MEASURING INFLATION: ANOTHER STOCHASTIC APPROACH APPLICATION TO CZECH DATA

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Abstract:
This paper presents measure of inflation based on the theory of the inner value of money. To account for the change in relative prices, (a)symmetric trimmed means are computed, as an approximation to Törnqvist price index adjusted by the trimmed means, which we consider as a plausible measure of inflation process.

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Introduction

Measurement of inflation is rather far from being an easy task. Suprisingly the problem may not be just in the data and computation difficulties, but also in the unsufficient or flawely defined theoretical framework.

In this paper we try to apply the version of stochastic approach to inflation measurement defined in Andrle (2003). Approach adopted is based on the theory of the inner value of money proposed by Carl Menger. We make attempt to operationalize the concept using the stochastic approach to index numbers with reference to characteristics of cross-section distribution of price changes. I hope it can reveal some relevant facts about inflation process and the behavior of prices in the Czech Republic, which would be otherwise unrecognized.

First, we introduce very briefly the theoretic framework for definition and measurement of inflation measure applied in the paper. Then we present an application of suggested framework to Czech data in period 1995:1 -- 2000:12. This paper is mainly empirical and presents results of the theoretical procedures described at length in Andrle (2003).

1. Elements of theoretical concepts adopted

1.1. Defining inflation

Carl Menger distinguishes inner and outer value of good. The outer value of money is meant to be the price of the good, i.e. the amount of money per unit of good that must be spent in order to make an exchange (in equilibrium). Similarly the outer value of money is the purchasing power of the money, i.e. the basket of goods available for one unit of the money. Using Menger's terminology, we can understand the consumer price index (CPI) as a measure for the outer value of money.

By changes in the inner value of money we understand only such price changes occured due to monetary causes. We adopt an approach that we take inflation as a change in the inner value of money (Menger,1976; Mises, 1953; Fase and Folkertsma,1997; Andrle,2003). The inflation phenomenon defined in this way is not directly observable (measurable), however. We may only adopt identifying conditions for measurement based on the *price effect* of the underlying process. Thus the inflation itself can never be measured exactly. However, it is important to realize that we have refused here the approach to inflation measurement based on the cost-of-living theory or the pure price level comparisons, which are the mostly used underlying concepts of the CPI. Inflation is then always and everywhere a monetary phenomenon. We shortly introduce the basic propositions.

Let's $p_{i,t}$ be the relative change in the nominal price of the *i*-th good in time t. Following Menger (1976) and Fase and Folkertsma (1997) we define relation

$$\pi_{i,t} = \alpha_t^M + \alpha_{i,t}^M + \beta_{i,t} + \lambda_{i,t} \tag{1}$$

We claim that the observed (relative) change of the *i*-th good is the result of the change in relative price due to real factors $\beta_{i,t}$, and due to monetary expansion $\alpha_t^M + \alpha_{i,t}^M$. The term $\lambda_{i,t}$ stands for the error of measurement (observation). The effect of the (excessive) monetary expansion we can decompose in two parts. The first one is the change in relative price of the *i*-th good caused by monetary expansion $\alpha_{i,t}^M$ and the second is the *change in the inner value of money* α_t^M, common to all goods – therefore missing the subscript *i*. We think that (1) can be treated as an identity and we do so. It should be noted that it is a flexible concept, as it allows the effect of monetary expansion on the relative price of the goods in the short-run. Also as we conclude in Andrle (2003) this approach does not require money to be exogenous and is suitable for the complexities of endogenous money creation.

If we omit to distinguish the reason for the change in the relative prices (monetary or real) we can rewrite (1) as follows:

$$\pi_{i,t} = \Pi_t + \varepsilon_{i,t} \tag{2}$$

where $\Pi_t = \alpha_t^M$ and $\varepsilon_{i,t} = \alpha_{i,t}^M + \beta_{i,t} + \lambda_{i,t}$. The change in the value of money (the inflation) is expressed in Π_t and is consistent with the definition of inflation adopted. Our effort is thus to extract the inflation from existing price data and to adopt an identifying conditions for the inflation process Π_t. As we believe that the plausible next step in measuring inflation is to use probability theory, we continue with probability approach to measuring inflation.

1.2. Stochastic approach to measuring inflation

Expression in (2) says that if changes in relative prices are zero, the whole change in nominal prices of the goods is due to monetary phenomenon (inflation) and the structure of relative prices is unchanged. Menger claimed that if the price changes are of the same direction and magnitude, the hypothesis of change in the inner value of money is more *probable* than hypothesis of simultaneous change in the inner value of every good. Of course that it is not certain, as economic agents have their own perceptions of relative prices. We propose statistical, probability treatment of this issue. There are two main probability aspects of our problem: (i) we try to extract signal from the disposable price data and (ii) these price data are considered as a draw from unknown population of price changes.

