Abstract
Inflation is in present time one of the most frequently applied economic terms in Czech Republic. The computation of the consumer price index is based on Laspeyres formula. On its basis the quarterly and annual rate inflation can be constructed. The annual rate of inflation is the product of four quarterly rates of inflation. The interpretation of the time behaviour of the annual rate of inflation is problematic even if from the point of view of its construction the shape of time series is logic. When this time series is published separately it evokes impression that the dynamic of the growth of the consumer price index has the same shape. While from the time series of the quarterly rate of inflation it is possible to create relatively simply the picture of the shape of time series of the consumer price index, the movement of the annual rate of inflation do not show it clearly.

1. Introduction
Inflation is in present time one of the most frequently applied economic terms in Czech Republic. It is employed not only by professionals from different economic branches but also by non professional people as they live in common economic reality. These people know very well that inflation is a negative phenomenon. Professional economists studied very intensively what consequence results from its inadequate growth. And it seems that these people or many of them are convinced that the inflation statistics is not problematic part of topic "inflation”. The method of measurement of inflation is automatically considered as a clear and perspicuous “constant”, where is no space for some improvements and changes in any way. Indeed that is not truth, the problem of inflation cover not only its reduction but also its measurement.

This paper is engaged only in one aspect of question of the measurement of inflation i.e. in the problem of construction and especially interpretation of short-term time series of the annual rate of inflation. The problem is illustrated by empirical analysis of development of inflation in Czech Republic in 1994 – 2006.

2. The rate of inflation
The computation of the consumer price index is based on Laspeyres formula

\[ I_{h/0} = \frac{\sum p_h q_0}{\sum p_0 q_0}, \]

where \( p_h \) is the price of commodity in the common month, \( p_0 \) is the price of commodity in the base time, \( p_0 q_0 \) are expenses of households for the commodity in the base time.

From the monthly time series of the consumer price index it is possible to construct quarterly time series of the consumer price index by the chronological mean. From the

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quarterly consumer price index a quarterly rate of inflation is computed. It is in the fact the coefficient of growth or the relative addition of the consumer price index. As the relative addition equals the coefficient of growth minus one, it is possible to compute the rate of inflation as the coefficient of growth. If time variable \( t = 1, 2, \ldots, T \) expresses individual quarters, the quarterly rate of inflation computed in quarter \( t \) has the following form

\[
RI_t = \frac{\sum p_t q_0}{\sum p_{t-1} q_0}.
\]  

(2)

The annual rate of inflation in quarter \( t \) is computed as

\[
R_{IA} = \frac{\sum p_t q_0}{\sum p_{t-4} q_0}.
\]  

(3)

This rate of inflation is possible to express also in the form

\[
\frac{\sum p_t q_0}{\sum p_{t-4} q_0} = \frac{\sum p_{t-3} q_0}{\sum p_{t-4} q_0} \cdot \frac{\sum p_{t-2} q_0}{\sum p_{t-3} q_0} \cdot \frac{\sum p_{t-1} q_0}{\sum p_{t-2} q_0} \cdot \frac{\sum p_t q_0}{\sum p_{t-1} q_0}.
\]  

(4)

It means that the annual rate of inflation is the product of four quarterly rates of inflation. The annual rate of inflation in quarter \( t+1 \) can be express as

\[
\frac{\sum p_{t+1} q_0}{\sum p_{t-3} q_0} = \frac{\sum p_{t-2} q_0}{\sum p_{t-3} q_0} \cdot \frac{\sum p_{t-1} q_0}{\sum p_{t-2} q_0} \cdot \frac{\sum p_t q_0}{\sum p_{t-1} q_0} \cdot \frac{\sum p_{t+1} q_0}{\sum p_t q_0}.
\]  

(5)

