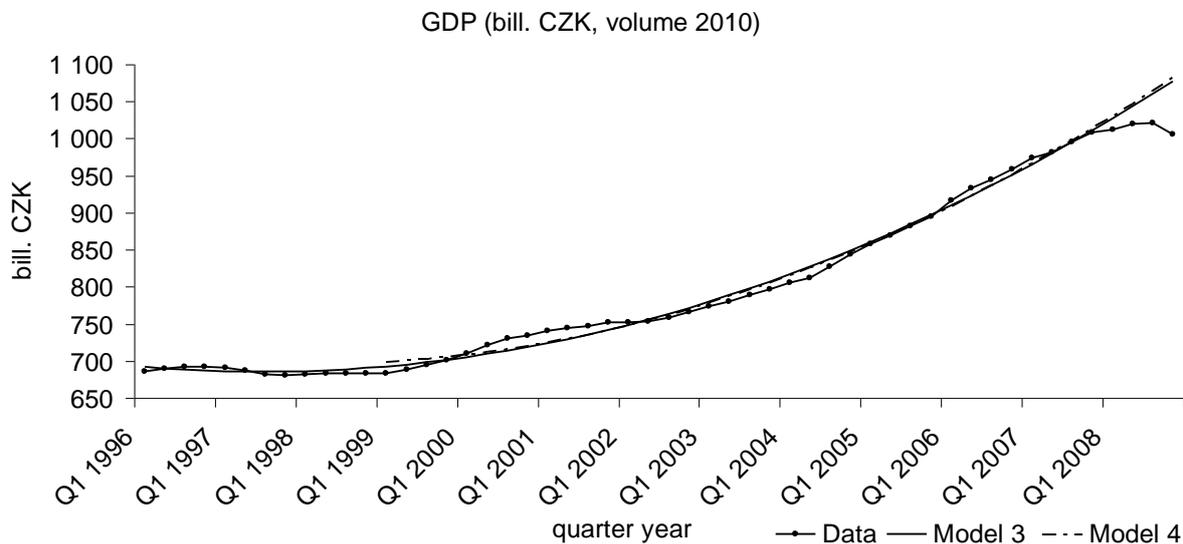


Figure 6. Seasonally adjusted quarterly GDP of the Czech Republic in 1996 – 2008, fitted lines of Models 3 and 4 with forecasts for 2008 (bill. of CZK, volumes of 2010)

Data source: Czech Statistical Office, own calculations

The extrapolation based on the period ending with the year 2007 shows the unreal increase in future years. Both models expect rapid growth in the following years but the current data show the opposite development. We can state that the estimated trend of models 3 and 4, is very optimistic regarding the economy's development.

The cases shown demonstrate the complication the forecaster can meet. All models from the classical point of view seem appropriate, but which of them to prefer? As questioned in the thesis (Svobodová, 2010) the sense for data and non-sample knowledge is one of the important aspects for the forecasting process. The decision made can often lead to critical consequences, such as significant loss or a misdirection of action.

In general we think that forecasting in such an insecure environment and time must be made with great caution and all possible aspects need to be taken into account. We will leave the individual solution to the decision maker himself. The purpose of this article is only to discuss the difficulties that can arise when forecasting in an unstable environment.

3. Conclusion

When forecasting the economic growth of an individual country or group of countries, even whole continents or integration groupings, we have to consider the business cycle not only as fluctuations of ups and downs in economic indicators but also as the result of interventions provided by governments of individual countries or international bodies.

We have to observe governments and their policies as a strong factor influencing the trend and fluctuations of economic development in individual countries. Government fiscal policy as such would, logically, be a pro-cyclical issue showing increasing revenues in periods of expansion and increasing spending in recessions leading usually to increasing deficits and debts. It is the role of executive bodies to provide an “anti-cyclical policy” promoting economic growth and mitigating recessions. The role of stabilizing the economy belongs to

the central bank and may lead to slowing down economic growth and changing the trend of the development. Governments play a remarkable role in the economic growth of countries in both directions: a positive role when mitigating business cycle volatility and a negative role when enforcing volatility as a consequence of inadequate and delayed steps taken in their fiscal and monetary policies.

In our article we have shown that different periods, incorporating only a few years more or less, give different results in the assessment of economic growth and may lead to different conclusions or even actions.

From a statistical point of view the success of the decision made based on the extrapolation, depends on the quality of the forecasting approach, period chosen and the experience of the forecaster. This conclusion of course applies to most forecasting attempts and not only for the GDP of the Czech Republic.

Government macroeconomic policy actions reflect the economic growth of the country and are often influenced by economic growth predictions. The statistical extrapolation methods used for the forecast of economic growth should consider professional skills in both statistics and economics.

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