In Andrle (2003) we conclude that we need to find proper weights (and the economic motivation for these weights) in the estimator

$$\overline{\Pi}_t = \sum_{i=1}^{N} w_{i,t}\pi_{i,t} \ , \tag{3}$$

which we want to use as a measure of the inflation process. We need to integrate in these weights economic weighting with reference to quantity of transactions with each commodity (its importance) and the weighting reflecting the volatility of each price change, which complicates extraction of the inflation signal. [1] But the interesting point is that the weights in (3) ideally should not be motivated with reference to consumer and his consumption basket, his costs-of-living. Following Theil (1967, pp. 136 –137) we try to capture the economics (transaction) importance of the good also in a probabilistic way. The more important each commodity is, more frequently it is represented in the population of the prices of commodities from which we should make random draw. The probability of drawing particular good *i*, is $s_{i,t} = (p_{i,t}q_{i,t}) / \sum_{k=1}^{M} p_{i,t}q_{i,t}$,where p and q stands for price and quantity, respectively. Thus a commodity which is subject to more transactions is more important in the economy and it is also more important for measuring inflation. As the price change takes place between two periods t and $t-1$, we use as a weight arithmetic average of the weights in both periods. This information can be used to derive Törnqvist price index

$$\log P_t = \sum_{i=1}^{N} \frac{1}{2}(s_{i,t} + s_{i,t-1}) \log(p_{i,t} / p_{i,t-1}) \tag{4}$$

Taking antilog of (4) we obtain Törnqvist-Theil price index, which has important role both in economic and axiomatic approach to index numbers, see Diewert (1976, 2001).

As mentioned above, an extraction of the inflation signal also depends on the volatility of the price changes, i.e. on the frequency of the *changes in relative prices*. As argued already in Edgeworth (1887, 1888) or Bryan, Cecchetti and Wiggins II (1997), large, often and sudden changes in price of the good are *probably* changes in its relative prices. In each period we have at our disposal only a sample of price changes, from which there may be also price movements highly unrepresentative for the inflation measure, i.e. for the estimate of the central tendency of the population. These unrepresentative price changes (changes of relative prices) may be divided into four main groups: (i) administrative measures, (ii) seasonal price changes, (iii) price inadjustment to monetary shock due to menu-costs, imperfect information, etc. and (iv) "real shocks". This list is not complete and individual items are not mutually exclusive. For detailed discussion see Andrle (2003). Theory deals mainly with (iii) and (iv), however we consider (i) very important in the case of the transition economies.

With reference to existing empirics (e. g. Edgeworth 1888, Bryan et al. 1997, Aucremanne 2000) on sample cross-section distributions of price changes, we may assume that the population distribution is highly kurtotic and often asymmetric in majority of countries.[2] Also the cross-section distributions of price changes possess *long tails*, i.e. there is relatively small number of extremely large outliers. Naturally, this fact may significantly affect estimates of the central tendency of the population distribution. As an illustration we have chosen sample distribution in non-extreme month in the case for the Czech Republic in Fig. 1.

--------------- Fig. 1 about here ------------

More detailed discussion of the distribution of price changes and its relevance to inflation measurement can be found in (Kearns 1998, Ball and Mankiw 1995, Andrle 2003). One should also realize that even from symmetric population it is possible to get asymmetric sample distribution. More kurtotic the population distribution is, the higher is the probability of drawing some extreme observations, which will be not balanced with the similar way on the opposite end of the distribution. This may be the case with price changes – we may have extreme increase in price of some seasonal good, which may not be balanced by fall in price of another commodity, etc. In reality we are not facing full general equilibrium model. Let's assume that the population distribution is symmetric. An estimate of the central tendency then crucially depends on the kurtosis of the distribution. Sample mean is definitely not the most suitable estimator of central tendency for all kinds of distributions. Even small departure from Normality causes the sample mean to be much less efficient with respect to different estimators, however it is still unbiased estimator.

The sample mean is too affected by outliers. Using similar (statistical not economic) arguments already Edgeworth (1887, 1888) proposed using a *median*[3] for measuring inflation. But we seek for *robust*, not just *efficient* estimator of central tendency of population distribution. It stems from the fact that we do not know the shape of the population distribution and it is also probably changing in time. Therefore the demanded estimator does not have to be the most efficient for particular distribution, but it is on average very efficient for some family of distributions on which we can infer using sample information. [4] As we limit ourselves to linear estimators, we shall work with so called L-estimators. This class of robust estimators is based on linear combination of order statistics. We shall use special L-estimator – trimmed mean—, which has a special feature, that sample mean and the sample median are subsets of the trimmed mean. The use of robust estimators, especially of L-estimators in measuring inflation is not unusual (although the economic reasoning may differ from ours), see Bryan et al. (1997), Aucremanne (2000), Roger (2000) and others. As median is also the member of the L-estimators and trimmed mean can mimic median, the first researcher using "robust" statistics for measuring inflation was F. Y. Edgeworth (1887, 1888).

L-estimators are constructed as follows: Observations are ordered, and weighted according to theirs relative position and then averaged. Trimmed means assigns α % of observations at each tail of the distribution zero weights, i.e. information about α %observations at each tail is discarded. The sample mean is if we have $\alpha \to 0$, in the case of $\alpha \to 50$ we obtain sample median. The ordered observations in our study are the transaction-weighted price changes. Hence, the statistical weighting (applying the trimmed mean) comes after the transaction weighting (Törnqvist price index).

Symmetric trimmed means mentioned above are not plausible for estimation of central tendency from asymmetric population distribution. If the population distribution is positively skewed, then symmetric trimmed means will produce systematically biased estimates (biased downwards) of the central tendency. To eliminate this bias in the case of positively skewed distribution, we have to trim more observations from the left tail than from the right tail. Therefore we shall introduce asymmetric trimmed-means. In following empirical application to Czech Republic we conclude that the positive skewness of population distribution of cross-section price changes may be the case for the Czech Republic.

Hence, we propose (a)symmetric trimmed means applied to Törnqvist price index as a plausible measure of the inflation signal, i.e. the change in the inner value of money. [5]

Although trimmed means cannot be judged as an ideal measure of inflation, it may serve as a close approximation. The main advantage of this measure is that we apply the same rule to all information possibly corrupting the inflation signal (i.e. the changes in relative prices) and we do not exclude some information a-priori. However, as we do not investigate each change in price of individual commodity – which is impossible and implausible, both theoretically and empirically, see Jevons (1863) – there might be situations where we discard some (or the only) information about the change in the inner value of money (Bakhshi and Yates 1997, Andrle 2003). Our tool is based on probability and we conclude that the probability of such a situation is almost negligible.

The theoretical motivation for suggested measure of inflation is investigation of the change in the inner value of money. As it can never be measured accurately (Mises 1953, Menger 1976) we can locate the inflation signal with certain degree of probability and to adjust from majority of other factors. We believe this to be very valuable information about economic development in each country, together with disaggregated statistics on cross-section behavior of prices.

2. Applying trimmed means to Czech data

In this section we try to operationalize the theoretical concept outlined above. First we comment on data and data constraints, then we present basic relations used for computations and finally we present the results.

Because of the space limitations we present just the very basic calculations, but all other information can be obtained from the author upon request, or in Andrle (2002) and its accompanying CD-ROM – computer codes, raw data and various detailed results on the behavior of the prices in the Czech Republic. All computations were carried out using OX – Object-Oriented Matrix Programming Language, see Doornik (1999).

2.1. Data and data constraints

The main problem of our analysis is the impossibility of construction of Törnqvist price index at monthly frequency for the Czech Republic. We work just with consumer price statistics and the only weights at our disposal are the *constant weights*, reflecting the importance of the goods for the consumers, based on household surveys. We can, however, treat these weights as first-order approximation to transaction weights proposed above without major problems. The only possible advantage of the weihts used is that the trimmed mean using $\alpha = 0$ is the sample mean, i.e. the standard CPI.

The weights are constant through 1995:1 – 2000:12. We work only with this period, as the items in consumer price statistics changed, together with theirs corresponding weights. Thus we have 72 months and 192 items, as we work with the aggregation SKP4, not directly with the individual items. To differentiate the analysis, we construct three main data sets: CPI, NET and NET-SA.

CPI: This basket is based on all items of consumer statistics, used for construction of Consumer Price Index (CPI). Our calculations reproduce exactly the official CPI.

NET: This data set uses the adjusted basket, with the same weights or remaining commodities. It has been used for construction so called “net inflation index”, which used to be an inflation target of the Czech National Bank. The items with administratively set (regulated) prices are excluded from the full basket. Extracted are concrete items with theirs weights, the impact of other administrative measures is not eliminated here.

NET-SA: This data set contents the same items as NET, but the items are seasonally adjusted. Many researchers on price measurement work only with seasonally adjusted prices. As we do not want to introduce additional uncertainty into our calculations, we work with both data sets. This allows us also to comment on the seasonal behavior of the prices. The seasonal adjustment was done using the X-12-ARIMA procedure.[6]

We are of the opinion (Jain, 1989) that the seasonal adjustment of the prices should be exercised on the aggregate measure, not the individual items. The individual (and not interlinked) seasonal adjustment using time series procedures may corrupt existing offsetting relationships among the prices in the economy and to distort the computations significantly. Even the fact that we work with the draw of the commodities from the population space may introduce these distortions and we do not want to add another complication. However, our computations show that the seasonal effects tend to offset one another, even in our draw from the population of consumer prices. This may be recognized even from the Fig. 2, where the NET and NET-SA are depicted, (weighted) sample means month-to-month changes.

--------------- Fig. 2 about here -------------

These results strengthen our conviction that use of the year-over-year growth rates in consumer statistics is not to acclaimed seasonality of the indices, but to smooth the data and reduce the noise coming from the changes in relative prices. The year-over-year variations present the geometric mean without using the 12 root and therefore depend crucially on the entering and exiting element (i.e. in time *t* and *t-12*). This measure has then limited information on current development on prices (in current month), so we continue in our analysis using the month-to-month changes in price indices.

2.2. Characteristics of the sample distribution of the price changes

Before we start the discussion of the characteristics of the distributions of price changes in the Czech Republic, we shall briefly review the computations details.

The consumer price index (and also NET and NET-SA) is computed as

$$\mathrm{CPI} = \sum_{i=1}^{N} w_i p_{i,t} \qquad w_i > 0; \quad \sum_{i=1}^{N} w_i = 1 \tag{5}$$

where w_i stands for the *constant* expenditure weights and $p_{i,t}$ are the level indices of the individual items with the same base. The price change of the individual *i*-th commodity we compute simply as

$$\pi_{i,t}^{h} = (p_{i,t} / p_{i,t-h}) - 1, \tag{6}$$

where we have set $h = 1,3,6$ and 12, although in this paper we present the results for $h = 1$ only.[7] Next we can define

$$\overline{\Pi}_{t}^{h} = \sum_{i=1}^{N} w_{i,t}^{h} \pi_{i,t}^{h} , \tag{7}$$

with time-varying weights $w_{i,t}$, reflecting relative importance of the *i*-th good. To obtain consistency of (7) with the growth rates of (5), we adjust the constant weights to account the change in the relative prices, see Bryan et al. (1997) or Aucremanne (2000), as follows:

$$w_{i,t}^{h} = w_i (p_{i,t-h} / \mathrm{CPI}_{\mathrm{t\text{-}h}}) \tag{8}$$

Using this transformation we make relative changes in CPI (5) equal to (7), so zero trimmed mean applied to (7) will reproduce exactly the CPI growth rate. This transformation is not necessary for the theoretical approach adopted.

For characterizing the price distributions we use weighted, standardized central moments, especially the skewness and kurtosis. These two measures, together with the variance are weighted by the time-varying weights $w_{i,t}$ -- see Spanos (2000), Aucremanne (2000) or Kearns (1998). The positive skewness coefficient indicates positive skewness (right-skewed distribution). If the distribution is symmetric the skewness coefficient is zero, the opposite does not hold. The kurtosis coefficient is related to Normal distribution which has the kurtosis coefficient of three (mezzokurtic), values above three indicate leptokurtic distributions; the values bellow three indicate platykurtic distributions. In Tab. 1 we present the mean and standard deviation of the weighted variance, skewness and kurtosis coefficient and Jarque-Bera statistic for all used data samples, for the case of $h=1$.

------------- Tab. 1 about here --------------

The results indicate very high kurtosis during the whole sample and on average positive skewness for all data sets. However, the skewness coefficient is highly volatile and often changes sign as may be seen on Fig. 3. Variance, skewness and kurtosis coefficients are highest for CPI, much smaller for NET and smallest for NET-SA. As expected and indicated by the Fig. 2, the differences between NET and NET-SA are very small. This supports the hypothesis that influences of seasonality are to large extent idiosyncratic. The computations also allow as making assumptions about population distributions as to high kurtosis and positive skewness, and the results are not qualitatively different from other countries results. Especially the great kurtosis is well known stylized fact with the mentioned consequences for the sample mean. Calculated Jarque-Bera statistic allows us to reject the hypothesis of Normality for almost every month for all data sets, which is not surprising.

------------------- Fig 3 --------------------

The significant differences between CPI dataset and NET (or NET-SP) may be attributed to regulated prices. Regulated items are gradually deregulated, the price changes are almost exclusively positive and very large, i.e. on the right tail of the distribution of the respective month. As the tails are prolonged by these movements, kurtosis coefficient is higher and because it is related to right tail, the skewness coefficient reflects the positive skewness of the distribution. Of course, the absolute majority of these administrative price movements are not representative for indicating the change in the inner value of money, as the items are set closer to natural market price. These price changes are thus the natural candidates for trimming.

2.3. Application of symmetric trimmed means

We believe that applying the trimmed means to Czech data may help to extract the inflation signal from the price data. Following Bryan et al. (1997) and Aucremanne (2000) we construct symmetric trimmed means in the following way: First we order the observations $\{\pi_{1,t},\ldots,\pi_{N,t}\}$ and the corresponding weights $\{w_{1,t},\ldots,w_{N,t}\}$. We define the $W_{i,t}$ as cumulative weight $W_{i,t}=\sum_{i=1}^{j} w_{i,t}$. We determine the set of observations that will be used for computation to be centered as $\alpha/100 < W_{i,t} < (1-\alpha/100)$ and denote this interval as I_α. The symmetric trimmed mean is then constructed as

$$\mathrm{TM}_\alpha = \frac{1}{1-2\dfrac{\alpha}{100}}\sum_{i\in I_\alpha} w_{i,t}\pi_{i,t} \tag{9}$$

We carried out the computations for the CPI, NET and NET-SA and in this paper we present the results for $h=1$, i.e. mont-to-month changes. The most important question now is how to determine the optimal trimming percentage α. Theory indicates that the optimal trim should be set according to kurtosis of the population distribution. However that is what we do not know and that is why we try to construct the robust measures. There are basically two main approaches how to choose the optimal level of trimming percentage (Aucremanne 2000, Bryan et al. 1997, Andrle 2003). The first one is to base the choice on the information coming from the sample distributions and to construct time-varying α. This procedure was used by Aucremanne (2000), where the trimming process was stopped after the hypothesis of Normality of the distribution could not be rejected using the Jarque-Bera test. The second and most used is the calibration to trend, using arguments from Bryan et al. (1997). They took 12, 24 or 36 month moving average of the sample mean as a trend. For chosen time period the optimal trim is constant, then. Both procedures have positive and negative features (Andrle

2003). The main problem of the constant optimal trimming percentage is the fact that in some month there can be excluded too much information, whereas in other month too few information.

We decided to use the calibration to trend. However, we decided to use Hodrick-Prescott filter instead of moving averages. Using HP-filter we can obtain smooth, nonlinear trend; we use four settings of smoothness with λ=500, 200, 1600, 4800. The smaller λ, the closer the trend is to the original series. Optimal trimming percentage for the whole period 1995:1 – 2000:12 is set on the base of RMSE (Root Mean Square Error) or MAD (Mean Absolute Deviation). As these two measures sometimes differ dramatically – RMSE put more weight on larger deviations – the primary judging tool is RMSE.

Using HP-filter has another attractive feature for us – we do not loose any observations, which is convenient as we have rather short time series. Another positive feature is the flexibility of setting the smoothness parameter λ, we can easily test the sensitivity for chosen benchmark. The main disadvantage of using the procedure of calibration to trend is the fact, that in the presence of large extremes in CPI data set, whole trend is shifted upwards because of few extreme months and the procedure seeking for optimal trimming percentage fails more easily. The consequence of this might be that the result for optimal trim will be smaller than without the outliers. As we will show, this is the case for the CPI data set and the only possibility to overcome this problem is to try to employ the time-varying α based on the Normality hypothesis (Aucreanne 2000).

The results on optimal trimming percentages, for various benchmarks and evaluated both by RMSE and MAD for h=1, are presented in Tab. 2.

------------ Tab. 2 about here ----------

As can bee seen in Tab. 2, the trimming percentage for CPI data set is significantly lower than for the NET or NET-SA. This is the above mentioned consequence of the “trend shift” due to outliers. Thus applying this method on the data set including regulated items in the transition countries is not feasible. The evolution of RMSE or MAD depending on the level of trim at first dramatically decline and after the optimum point both measures increase again, more gradually. However, these results are unsatisfactory as we have argued that in the presence of chronic positive skewness of the sample distributions (hence probably the population distribution) the symmetric trimmed means are systematically biased. We need to introduce asymmetric trimmed means with the trimming percentages (α, β) different for each tail.

2.4. Application of asymmetric trimmed means

The calculation of asymmetric trimmed means is carried out in very similar style as in the case of symmetric ones. However, we calculate all possible combinations of right and left trimming percentages and the resulting series are then evaluated by RMSE and MAD. As the symmetric trimmed means are centered around 50th percentile, the asymmetric trimmed means are centered around different percentile. When the distribution is positively skewed and the trimming was done asymmetrically, then the trimmed means are centered around the percentile higher than 50th percentile; we call this point mean percentile.

----- Tab. 3 about here -----

We present the results for various benchmarks for h=1, evaluated by RMSE in Tab. 3. Optimal trimming percentages evaluated by MAD were significantly different. As we expected, the left tail trimming percentage is higher than the right one. Also the process is more stable, i.e. less sensitive to selected benchmark than the results in Tab. 2. The mean percentiles are close to 60th percentile as presented in Tab. 4. (evaluated by RMSE).

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As an additional exercise we carried out simulation where the benchmark for CPI data set was the NET data set. The optimal trimming percentages were (39, 18) and the structure of excluded items is rather different from just the administrated set. [8] Example of optimal trimmed mean (for λ=50 and *h*=1) of NET data set is presented in Fig. 4.

--------- Fig. 4 about here ----------

One of the interesting thing is, that the optimal trimmed means (for various level of trend smoothness) are very close to one another for CPI, NET and NET-SA – except the large hike in CPI series in 1997:11 which shows that the influences of deregulations were not eliminated by trimming. Further exploration of the features of obtained computations may be led towards the more detailed results on the behavior of prices, or evaluation of the information contents of the trimmed means opposite to the original "sample means" series. In this paper we follow the line of exploring the information contents.

3. Information contents of the trimmed means

It is not a trivial task to evaluate the "feasibility" of the measures we have computed. We cannot compare this measure with true, unobservable inflation process. However, as we have reached consistency of the zero trimmed mean with the (CPI, etc.) we can test the difference of the inflation signal of those two series. The fact we can test is whether our inflation measures are less spoiled by relative prices than the officially computed measures (which are also motivated by different theory).

As we have calibrated the trimmed means to extracted trend, see Bryan et al. (1997), we may look whether the adjusting procedure used really dampens the fluctuations of the month-to-month index caused by the noisy changes of relative prices. There is no doubt that we have reduced the volatility dramatically, see Tab. 5.

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However we consider the information content either with regard to theory or the practical application more important. We can focus on the excluded price changes – on their properties and on the properties of the computed measures. Two aspects of our results are interesting – whether the excluded parts are stationary and whether the trimmed-means and headline measures display non-diverging pattern. These assumptions are important for practical use of the inflation measures, but need not necessarily hold with regard to theory of inner value of money.

The residuals from the trimming exercise are stationary, with the zero mean – except for the residuals from CPI, as expected due to pattern of the huge administrative changes. In the sample period the trimmed means and the headline-rate does not display diverging patterns, even after recalculation year-to-year percentage changes. Andrle (2002) tests for the Granger causality between the original and adjusted series. His results are, however, affected by the fact that the test was possible to undertake only within sample.

4. Conclusion

In this brief paper we tried to introduce alternative measure of inflation, based on different theoretical motivation than the cost-of-living theory of the pure price level comparison. We have argued that the Törnqvist price index adjusted by asymmetric trimmed means is an interesting option how to monitor the inflation process in the (transition) economy.

However, due to data constraints we presented only CPI measure adjusted by the trimmed means. We concluded that asymmetric trimmed means are superior measure of inflation process than the symmetric ones, because of the average positive skewness of the sample cross-section distribution of prices.

However not perfect yet, the measures outlined above give an interesting insight in the inflation process in the country and allow to study more closely (on systematic basis) the behavior of prices, especially the characteristics of the sample cross-section distribution of prices, which is undoubtedly important indicator for the policy makers. In the transition economies, statistical measures describing the behavior of price are even more interesting and we think that regular publication of characteristics of the sample cross-section distribution of prices may be beneficiary.

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Tables

Tab. 1 – descriptive statistics of the price data

h=1	**CPI**		**NET**		**NET-SA**	
	mean	*std.*	*mean*	*std.*	*mean*	*std.*
Variance	12,63	23,00	9,70	15,50	4,14	4,43
Skewness	2,77	6,08	1,93	4,65	1,21	4,89
Kurtosis	69,98	22,93	44,07	48,88	45,90	47,90
JB-stat	140820	544910	29122	80752	29579	81282

Source: Czech Statistical Office (CSU), own calculations

Tab. 2 – optimal trimming percentage for the symmetric TM

h=1	**CPI**		**NET**		**NET-SA**	
	RMSE	*MAD*	*RMSE*	*MAD*	*RMSE*	*MAD*
50	10,00	14,00	25,00	20,00	12,00	21,00
200	10,00	15,00	18,00	25,00	13,00	29,00
1600	11,00	15,00	20,00	30,00	45,00	37,00
4800	13	15	23	33	48	48

Source: own calculations

Tab. 3 – optimal trimming percentage for the asymmetric TM

h=1	**CPI**		**NET**		**NET-SA**	
RMSE	*alpha*	*beta*	*alpha*	*beta*	*alpha*	*beta*
50	47,00	26,00	45,00	33,00	40,00	28,00
200	47,00	26,00	45,00	34,00	47,00	36,00
1600	47,00	27,00	43,00	34,00	47,00	37,00
4800	47	28	44	35	47	38

Source: own calculations

Tab. 4 – mean percentiles

lambda	CPI	NET	NET-SA
50	60,5	56,0	56,0
200	60,5	55,5	55,5
1600	60,0	54,5	55,0
4800	59,5	54,5	54,5

Source: own calculations

Tab. 5 – descriptive stats for the extracted series

	NET1_45_30	CPI1_47_26	NETSA1_47_36	NETSA1_0_0	NET1_0_0	CPI1_0_0
Mean	0,32	0,35	0,34	0,37	0,37	0,52
Median	0,28	0,30	0,35	0,37	0,35	0,41
Maximum	1,05	2,15	0,86	2,09	2,40	3,98
Minimum	0,00	0,02	0,00	-0,46	-0,57	-0,25
Std. Dev.	0,24	0,31	0,22	0,41	0,49	0,73

Source: own calculations

Graphs

Fig. 1 – Cross-section distribution of monthly price changes, comp. with Normal density

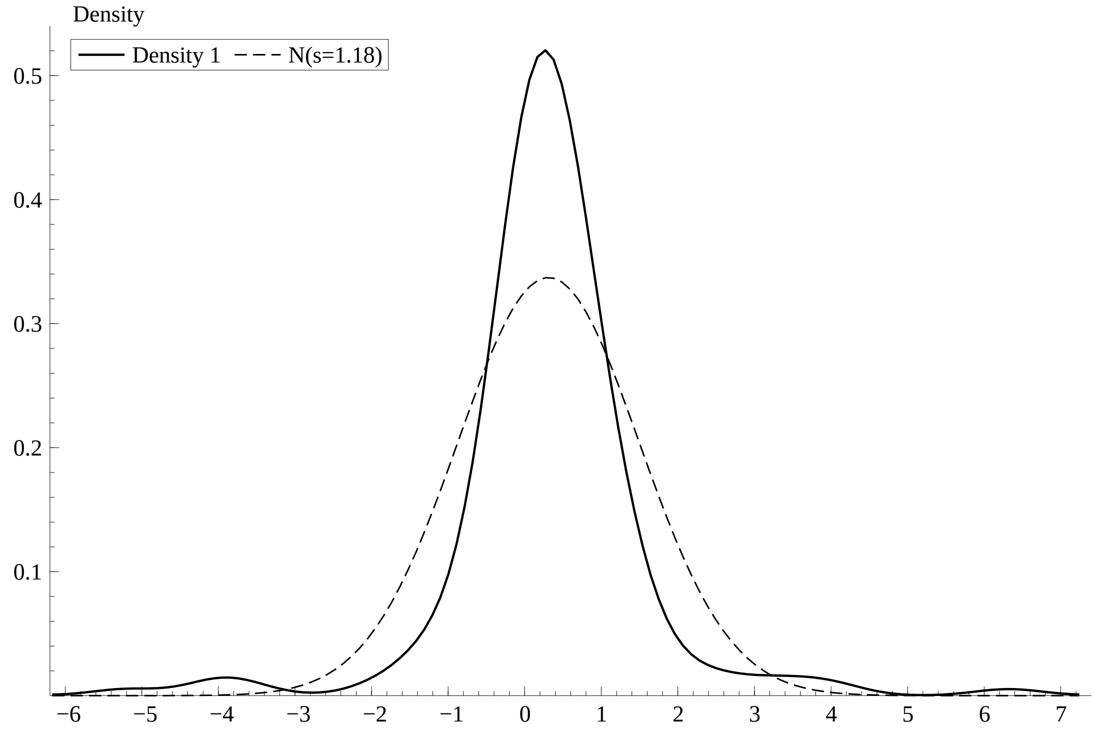


Fig. 2 – NET and NET-SA (m/m)

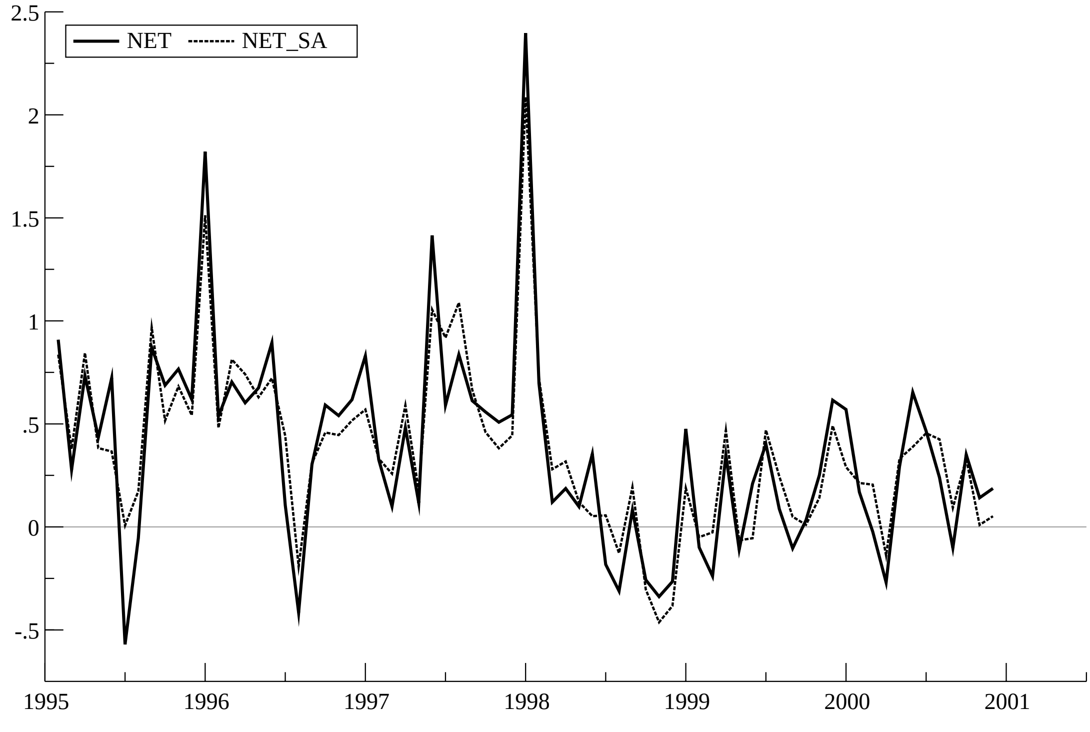


Fig. 3 – Skewness coefficient for the NET dataset (m/m)

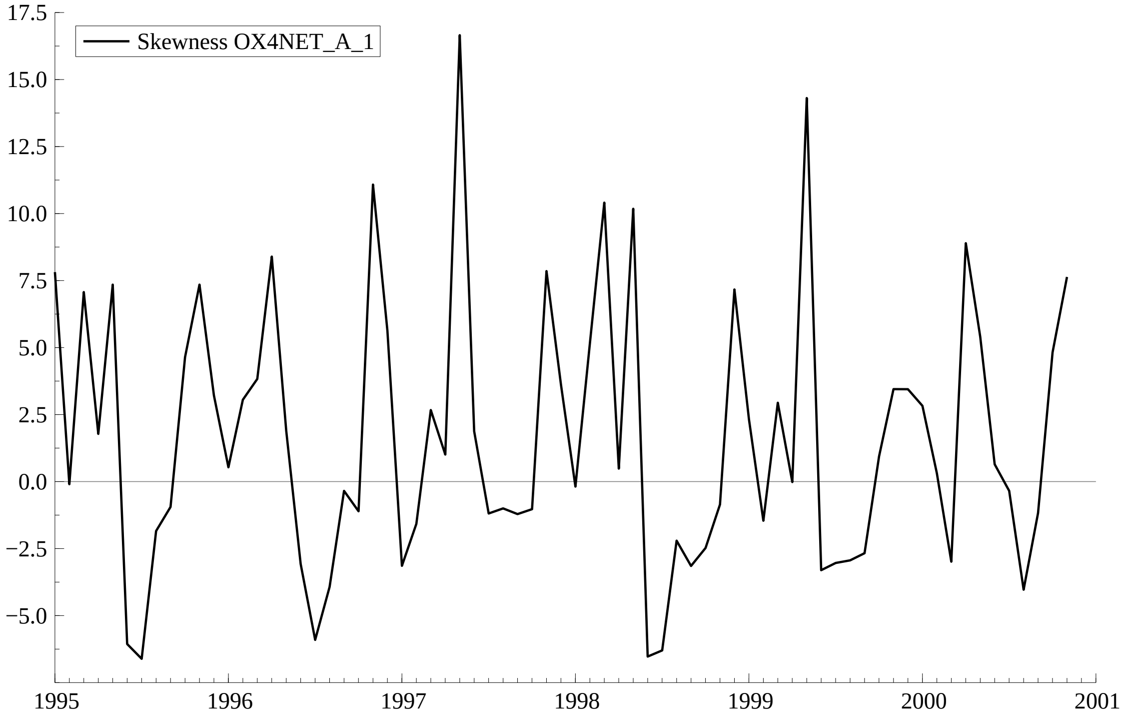
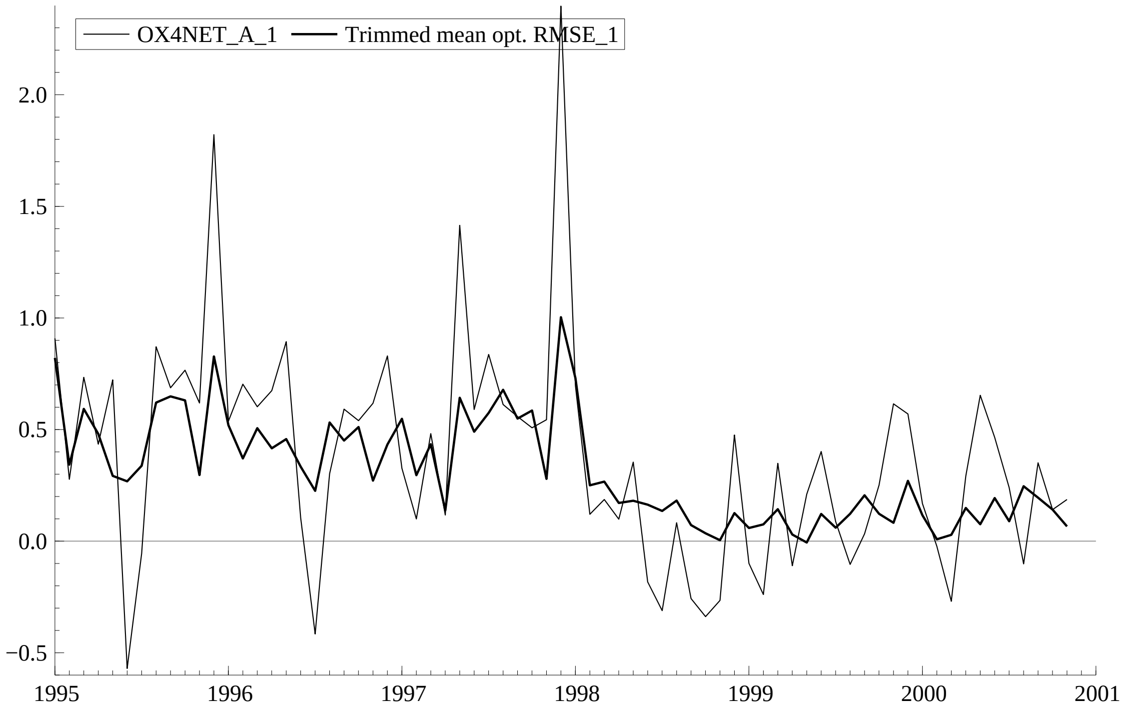


Fig. 4 – Optimal trimmed mean (λ =200) for NET, (m/m)



Footnotes

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[1] Derivation of the estimator and the thorough discussion of importance of the „economic“ and „statistical“ weighning as an identifying conditions for inflation is discussed in Andrle (2003). Applying GLS on (2) using *appropriate* identifying conditions, it is possible to derive Laspeyres or Paasche price index, Jevons price index or Törnqvist-Theil price index. The survey of possibilities and their plausibilty may be found in Diewert (1995), Clements and Izahn (1987) or in Andrle (2003).

[2] As to kurtosis of the distribution, the results for sample distributions are highly persuasive that the kurtosis is also the case for the population distribution. However, the (a)symmetry of the population distribution is more difficult question. For some countries the empirical computations show that on average (in time) the sample distribution is symmetric. For other countries even on average the sample distributions are asymmetric (positively skewed) and with some caution we can assume then the population distribution also asymmetric. This fact – as we will present – has dramatic implictions for construction of the inflation measures.

[3] Edgeworth (1887, 1888) proposed unweigthed median – uweighted with respect to transactions. This omission of transaction or "economic" importance weightning was one of the main issues in so called Keynes' critique to unweighted stochastic approach to measuring inflation, originated by Jevons and Edgeworth. For details see Andrle (2003) or Clements and Izahn (1987).

[4] For formal treatment see Blatna (2000) and Huber (1964, 1981)

[5] In the whole text we treat the terms "measurement" and "inference" as synonymous. For details see Andrle (2002).

[6] It is our intention to leave the regulated prices out of the NET data set, as the regulated prices – if changed in regular rounds – they may introduce very regular pattern, or some kind of seasonality to the prices. Seasonal dummies can explain about 60 % of the variations in regulated prices and these regulations are the main source of seasonal variations in the full CPI data set in the Czech Republic. Majority of the administrative measures takes place in January and July.

[7] The same methods are used e.g. in Aucremanne (2000), but are different from Bryan et al. (1997) who use the logarithmic approximation. Also we do not annualize the data.

[8] Andrle (2002) presents also the ranking how the individual items were excluded from the left and right tail during the time (in absolute and relative terms). Also the ranking of the commodities according the volatility is presented, together with detailed information on RMSE and MAD *trajectories* both for symmetric and asymmetric trimming. This information can be obtained upon request from author, as it is outcome of each trimming round.