From relationships (4) and (5) it is clear that the annual rate of inflation in quarter \( t+1 \) is very simply computed from the annual rate of inflation in quarter \( t \). The change of the annual rate of inflation in quarter \( t+1 \) in comparison with the annual rate of inflation in quarter \( t \) depends on the ratio of the quarterly rates of inflation in quarters \( t+1 \) and \( t+3 \). The quarterly time series of the annual rates of inflation can be interpreted as the moving aggregate of the quarterly rates of inflation. The ratio of excluded and newly included quarterly rates of inflation determines the development of quarterly time series of the annual rate of inflation. If this time series is considered as the measure of development of inflation in the actual quarters, there is a big difficulty to interpret it. As a result there can be for example such paradoxical situation that the consumer price index displays very intensive growth for many quarters but the annual rate of inflation declines. It is obvious that also the opposite situation is possible. Picture 1 shows one of these situations. The basic time series (SI) is created artificially. First 12 values have linear growth, next 12 values have exponential growth and the last 4 values have again linear growth. From the picture it seems that the time series has exponential growth during the whole time period. The movement of the coefficients of growth with lag 4 (SI4) gives no information about the development of the base time series.
In this connection it has to be stressed that the reason of the construction of time series of the rate of inflation is to give information about the dynamic of movement of the price level.

The annual rate of inflation can be constructed also as the product of twelve monthly rates of inflation. The change of the annual rate of inflation in month \( t + 1 \) in comparison with the annual rate of inflation in month \( t \) depends on the ratio of the monthly rates of inflation in month \( t + 1 \) and in month \( t - 11 \).

From (4) and (5) it follows still one fact. The 4\(^{th}\) root of the annual rate of inflation, i.e.

\[
\sqrt[4]{\frac{\sum p_t q_0}{\sum p_{t-4} q_0}} = \sqrt[4]{\frac{\sum p_{t-3} q_0}{\sum p_{t-4} q_0} \cdot \frac{\sum p_{t-2} q_0}{\sum p_{t-3} q_0} \cdot \frac{\sum p_{t-1} q_0}{\sum p_{t-2} q_0} \cdot \frac{\sum p_t q_0}{\sum p_{t-1} q_0}}
\]

(6)

is simple geometric mean of the given quarterly rates of inflation. The time series of this indicator is therefore the series of the simple moving geometric means with the length of four quarterly rates of inflation. The monthly time series of the 12\(^{th}\) roots of the annual rates of inflation is time series of the simple moving geometric means with the length of twelve monthly rates of inflation. The interpretation of these time series is clear and obvious.


Picture 2 shows the quarterly consumer price index (CPI) and the quarterly rate of inflation in the form of the coefficient of growth in lag one (RI1). In the time series of consumer price index any type of seasonal pattern was not identified (by the periodogram and by the autocorrelation function). But this conclusion is possible to make also just by simple subjective checking of the picture of time series.

The series of the quarterly rate of inflation was in years 1994 – 1998 very variable and relatively high. Than in the years 1999 - 2003 the rate of inflation declined and than after 2003 it slightly grows.

On the picture 3 there are time series of the consumer price index, the quarterly rate of inflation and the annual rate of inflation transformed on the level of the quarterly rate of inflation. It can be seen that the movement of the annual rate of inflation copy in some shift forward the movement of the quarterly rate of inflation, but in the more smoothed shape.
From the picture 4, where are the non transformed quarterly rate of inflation and annual rate of inflation it is also seen that the annual rate of inflation is characteristic by the more cyclical behaviour.

From the above mentioned it follows that the interpretation of the time behaviour of the annual rate of inflation is problematic even if from the point of view of its construction the shape of time series is logic. When this time series is published separately it evokes impression that the dynamic of the growth of the consumer price index has the same shape. But the reality is different, for example from the second to third quarter 1998 there is relatively sharp growth in the consumer price index which is monitored by quarterly rate of inflation but the annual rate of inflation drops. While from the time series of the quarterly rate of inflation it is possible to create relatively simply the picture of the shape of time series of the consumer price index, the movement of the annual rate of inflation do not show it clearly.

Picture 5 gives very interesting view of this problem. It shows the time series of the quarterly rates of inflation and the series of the 4th roots of the annual rates of inflation laged by two quarters, i.e. the moving geometric means of the quarterly rates of inflation (GRI1).
References:


