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### PŘEDPOVÍDÁNÍ INFLACE NA SPECIFICKÉM PŘÍKLADU

#### INFLATION FORECASTING ON A SPECIFIC EXAMPLE

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#### Abstract

This paper is a comprehensive overview of inflation forecasting and inflation rate predictions. The scope of the problem is defined by the definition of inflation and rate calculation of inflation. A separate chapter is dedicated to the impact of inflation on the residents and the management of the economy. A specific example then deals with inflation in the Czech Republic and Czech National Bank controlling inflation. The paper ends with the possibilities of inflation forecasting in other countries and transnational territories incl. introducing input data.

Key words: inflation, inflation forecasting, predictions, methods

#### Abstrakt

Tento příspěvek je komplexním přehledem předpovědí inflace a predikcí míry inflace. Rozsah tohoto problému je představen definicí inflace a výpočtem míry inflace. Zvláštní kapitola je věnována dopadu inflace na obyvatele a řízení ekonomiky. Konkrétní příklad se zabývá inflací České republiky a České národní banky kontrolující inflaci. Závěrem jsou uvedeny možnosti předpovědi inflace v jiných zemích a nadnárodních územích včetně zavádění vstupních dat.

Klíčová slova: inflace, předpověď inflace, predikce, metody

#### Introduction

Estimating the future inflation rate is a key planning issue at the macroeconomic level. There are different procedures. This article attempts to present a comprehensive overview of these issues. The text begins with the problem definition, continues with a specific example and ends with suggestions of wider use.

#### The definition of inflation

According to the Czech Statistical Office (2017) inflation is defined as an increase of general price level of goods and services in the specific economy period. Equivalently, it can be defined as a decrease in inflation, the purchasing power of money. Enke and Mehdiyev (2014) state that inflation is one of the central terms in macroeconomics as "it 1) harms the stability of the acquisition power of the national currency, 2) affects the economic growth because investment projects become riskier, 3) distorts consuming and saving decisions, 4) causes an unequal income distribution and 5) causes difficulties in financial intervention".

Ismailov, Kakinaka, and Miyamoto (2016) proclaim that the empirical result shows that countries' decision of adoption of inflation targeting depends highly on their development stage. Inflation targeting is a monetary policy framework to maintain prices or inflation rates at a target level or within a specific range by controlling policy rate and other monetary policy measures (Murat, 2013).

Alimi (2014) proves that high rate of inflation worsens the efficiency of the financial sector through financial market frictions and slows down the economic performance. Zapodeanu, Cocibua, and Petris (2016) mention that inflation represents a great cost for households, business and the economy in general so understanding the characteristics of inflation is central in macroeconomics. According to O'Connell (2016), Keynes tends to be

represented as someone who thought that alleviating unemployment was more important than any other consideration. He did not recommend employment creation under all conditions of excess labor supply. In 1920, he recommended that inflation in the UK be controlled even if some unemployment would result, and there is at least some hint in his work that to him the relative importance of inflation and unemployment did not vary much over the remainder of his life.

#### **Rate calculation of inflation**

Inflation monitoring methods are used: the consumer price index (CPI-Consumer direct index), the producer price index. The producer price Index (PPI-Producer price index) deflator (ratio of nominal and actual VAT) (Czech Statistical Office, 2017). Moretti (2014) presents inflation targeting which has been adopted by an increasing number of central banks since the beginning of the 1990s. This new monetary policy framework requires a numerical objective for inflation, the absence of intermediate targets and a high level of transparency and accountability of the central bank.

Ashraf, Gershman and Howitt (2016) used an agent-based computational approach to show how inflation can worsen macroeconomic performance would be disrupting the mechanism of exchange in a decentralized market economy. Bruno and Easterly (1998) declare that inflation is not a purely economic or math class, also depends on the irrational behavior of people. The government frequently circulation of money, for political reasons, consumers on the other hand unreasonably buy certain goods or otherwise creating conditions for inflation. Explanation of Engelbrecht and Langley (2001) provides a simple historical description of per capita GDP growth rates before, during and after periods of high inflation crises. The pattern of growth shows a resurgence in after-crisis growth to above the before-crisis level. The robustness of this finding is tested against justifiable changes in the data sample used and against different crisis definitions.

According to Kajuth (2016), meaningful estimates of the non-accelerating inflation rate of unemployment (NAIRU) within a Phillips curve framework require an identified trade-off between inflation and unemployment. However, observations of inflation and unemployment are equilibrium points giving rise to a simultaneity problem.

#### Impact of inflation on the residents and the management of the economy

Impact per capita: inflation devalues savings and other monetary assets, causing rises in the price of goods and services, if the same rate shall not be increased wages and pensions are becoming poorer residents, can lead to a shortage of goods, which will atone for fear that it will not (Czech Statistical Office, 2017). Brada et al. (2015) describe that individual behavior has implications for organizations since individuals' own reactions to gains and losses resulting from the decisions they make on behalf of their organization are unlikely to reflect the organization's or their superiors' assessment of the same gains and losses.

Chang et al. (2015) show that if consumption and leisure are substitutes and their substitutability is relatively large, a temporary rise in inflation can raise, rather than lower, the shadow value of assets. Campbell and Vuolteenaho (2004) prove that at the market level, the

dividend yield is positively related to future inflation, and inflation explains 80% of the mispricing component in the S&P 500 dividend yield.

Anbarci, Dutu and Feltovich (2015) find the inflation tax harmful – with cash holdings, production, and welfare all falling as inflation rises – and that its effect is relatively larger at low inflation rates than at higher rates. Valadkhani (2014) examines the way in which output gap influences quarterly inflation during the period 1970q1–2013q1 in Canada, the UK, and the US by adopting a Markov regime-switching model.

According to Spiesova (2014) regarding inflation, the result of simultaneous model or the paired regression is the fact that revenue from allowances and inflation are independent of each other. Young and Bologina (2016) report reasonably robust evidence that inflation and currency crises lead to decreases in the extent of government regulations throughout an economy over a 10-year horizon. Brada et al. (2015) mention in these economies, initial levels of inflation may be too high to allow targeting such low inflation rates because the costs of doing so in terms of forgone output may be too high.

In Zhang and Huidong (2015), empirical results with quarterly data spanning from 1984 to 2012 show that in 1994 there was a significant structural change in the inflation dynamics model, after which China's inflation responded more significantly to foreign economic slack while the slope of the inflation-domestic slack relation reduced substantively. According to (Jansky and Hait, 2016), inflation rates have traditionally been measured by the percentage change in the price level of a market basket of consumer goods and services purchased by households. The market basket represents the spending patterns of the average household. However, households differ in their spending patterns and there are differences in the price changes of various goods and services.

Araujo, Berriel and Santos (2016) show that low targets the ones close to the optimal inflation under perfect commitment are unattainable, leading to a trade-off between low and credible targets. Moreover, since noisy public information helps to coordinate expectations around the announced target, our article supports unconventional policy prescriptions.

#### **Czech National Bank controlling inflation**

From the above evaluation, it is obvious that low inflation is optimal. Czech National Bank, which uses these following methods (Czech National Bank, 2017). According to Fernando (2015), concern over political influence on the conduct of monetary policy is an important element in the design of government institutions. However, for more open economies, the real exchange rate depreciation following such discretionary action is larger, raising costs for households and businesses, this result proved (Ghosh, 2014). Kukal and Quang (2014) proclaim that today inflation targeting regime is often used to conduct monetary policy in most developed economies. In this regime, a central bank manipulates its key interest rate to steer an economy to the objectives it wants to achieve.

Capistrán and López-Moctezuma (2014) publish in several central banks and other institutions It has become common practice to design and collect surveys containing professionals' forecasts of a range of macroeconomic and financial variables. Gaetano, Costas and Bullard (2010) formulate the central bank's problem of selecting an optimal long-run inflation rate as the choice of a distorting tax and planner who wishes to maximize discounted

utility for a stationary and heterogeneous population of infinitely-lived households in an economy with constant aggregate income and public information.

Roca and Barón (2010) explore the relationship between central bank independence and inflation in Latin America, using the experience of Colombia (1923-2008) as a case study. The analysis suggests that the central bank independence, combined with a commitment to price stability, renders the best results in terms of price stability. Antinolfi, Azariadis and Bullard (2016) formulate a central bank's problem of selecting an optimal longrun inflation rate as the choice of a distorting tax by a planner who wishes to maximize discounted stationary utility for a heterogeneous population of infinitely-lived households in an economy with constant aggregate income and public information. We show that the optimum inflation rate is positive because inflation reduces the value of the outside option for credit agents and raises their debt limits.

#### **Causes of inflation**

The root causes of inflation on the demand side are, the growth of the money at the same market size and market growth, i.e. inquiring, with the same amount of money (Czech National Bank, 2017).

A permanent increase of work productivity in the number of goods and services that are offered in the market leads to the fact that the same financial unit can buy more. The faster productivity grows the faster-growing purchasing power of money (Czech Statistical Office, 2017). Blanchflower et al. (2014) find, conventionally, that both higher unemployment and higher inflation lower well-being. We also discover that unemployment depresses well-being more than inflation. Chengsi and Huidong (2016) investigate the changing impact of economic globalization on inflation in China over the post-reform era. Bac and De Gaye (2016) provide the impact of oil price shocks on macroeconomic and financial variables has been widely scrutinized both theoretically and empirically since the seventies. The negative impact on aggregate demand can also stem from international wealth redistribution effects (oil exporting vs importing countries) and the decrease of consumers' income due to the reduction of factors' marginal productivity and hence remuneration.

The study of persistence in inflation has long been the focus of research and policy debate in economics. This is because the existence of a high degree of persistence in inflation has important implications regarding macroeconomic modeling and economic policy formulation. From a theoretical point of view, for example, if there is a unit root in inflation, this is in line with the view of the accelerations hypothesis which implies a no stationary inflation rate, state by (Chen and Hsu, 2016).

Pino, Tena and Espasa (2015) study the performance of different modeling strategies for 969 and 600 monthly price indexes disaggregated by sectors and geographical areas in Spain, regions and in the Euro Area 12 (EA12) countries. Country disaggregation forecasts are also reliable for the EA12, but only because derived headline inflation forecasting is not significantly worse than alternative forecasts.

#### Historical experience with inflation

Using the statistical technique of fuzzy clustering, regimes of inflation and unemployment are explored for the United States (US), the United Kingdom (UK) and Germany between 1871 and 2009. We identify for each country three distinct regimes in inflation/unemployment space. Similarities exist across countries in both the regimes and the timings of the transitions between regimes (Ormerod, Rosewell and Phelps, 2013).

#### Results

The results will assess the development of inflation in the Czech Republic and the development of inflation in the World.

#### Inflation in the Czech Republic

The Czech Republic (Czechia) was formed by the division of Czechoslovakia on January 1, 1993. The year-on-year inflation can, therefore, be measured since 1994.

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
10.0	9.1	8.8	8.5	10.7	8.1	3.9	4.7	1.8	0.1	2.8
2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1.9	2.5	2.8	6.3	1.0	1.5	1.9	3.3	1.4	0.4	0.3

Table 1 – Inflation in the Czech Republic

Source: Czech Statistical Office (2017, https://www.czso.cz/)

Until 1999, inflation was high. It was due to the transformation of economic operators, the introduction of new legislation and general conditions. Since 2000 there is an optimal level of inflation, except for the year 2008, higher inflation was due to the high price of oil \$ 150 per barrel and the culmination of the global economic crisis. Czech Statistical Office (2017). Darvas and Varga (2014) find that inflation persistence tends to be higher in times of high inflation. Since the oil price shocks, inflation persistence has declined both in the United States and the euro area.

Intervention variables	2017	2019	2021	2023	2025
Negative situation in Czechia	0.1	0.2	0.1	0.2	0.2
Populist Government behaviour	0.1	0.3	0.0	0.0	0.2
Lack of labour force	0.3	0.4	0.4	0.5	0.3
Labour productivity growth	0.0	-0.3	-0.4	-0.4	-0.5
High rate of efficiency of investment	0.0	-0.2	-0.1	-0.2	-0.2
Ageing of the population	0.3	0.4	0.4	0.4	0.5
Price of oil	0.3	0.5	0.5	0.2	0.2
Election of populist President of the USA	0.1	0.2	0.0	0.0	0.0
Immigration crisis	0.0	0.3	0.4	0.3	0.5
Any instability in the EU	0.0	0.3	0.4	0.4	0.3
Effects of globalization	-0.2	-0.2	-0.2	-0.2	-0.2
Total effect of the intervention variables	1.0	1.9	1.5	1.2	1.3

Table 2 – Inflation forecasting based on intervention variables Source: Czech Statistical Office (2017, https://www.czso.cz/)

The average inflation rate in 10 years is 2.1%. Overall price level growth is therefore expected to be 2.1% by 2017, 4.1 by 2019, 6.1% by 2021, 7.3% by 2023 and 9.5 % by 2025.

Intervention variables	2017	2019	2021	2023	2025
Upper confidence limit 0.99	6.4	8.2	9.3	10.2	10.9
Upper confidence limit 0.95	4.7	5.9	6.6	7.0	7.4
Expected inflation rate	-0.6	-1.5	-2.3	-3.2	-4.0
Lower confidence limit 0.95	-5.9	-8.8	-11.2	-13.4	-15.4
Lower confidence limit 0.99	-7.6	-11.1	-14.0	-16.6	-19.0

Table 3 – Inflation forecasting based on the extension of the time series of past developments Source: Author

Forecasts based on time series are a little bit lower than forecasts based on intervention variables. The reason is that inflation was high in the last decade of the 20th century because of the economic transformation and low in the first decade of the 21st century because of the economic stabilization. The trend is decreasing, therefore, which means this model expects to continue the downward trend.

#### Inflation in the World

Similar inflation forecasting methods could be used for other world economic data.

Country	1994	1995	1996	1997	•••	2013	2014	2015	2016
Czech Republic	10.04	8.99	8.76	8.60		1.44	0.34	0.31	0.68
Euro area (19)				1.70		1.30	0.40	0.00	0.20
European Union (28)				7.30		1.50	0.50	0.00	0.30
G7	2.25	2.34	2.31	2.05		1.33	1.55	0.25	0.84
Germany	2.69	1.71	1.45	1.94		1.50	0.91	0.23	0.48
China	24.10	17.10	8.30	2.80		2.60	2.00	1.40	2.00
OECD	4.70	5.92	5.55	4.69		1.61	1.73	0.59	1.09
Russia	307.72	197.41	47.75	14.76		6.75	7.82	15.53	7.04
Slovak Republic	13.42	9.84	5.78	6.14		1.40	-0.08	-0.33	-0.52
UK	2.00	2.60	2.50	1.80		2.60	1.50	0.00	0.70
US	2.61	2.81	2.93	2.34		1.46	1.62	0.12	1.26

Table 4 – Inflation in the World

Source: OECD (2017, https://data.oecd.org/)

It is always necessary to consider the specific macroeconomic situation of the analyzed country in inflation forecasts.

#### Conclusion

The aim of the article was to select a suitable methodology for predicting future inflation. A theoretical framework definition served to achieve this goal. As the most appropriate methods were selected forecasting based on intervention variables and forecasting based on the extension of the time series of past developments. The methods chosen were applied to specific data of the Czech Republic. An example showed that data from other countries or multinational groups such as the EU, G7, OECD, etc. could also be used.

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