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OBRAČUN BAZNE INFLACIJE, PRIMER SRBIJE

Rezime

U ovom radu obrađena je većina poznatih statističkih mera obračuna bazne inflacije. Ukazano je na prednosti i nedostatke svake statističke mere, sve sa ciljem pronalaženja obračuna bazne inflacije koji najviše odgovara u slučaju Srbije. Pokušali smo da damo ocenu koji od prikazanih obračuna bazne inflacije najviše odgovara u slučaju Srbije.

Ključne reči: bazna inflacija, TM metod, metod isključenja, inflaciono targetiranje, cene na malo

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CALCULATION OF CORE INFLATION, SERBIA

Summary

This paper covers most of the known statistical measures for calculation of core inflation. The strengths and weaknesses of each statistical measure are pointed out, with a view to determining the core inflation calculation method most suitable to the case of Serbia. We have tried to estimate which one of the presented core inflation calculation methods is the most appropriate for Serbia.

Key words: core inflation, TM method, exclusion method, inflation targeting, retail price index

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U procesu vođenja monetarne politike, od presudnog je značaja napraviti razliku između komponenata cenovnog rasta koje predstavljaju dugoročnu tendenciju i onih koji su privremenog karaktera (posledica trenutnih šokova). Greška u određivanju karaktera kretanja cenovnih komponenti može da bude skupa, s obzirom na odloženo dejstvo mera monetarne politike. Na primer, neprepoznavanje početka inflatornih pritisaka može da dovede do stalnog rasta cena i u tom smislu, zahtevati duži period vođenja restriktivne monetarne politike. Sa druge strane, preterana reakcija centralne banke na jednokratni rast cena može dovesti do neopravdanog pada ekonomske aktivnosti. Stoga, mogućnost centralne banke da napravi razliku između dugoročne i privremene komponente cenovnog rasta je presudna u određivanju odgovarajuće monetarne politike.

Razlog za praćenje bazne inflacije je u osnovi taj što, u suštini, monetarna politika ne treba da reaguje na kretanja cena izazvanim šokovima sa strane ponude.

Bazna inflacija igra važnu ulogu u procesu donošenja odluka iz sfere monetarne politike u poslednjih 25 godina. Čak i ako je target definisan u vidu ukupne inflacije, praćenje kretanja bazne inflacije je neizbežno. Ona predstavlja dugoročni trend ukupne inflacije. Pošto distribucija komponenata u okviru indeksa cena odstupa od normalnog rasporeda, uglavnom je asimetrična udesno i *leptokurtic* (ima teže repove), ponderisana aritmetička sredina nije dobar pokazatelj centralne tendencije. Iako se termin bazna inflacija koristi već godinama u stručnoj javnosti, ipak i dalje ne postoji opšte prihvaćena definicija kao ni metod obračuna.

Neke centralne banke koriste razne filtere, poput HP ili Kalman filtera pri obračunu bazne inflacije. Druge se oslanjaju na metod isključenja pri čemu se isključuju iste grupe proizvoda iz meseca u mesec, za koje se smatra da su izvor kratkoročnih i jednokratnih šokova; zatim se koriste i metodi isključenja ekstrema bez obzira koji je proizvod u pitanju - metod limitiranog uticaja (ponderisana mediana i TM^1).

NBS je od avgusta 2006. godine započela neformalno ciljanje bazne inflacije, pri čemu je za obračun korišćen metod isključenja na osnovu indeksa cena na malo. Koridor za baznu inflaciju je utvrđen kao numerički interval za kalendarsku godinu (decembar tekuće u odnosu na decembar prethodne godine). Nakon nešto više od dve godine stvorili su se uslovi da se pređe na targetiranje ukupne inflacije. Naime, režim ciljanje inflacije je zvanično usvojen u dogovoru sa Vladom RS, pri čemu rast regulisanih cena Vlada utvrđuje u dogovoru sa NBS. Tako da je NBS od januara 2009. godine prešla na ciljanje ukupnog indeksa potrošačkih cena.

Analiza različitih obračuna bazne inflacije urađena je za period od kada su nam bili dostupni podaci indeksa cena na malo (januar 1997) do septembra 2008. godine. Naime u poslednjih par meseci 2008. godine Monetarni odbor NBS pri donošenju odluka se vodio kretanjem indeksa potrošačkih cena, jer je već tada bilo izvesno da će se od početka 2009. godine preći na ciljanje ukupne inflacije.

Koncept bazne inflacije

Danas se kreatori monetarne politike i analitičari slažu u osnovnom: bazna inflacija bi trebalo da bude dobar indikator dugoročnog trenda ukupne inflacije. Bazna inflacija bi, prema Bryan i Cecchetti (1994), trebalo da prati komponente ukupne inflacije za koje se očekuje da će biti stabilne nekoliko godina, i u tom smislu, da bude pogodna za predviđanje u kratkom i srednjem roku. Dobra mera bazne inflacije je dobra ocena trenda ukupne inflacije u realnom vremenu (Bryan, Cecchetti, Wiggins 1997). Neki autori smatraju da bazna inflacija treba da bude mera promena cena koja je najviše korelisana sa reakcijama monetarne politike. Po ovoj teoriji, inflacija je monetarni fenomen u dugom roku, tako da bi bazna inflacija trebalo da beleži deo cenovnog rasta vezanog za monetarnu politiku (Bryan, Cecchetti 1994, Wiggins 1997, 1999). Pošto su relativne promene cena rezultat pomeranja u relativnoj tražnji za robom ili promenama u

¹ Trimmed Mean

When pursuing a monetary policy, it is of crucial importance to differentiate between the price growth components that represent a long-term tendency, and those that are temporary in character (result of momentary shocks). A mistake in determining the character of the price components' trends may be rather costly, given the deferred effect of the monetary policy measures. For instance, non-recognition of the commencement of inflationary pressures may result in constant price growth, thus requiring a longer period of restrictive monetary policy. On the other hand, an exaggerated reaction by the central bank to the one-off price increase may cause an unjustifiable slump in economic activity. Therefore, the capacity of the central bank to differentiate between the long-term and temporary price growth component is vital for determining the appropriate monetary policy.

The rationale for core inflation monitoring, in essence, is that monetary policy should not respond to the price trends caused by shocks on the demand side.

Core inflation has been playing an important role in the decision-making process in the sphere of monetary policy in the last 25 years. Even if the target is defined in the form of total inflation, core inflation trends are inevitably monitored. Core inflation represents the long-term trend of the total inflation. Since the distribution of components within the price index deviates from the normal distribution, being mostly asymmetric to the right and leptokurtic (having fat tails), the weighted average is not a good indicator of the central tendency. Although the term core inflation has been used for years in the academic circles, there is still no generally accepted definition or calculation method.

Some central banks use various filters, such as HP or Kalman filter, when calculating core inflation. Some others rely on the exclusion method, when the same groups of products, deemed to be the source of the short-term and one-off shocks, are excluded on a monthly basis; they also use the methods for excluding extremes, regardless of which product is

concerned - the limited influence method (weighted median and TM¹).

In 2006 the National Bank of Serbia (NBS) started the informal core inflation targeting, using the exclusion method based on the retail price index. The core inflation corridor was determined as a numerical interval for the calendar year (December on December). After about 2-plus years the conditions were created for total inflation targeting. The target inflation regime was officially adopted in agreement with the Serbian Government, with the Government determining the growth of the regulated prices in cooperation with the NBS. Thus, in January 2009 the NBS switched to the total retail price index targeting.

The analysis of the various core inflation calculations was conducted for the period starting from the moment the data on retail price index were available (January 1997) till September 2008. In the last couple of months in 2008, the decisions reached by the NBS Monetary Policy Committee were based on the retail price index trends, since it was already clear that starting from 2009 the switch will be made to total inflation targeting.

Core Inflation Concept

The monetary policy makers and analysts today agree on the basics: core inflation should be a good indicator of the long-term trends of total inflation. Core inflation should, according to Bryan and Cecchetti (1994), reflect the total inflation components expected to be stable in the next few years, and thus, be suitable for short-term and medium-term forecasts. A good measure of core inflation is a good evaluation of total inflation trends in the real time (Bryan, Cecchetti, Wiggins, 1997). Some authors believe that core inflation should be a measure of price changes which is the best correlated with the reactions of monetary policy. According to this theory, inflation is a monetary phenomenon in the long run, so that the core inflation should record a portion of the price growth related to the monetary policy (Bryan, Cecchetti, 1994, Wiggins, 1997, 1999). Since the relative price

¹ Trimmed Mean

ponudi iste, što nije posledica mera monetarne politike, bazna inflacija bi trebalo da isključuje relativne promene cena. Definisana na ovaj način, bazna inflacija je mera rasta cena na koju monetarna politika ima najviše uticaja (Roger, Cutler, Hogan, Johnson).

Pregled metoda za obračun bazne inflacije

Osmišljeni na pomenutim konceptima, analitičari su vremenom predlagali mnoge mere obračuna bazne inflacije. Neki indikatori bazne inflacije isključuju grupe proizvoda za koje se smatra da su izvor kratkoročnih i jednokratnih šokova u ukupnom kretanju cena, čak i ako promene nekih od njih nisu značajne svakog meseca. Druge vrste obračuna isključuju svakog meseca komponente cenovnog rasta u zavisnosti od njihovog varijabiliteta.

Indeks cena koji izračunava zvanična statistika nije adekvatno merilo inflacije sa stanovišta upravljanja monetarnom politikom, jer je često podložan slučajnim i povremenim promenama (sezonske fluktuacije). Takođe, eksterni šokovi (poput skoka cena nafte i drugih primarnih proizvoda na svetskom tržištu) imaju značajan uticaj na kretanje cena. Zato se sve više u svetu koristi *CORE* (bazna) inflacija, kao indikator inflacije koji je pod uticajem monetarne politike iz kojeg su apstrahovane trenutne i slučajne cenovne promene.

Postoje dva osnovna pristupa pri izračunavanju bazne inflacije. Moguće je izračunavanje na osnovu analize vremenskih serija indeksa cena uzimajući u obzir i druge makroekonomske varijable (BDP, kamatne stope...). Drugi način je analiza komponenti koje čine ukupan indeks (*cross section* analiza), pri čemu se postavlja pitanje nivoa agregiranja na kom se vrši izračunavanje, tj. da li se uzimaju grupe proizvoda ili pojedinačni proizvodi.

Najpoznatiji metodi obračuna bazne inflacije su:

- Metod isključivanja
- Metod ograničenog uticaja komponentata (*Limited influence estimator* metod ili TM)
- Modifikovanje postojećih pondera (*double weighting* metod)
- Strukturni VAR modeli

Od navedenih metoda, prva tri se svrstavaju

u statističke metode obračuna bazne inflacije, dok se poslednji vodi kao analiza vremenskih serija.

Metod isključivanja komponenti - Ovaj metod predstavlja najčešće korišćen metod izračunavanja bazne inflacije. Komponente koje se sistematski isključuju svakog meseca su uglavnom cene energije i hrane, jer one, uglavnom, najviše variraju. Nekad se isključuju čitave grupe ovih proizvoda, a ponekad su to samo određene komponente u okviru ovih grupa proizvoda. Uticaj cena nafte na svetskom tržištu, kao i variranje cena poljoprivrednih proizvoda zbog sezonskih uticaja su jedan od razloga za korišćenje ovog metoda. Nekada su to administrativno kontrolisane cene, u koje spadaju i cene saobraćajnih, komunalnih i ptt usluga itd.

Metod ograničavanja uticaja komponentata sa najvećim varijabilitetom - Ovim metodom se iz ukupnog indeksa cena otklanjaju sve komponente sa najmanjim i najvećim varijabilitetom u odnosu na prosek tog istog meseca, tako da se grupa proizvoda koja se isključuje menja iz meseca u mesec. Bryan i Cecchetti 1994 su začetnici ove vrste obračuna bazne inflacije. Isključivanjem najviših i najnižih promena cena svakog meseca, isključuju se najverovatnije relativne promene cena (Cutler). Odstranjivanjem relativnih promena cena koje nisu povezane sa dugoročnim inflacionim trendom, trebalo bi da dobijemo meru bazne inflacije koja sadrži samo stalnu komponentu cenovnog rasta. U okviru ovog pristupa izdvajamo dva metoda: simetrični i asimetrični TM. Izračunavanje bazne inflacije metodom simetričnog TM-a se vrši u prema formuli:

$$\pi_{\alpha} = \frac{1}{1 - 2\left(\frac{\alpha}{100}\right)} \sum_{i \in I_{\alpha}} \omega_i \pi_{it}$$

Ocena π_{α} se izračunava tako što se rangiraju komponente indeksa cena π_{it} sa njihovim odgovarajućim ponderom ω_i . Set komponentata koji treba da se uproseči (I_{α}), predstavlja cene proizvoda za koje se kumulativni ponderi

$$W_i = \sum \omega_i \chi_i$$

nalaze između $\alpha / 100$ i $1 - \alpha / 100$. Koliki će

changes are a result of the fluctuations in the relative demand or supply of goods, which do not come as a consequence of the monetary policy measures, the core inflation should exclude the relative price changes. According to this definition, core inflation is the measure of price growth on which monetary policy exerts the strongest influence (Roger, Cutler, Hogan, Johnson).

Review of Core Inflation Calculation Methods

Based on the above mentioned concepts, the analysts have over time proposed numerous methods for core inflation calculation. Some indicators of core inflation include the groups of products that are deemed to be the source of the short-term and one-off shocks in the total price trends, even if the fluctuations of some of them are not significant each month. Some other calculation methods exclude the price growth components each month depending on their variability.

The price index calculated within the official statistics is not an adequate measure of inflation from the point of view of monetary policy management, since it is often susceptible to accidental and occasional changes (seasonal fluctuations). In addition, external shocks (such as the increase in the prices of oil and other primary products at the global market) have a considerable impact on the price trends. Therefore, the CORE inflation has been increasingly used worldwide, as an indicator of inflation which is under the influence of monetary policy and from which all momentary and accidental price changes are excluded.

There are two basic approaches to core inflation calculation. It is possible to use the calculation method based on the analysis of price index time series, also taking into account some other macro-economic variables (GDP, interest rates, etc.). The other way is to conduct the analysis of the components constituting the total index (cross-section analysis), in which case the question arises which level of aggregation to choose for the calculation, i.e. whether to select groups of products or the individual products.

The best known methods of core inflation

calculation are the following:

- Exclusion method;
- Limited influence estimator method or TM;
- Double weighting method;
- Structural VaR models.

The first three of the mentioned methods belong to the category of statistical methods for core inflation calculation, whereas the last one is categorized as a time series analysis.

Components exclusion method - This method is the most frequently used method for core inflation calculation. The components that are systematically excluded each month are usually energy and food prices, because they are, typically, the ones that fluctuate the most. Sometimes the entire groups of these products are excluded and sometimes only certain components within these product groups. One of the reasons for using this method is the impact of oil prices in the global market, along with the fluctuations in the prices of agricultural products due to the seasonal influences. Sometimes the reason lies with the administratively controlled prices, such as the prices of transport, public utilities and telecommunication services, etc.

Limited influence of the highest variability components method - Within this method all components with the lowest and highest variability in comparison with that month's average are excluded from the total price index, so that the group of products to be excluded varies each month. Bryan and Cocchetti (1994) are the originators of this type of core inflation calculation. The exclusion of the highest and lowest price fluctuations each month excludes the most probable relative price changes (Cutler). By eliminating the relative price changes unrelated to the long-term inflationary trend, we should obtain a core inflation measure containing only the permanent price growth component. There are two methods within this approach: symmetrical and asymmetrical TM. Within the **symmetrical TM method** core inflation is calculated using the following formula:

$$\pi_{\alpha} = \frac{1}{1 - 2(\frac{\alpha}{100})} \sum_{i \in I_{\alpha}} \omega_i \pi_{it}$$

procenat proizvoda biti isključen iz obračuna (pridružuje im se ponder koji ima nultu vrednost), određuje se parametrom α . Za $\alpha=0$ reč je o ponderisanoj sredini.

$$\pi_{\alpha_1, \alpha_2} = \frac{1}{1 - \left(\frac{\alpha_1 + \alpha_2}{100}\right)} \sum_{i \in I_{\alpha_1 \alpha_2}} \omega_i \pi_{it}$$

Pri izračunavanju asimetričnog **TM-a** se polazi od pretpostavke da postoji asimetrija u podacima, zbog čega se vrši asimetrično isključivanje komponenata koje čine ukupan indeks:

$$W_i = \sum \omega_i \chi_i$$

pri čemu set komponenata koji treba da se uproseči (I_{α_1, α_2}), predstavlja cene proizvoda za koje se kumulativni ponderi nalaze između $\alpha_1/100$ i $1-\alpha_2/100$. Za $\alpha_1=\alpha_2$, imamo simetrični TM.

U slučaju kada je $\alpha_1=\alpha_2=50$ reč je o **ponderisanoj mediani**. Ova vrsta obračuna je takođe predložena od strane dva autora Bryan i Cecchetti 1994. Kao specijalan slučaj TM obračuna, mediana isključuje sve opservacije osim središnje vrednosti u distribuciji. Na primer, ako indeks cena sadrži 100 komponenata sa istim relativnim značajem, mediana bi predstavljala rast cena 50-te komponente. Da li će mediana imati bolje osobine od TM obračuna zavisi od distribucije komponenata mesečnog cenovnog rasta.

Modifikovanje postojećih pondera u zavisnosti od varijabiliteta cena pojedinačnih komponenata indeksa - Ovim metodom se kombinuju postojeći ponderi ω_i sa ponderima koji pokazuju varijabilitet date komponente kroz vreme η_i . Naime, postojeći ponderi se modifikuju u zavisnosti od varijabiliteta date komponente, tako da će ponder biti manji, ukoliko je varijabilitet posmatrane komponente veći.

$$\pi_t = \frac{\sum_{i=1}^n \omega_i \eta_i \pi_{it}}{\sum_{i=1}^N \omega_i \eta_i} \sum_{i \in I_{\alpha}} \omega_i \pi_{it}$$

pri čemu je

$$\eta_i = \frac{1}{\sum_{i=1}^N \frac{\sigma_i}{\sigma_i}}$$

gde je π_{it} indeks cena i-te komponente u datom mesecu, ω_i postojeći ponder i-te komponente ukupnog indeksa, σ_i standardna devijacija i-te komponente.

Strukturni VAR modeli - Izračunavanje bazne inflacije na osnovu strukturnog VAR modela uzima u obzir i druge makroekonomske pokazatelje. Naime, bazna inflacija predstavlja rezidual iz SVAR modela, gde se pored inflacije koriste i serije industrijske proizvodnje, kamatnih stopa, itd. Ovim metodom se naglašava nezavisnost kretanja cena od ukupnog privrednog rasta i šokova od strane ponude.

Očigledno je da postoji čitava lista mogućih načina za obračun bazne inflacije. S obzirom na značaj ovog pokazatelja, prosto je neverovatno da do sada nije usaglašena ni definicija ni metod obračuna bazne inflacije.

Pokazatelj bazne inflacije trebalo bi da ima sledeće osobine:

- da pomaže pri predviđanju buduće stope inflacije u kratkom i dugom roku
- da je imun na šokove od strane ponude (npr. rast industrijske proizvodnje ili promene cena nafte)
- da je što manje varijabilan
- da je visokokorelisan sa izabranim monetarnim agregatom
- da je jasna smernica monetarnim vlastima
- da je neutralan od ekonomskog rasta u dugom roku

Odluka o načinu obračuna bazne inflacije zavisi od svrhe u koje se analiza koristi, kao i od potreba kreatora monetarne politike.

Postoji još jedan važan kriterijum za odabir mere bazne inflacije: **složenost** obračuna. Korišćenje naprednih tehnika u statističkoj analizi ili analizi vremenskih serija ne mora uvek da dovede do boljih rezultata, naročito ako javnost treba da prihvati takav način obračuna kao zvaničan. Takođe je važno je da li je obračun moguć u realnom vremenu i da li su istorijski podaci podložni reviziji i izmenama.

The estimation π_α is calculated by ranking the price index components π_{it} with their appropriate weight ω_i . The set of components that need to be averaged (I_α) represents the product prices whose cumulative weights

$$W_i = \sum \omega_i \chi_i$$

range between $\alpha/100$ and $1 - \alpha/100$. The percentage of products to be excluded from the calculation (assigned the zero weight) is determined by the parameter α . When $\alpha=0$, we have the weighted average.

$$\pi_{\alpha_1, \alpha_2} = \frac{1}{1 - \left(\frac{\alpha_1 + \alpha_2}{100}\right)} \sum_{i \in I_{\alpha_1 \alpha_2}} \omega_i \pi_{it}$$

When calculating the **asymmetrical TM**, we start from the assumption that the data are asymmetrical, thus excluding the components from the total index in an asymmetrical manner:

$$W_i = \sum \omega_i \chi_i$$

with the set of components to be averaged (I_{α_1, α_2}) representing the product prices whose cumulative weights range between $\alpha_1/100$ and $1 - \alpha_2/100$. When $\alpha_1 = \alpha_2$, we have the symmetrical TM.

When $\alpha_1 = \alpha_2 = 50$, we have a case of the **weighted median**. This calculation method was also proposed by the two authors Bryan and Cecchetti (1994). As a special case of TM calculation, the median excludes all observations except for the average distribution value. For instance, if the price index contains 100 components of the same relevant importance, the median represents the growth of the 50th component. Whether a median will have better features than the TM calculation depends on the distribution of monthly price growth components.

Double weighting depending on the variability of prices of individual index components - This method combines the existing weights ω_i with the weights reflecting the variability of the component throughout the time η_i . The existing weights are modified depending on the variability of the given

component - the smaller the weight, the higher the variability of the concerned component.

$$\pi_t = \frac{\sum_{i=1}^n \omega_i \eta_i \pi_{it}}{\sum_{i=1}^N \omega_i \eta_i} \sum_{i \in I_\alpha} \omega_i \pi_{it}$$

with

$$\eta_i = \frac{1}{\sum_{i=1}^N \frac{\sigma_i}{\sigma_i}}$$

where π_{it} is the price index of the i^{th} component in the given month, ω_i the existing weight of the i^{th} component of the total index, and σ_i the standard deviation of the i^{th} component.

Structural VaR models - The calculation of core inflation based on the structural VaR model takes some other macro-economic indicators into consideration, too. Namely, core inflation represents the residual from SVAR model, which, in addition to inflation, uses the series of industrial production, interest rates, etc. This method underlines the independence of price fluctuations from the total economic growth and shocks in supply.

Obviously, there is a whole list of possible methods for core inflation calculation. Given the importance of this particular indicator, it is simply unbelievable that there has been no final agreement so far on a definition or a method for core inflation calculation.

An indicator of core inflation should feature the following characteristics:

- It should help forecast the future inflation rates both short-term and long-term;
- It should be immune to shocks in supply (e.g. growth in industrial production or oil prices fluctuations);
- Its variability should be as low as possible;
- It should be in high correlation with the chosen monetary aggregate;
- It should provide a clear guideline to the monetary authorities;
- It should be independent from the economic growth in the long run.

The choice of the method for core inflation

Ako se rezultati žele predstaviti široj javnosti, najbolji metod je metod isključivanja, jer je transparentan i lak za objašnjenje. Korišćenje SVAR modela je dobro jer na osnovu njih je moguće predviđanje, ali sa druge strane, mesečni iznos inflacije se menja sa unošenjem svakog novog podatka, tako da prethodno računati podaci više nisu isti. TM zahteva detaljnu analizu svakog mesečnog podatka, nije transparentan, jer se komponente koje se isključuju menjaju iz meseca u mesec. Takođe, sam metod je velika nepoznanica za širu javnost.

Pošto se izračuna bazna inflacija za određeni period, ona se poredi sa nekom od mera dugoročne tendencije ukupne inflacije. Uglavnom se u tu svrhu koristi centrirani 12-mesečni ili 24-mesečni pokretni proseki. Korišćenjem statistika RMSE (koren srednje kvadratne greške) i MAD (mediana apsolutne razlike), određuje se najbolja ocena.

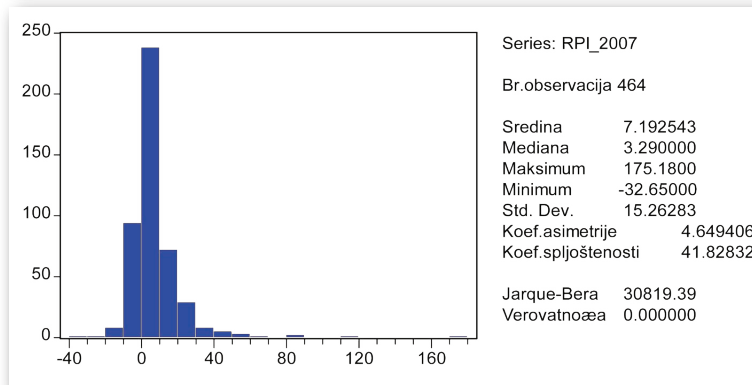
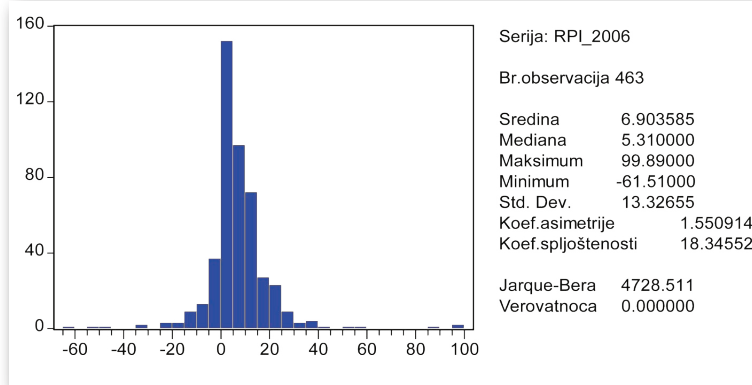
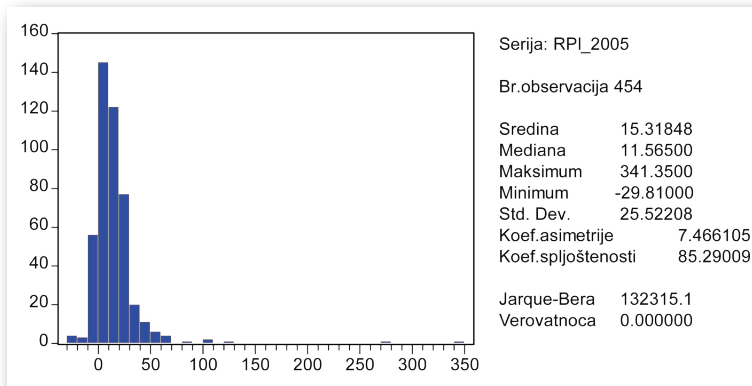
Empirijska analiza karakteristika mera bazne inflacije u Srbiji

Pri izračunavanju indeksa bazne inflacije u Srbiji korišćena je serija podataka cena na malo u periodu od januara 1997. do septembra 2008. godine. U poslednjem tromesečju 2008. godine, odluke Monetarnog odbora NBS su se pretežno bazirale na budućim kretanjima i faktorima koji utiču na indekse potrošačkih cena, pa stoga nismo u analizu uključili i pomenuta tri meseca.

Podaci pokazuju izraženu asimetriju udesno i spljoštenost. Raspored cena znatno odstupa od normalnog rasporeda, što pokazuje i *Jarque-Bera* statistika. Naime, ovaj test ima za nultu hipotezu normalnost rasporeda. Pošto je verovatnoća 0%, odbacujemo nultu hipotezu o normalnosti raspodele.

Grafički prikazi (histogrami) nam pokazuju znatno odstupanje od oblika zvona, koje je karakteristično za normalnu raspodelu.

Analizirali smo godišnje stope rasta u tri uzastopne godine 2005, 2006. i 2007. godini (decembar na decembar prethodne godine). Koristili smo najveći stepen dezagregiranosti podataka (pojedinačne proizvode i usluge). Podaci pokazuju izraženu asimetriju udesno i spljoštenost. Raspored cena znatno odstupa od normalnog rasporeda, što pokazuje i *Jarque-Bera* statistika. Naime, ovaj test ima za nultu hipotezu normalnost rasporeda. Pošto je verovatnoća 0%, odbacujemo nultu hipotezu o normalnosti raspodele. Grafički prikazi (histogrami) nam pokazuje znatno odstupanje od oblika zvona, koje je karakteristično za normalnu raspodelu.



calculation depends on the purpose of the analysis, as well as on the needs of the monetary policy makers.

There is another important criterion for choosing the core inflation measure: **calculation complexity**. The use of the advanced techniques in statistical analysis or time series analysis does not necessarily lead to better results, especially if the general public needs to accept the concerned calculation method as official. It is also important whether the calculation is feasible in the real time and whether historical data are available for review and modifications.

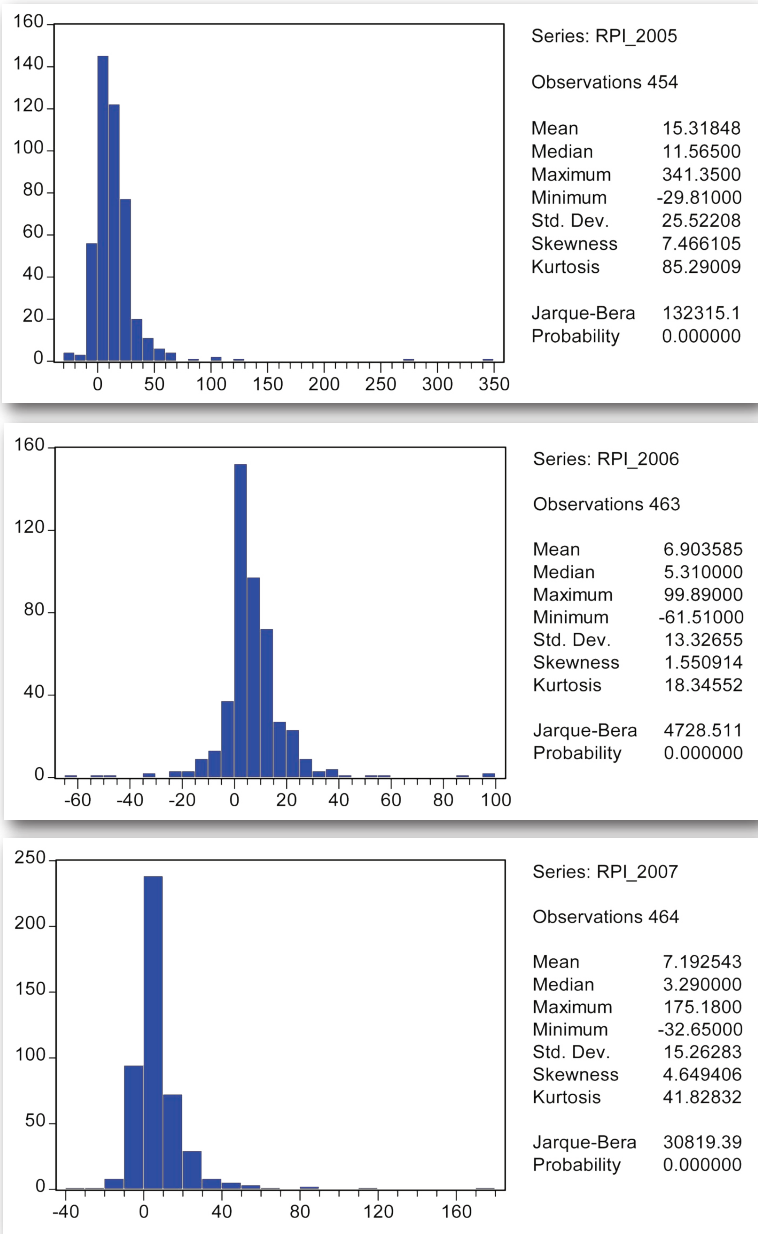
If the results are to be presented to the general public, the best method would be the exclusion method, since it is transparent and easy to explain. The usage of SVaR models is suitable because they enable forecasting, but, on the other hand, the monthly amount of inflation changes whenever the new data are entered, so that the previously calculated data are no longer the same. TM method requires a more in-depth analysis of each piece of monthly data; it is not transparent, since the components to be excluded are different each month. Also, the method itself is unknown to the general public.

After the core inflation has been calculated for a certain period, it is compared with some of the measures of long-term tendency of total inflation. To this end, what is mostly used is the centered 12-month or 24-month moving average. By applying the RMSE (Root Mean Squared Error) and MAD (Median Absolute Distribution) statistics, the best price is determined.

Empirical analysis of the characteristics of core inflation measures in Serbia

In calculating the core inflation index in Serbia, we used a series of retail price data in the period from January 1997 till September 2008. Since in the last quarter of 2008 the decisions of the NBS Monetary Policy Committee were primarily focused on the future trends and factors impacting the retail price index, we excluded these three months from the analysis.

The data show considerable skewness and kurtosis to the right. The distribution of prices significantly deviates from the normal distribution, which is also demonstrated by Jarque-Bera statistics. Namely, this test takes normal distribution as a null hypothesis. Since probability equals 0%, we dismiss the null hypothesis on normal distribution. The charts



Ako postoji pozitivna asimetrija (duži desni kraj na histogramu), aritmetička sredina je veća od medijane. To je jedan od razloga zašto je ponderisana aritmetička sredina (kao metod obračuna zvanične statistike) loš indikator kretanja cena.

U slučaju kada je mera spljoštenosti veća od 3, dobra mera centralne tendencije bi trebalo da pridruži manje pondere opservacijama na krajevima, dok u slučaju kada je koeficijent spljoštenosti manji od 3, najbolja ocena bi dala veće pondere opservacijama na krajevima distribucije.

Najpoznatiji u svetu, i najviše do sada korišćeni metod za obračun bazne inflacije, je **metod** isključenja. Isključuju se komponente čije su cene volatilne (ili su pod nekim vidom kontrole). Najpoznatija je mera bazne inflacije koja se dobija isključenjem cena hrane i energije. Narodna banka Srbije koristi metod isključenja pri obračunu bazne inflacije. Isključuju se poljoprivredni proizvodi, kao i proizvodi i usluge čije cene su pod nekom vrstom regulacije od strane države. Kod poljoprivrednih proizvoda se isključuje čitava grupa, dok se kod ostalih proizvoda sa liste uzima u obzir pojedinačni proizvod. Poslednjih godina procenat regulisanih cena u indeksu cena na malo se kretao oko 45%. Prikazana tabela pokazuje strukturu cena na malo razvrstanu na osnovu grupa proizvoda koji se isključuju pri obračunu bazne inflacije.

Učešće komponenta cenovnog rasta u indeksu cena na malo	
	Bazni ponderi, 2008
Ukupno	100.0%
Bazna inflacija	50.8%
Nebazna inflacija	49.3%
Poljoprivredni proizvodi	3.4%
Regulisane cene	45.9%
Električna energija	7.2%
Naftni derivati	9.6%
Ugalj i gas	0.5%
Komunalno-stambene usluge	8.4%
Usluge društvene zaštite	1.7%
Saobraćajne usluge	3.4%
PTT usluge	4.3%
Hleb i brašno	2.2%
Cigarete	3.5%
Mleko	1.1%
Lekovi	2.3%
Ostalo (TV, osig, taksa)	1.7%

Ponekad, isključenje volatilnih komponentata ne mora da rezultira indeksu koji je manje volatilan od indeksa ukupne inflacije.² To se dešava zbog mogućeg neutralisanja volatilnosti suprotnim kretanjem komponentata u okviru ukupnog indeksa. Zbog toga smo uradili analizu grupa proizvoda iz cena na malo u tri podperioda, od početka 1997. do septembra 2008., od januara 2001. do septembra 2008. i januara 2004. do septembra 2008. Želeli smo da ispitamo volatilnost proizvoda u pomenutim periodima da bismo utvrdili da li je lista isključenih proizvoda adekvatna i ima li smisla iz ugla volatilnosti.

Prikazane tabele prate mesečnu volatilnost ukupne inflacije i pojedinih grupa proizvoda u okviru nje u različitim periodima.

² Češka centralna banka je godinama ciljala neto inflaciju koja je bila volatilnija od ukupne.

(histograms) show a significant deviation from the bell shape, characteristic for normal distribution.

We analyzed the annual growth rates in the three consecutive years - 2005, 2006 and 2007 (December on December). We applied the highest level of disaggregation of data (individual products and services). The data show considerable skewness and kurtosis to the right. The distribution of prices significantly deviates from the normal distribution, which is also demonstrated by Jarque-Bera statistics. Namely, this test takes normal distribution as a null hypothesis. Since probability equals 0%, we dismiss the null hypothesis on normal distribution. The charts (histograms) show a significant deviation from the bell shape, characteristic for normal distribution.

In case of a positive skewness (longer right tail in the histogram), the arithmetic mean is greater than the median. This is one of the reasons why weighted arithmetic mean (as a calculation method in the official statistics) is a poor indicator of the price fluctuations.

When skewness is higher than 3, a good measure of the central tendency should allocate lower weights to tail observations, whereas when skewness ratio is lower than 3, the best estimation should allocate higher weights to observations in the distribution tail.

Exclusion method is the most famous method for core inflation calculation worldwide, and the method most frequently used to date. The components whose prices are volatile (or under some kind of control) are excluded. The best known core inflation measure is obtained by excluding food and energy prices. The National Bank of Serbia uses the exclusion method for core inflation calculation. What is excluded are agricultural products, as well as the products and services whose prices are under some kind of state regulation. In case of agricultural products, the entire group is excluded, whereas in case of other products, a

separate product is chosen from the list. In the last years, the fraction of regulated prices in the retail price index was about 45%. The table provided shows the structure of retail prices divided by groups of products excluded in the core inflation calculation.

Share of price growth components in retail price index	
	Core weights, 2008
Total	100.0%
Core inflation	50.8%
Non-core inflation	49.3%
Agricultural products	3.4%
Regulated prices	45.9%
Electricity	7.2%
Oil derivatives	9.6%
Coal and natural gas	0.5%
Public utilities / housing services	8.4%
Social protection services	1.7%
Transport services	3.4%
Telecommunication services	4.3%
Bread and flour	2.2%
Cigarettes	3.5%
Milk	1.1%
Medicines	2.3%
Other (TV, insurance, tax)	1.7%

Sometimes the exclusion of volatile components does not necessarily result in the index less volatile than the total inflation index². This happens due to the possible offsetting of volatility by the opposing component fluctuations within the total index. Therefore, we conducted an analysis of certain groups of products from the retail price index in the three sub-periods, from the beginning of 1997 to September 2008, from January 2001 to September 2008, and from January 2004 to September 2008. Our aim was to examine product volatility in the mentioned periods, in order to determine whether the list of excluded products was adequate and meaningless in terms of volatility.

The tables provided monitor the monthly volatility of total inflation and certain groups of products within it in different periods.

² For years the Central Bank of the Czech Republic targeted the net inflation more volatile than total inflation.

Mesečna volatilnost inflacije i njenih komponenata u periodu januar 1997 - septembar 2008			
	Standardna devijacija	Prosečna mesečna stopa rasta	Racio st. dev komponenata/ st. dev ukupne inflacije
Ukupna inflacija	3.2	2.0	1.0
Šećer	32.4	3.4	10.2
Tečna goriva i gas	17.3	3.5	5.5
Sveže i kiselo mleko	14.3	3.3	4.5
Sveže povrće	12.6	3.1	4.0
Duvan	11.2	2.6	3.6
Finansijske i druge usluge	10.8	1.9	3.4
Tečna goriva i maziva	10.2	2.9	3.2
Putnički automobili	9.7	2.1	3.1
Sveža jaja	9.6	2.1	3.0
Električna energija, rasveta i instalacioni mat.	8.9	2.7	2.8
Masnoće	8.7	2.1	2.7
PTT usluge	7.8	1.7	2.5

Mesečna volatilnost inflacije i njenih komponenata u periodu januar 2001 - septembar 2008			
	Standardna devijacija	Prosečna mesečna stopa rasta	Racio st. dev komponenata/ st. dev ukupne inflacije
Ukupna inflacija	1.0	1.1	1.0
Sveže povrće	11.6	2.0	11.6
Finansijske i druge usluge	11.2	0.7	11.3
Električna energija, rasveta i instalacioni mat.	8.3	0.9	8.3
Ptt usluge	6.7	0.2	6.7
Sveža jaja	6.7	1.3	6.7
Hleb i pecivo	6.6	1.2	6.7
Stambeno-komunalne usluge	6.3	1.2	6.4
Poljoprivredni proizvodi	6.1	1.6	6.2
Usluge društvene zaštite	5.9	1.2	5.9
Knjige i udžbenici	5.8	1.0	5.8
Tečna goriva i gas	4.9	1.5	4.9
Novine i časopisi	4.3	0.5	4.4
Lekovi i ostalo za negu zdravlja	4.3	0.7	4.3
Saobraćajne usluge	3.6	1.4	3.7

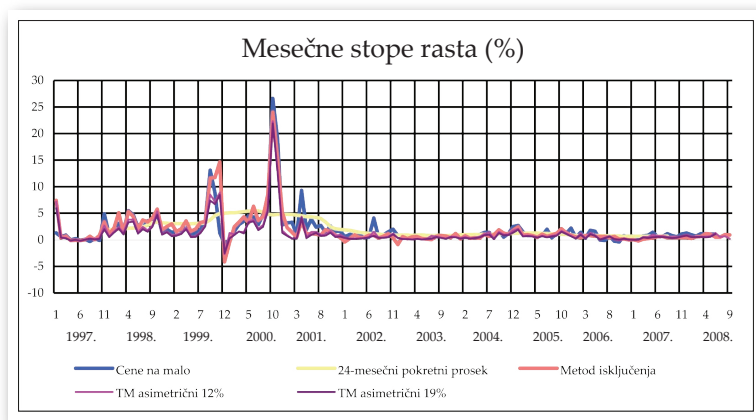
Mesečna volatilnost inflacije i njenih komponenata u periodu januar 2004 - septembar 2008			
	Standardna devijacija	Prosečna mesečna stopa rasta	Racio st. dev komponenata/ st. dev ukupne inflacije
Ukupna inflacija	0.6	1.0	1.0
Poljoprivredni proizvodi	6.5	1.6	10.3
Sveža jaja	6.4	1.3	10.1
Tečna goriva i gas	6.2	1.5	9.7
Finansijske i druge usluge	4.3	0.7	6.8
Mleveno i ljušteno žito	3.9	1.0	6.1
Saobraćajne usluge	3.5	1.4	5.5
Tečna goriva i maziva	3.3	1.4	5.2
Šećer	3.3	0.7	5.1
Usluge društvene zaštite	3.3	1.2	5.1
Masnoće	3.2	1.2	5.1
Sveže meso	3.1	0.9	4.9
Stambeno-komunalne usluge	3.0	1.2	4.8

Monthly volatility of inflation and its components in the period January 1997 - September 2008			
	Standard deviation	Average monthly growth rate	St. deviation of components/st. deviation of total inflation ratio
Total inflation	3.2	2.0	1.0
Sugar	32.4	3.4	10.2
Liquid fuels and natural gas	17.3	3.5	5.5
Fresh and soured milk	14.3	3.3	4.5
Fresh vegetables	12.6	3.1	4.0
Tobacco	11.2	2.6	3.6
Financial and other services	10.8	1.9	3.4
Liquid fuels and lubricants	10.2	2.9	3.2
Cars	9.7	2.1	3.1
Fresh eggs	9.6	2.1	3.0
Electricity, public lighting and instalation materials	8.9	2.7	2.8
Fats	8.7	2.1	2.7
Telecommunication services	7.8	1.7	2.5

Monthly volatility of inflation and its components in the period January 2001 - September 2008			
	Standard deviation	Average monthly growth rate	St. deviation of components/st. deviation of total inflation ratio
Total inflation	1.0	1.1	1.0
Fresh vegetables	11.6	2.0	11.6
Financial and other services	11.2	0.7	11.3
Electricity, public lighting and instalation materials	8.3	0.9	8.3
Telecommunication services	6.7	0.2	6.7
Fresh eggs	6.7	1.3	6.7
Bread and pastry	6.6	1.2	6.7
Housing and public services	6.3	1.2	6.4
Agricultural products	6.1	1.6	6.2
Social protection services	5.9	1.2	5.9
Books and textbooks	5.8	1.0	5.8
Liquid fuels and natural gas	4.9	1.5	4.9
Newspapers and magazines	4.3	0.5	4.4
Medicines and other healthc. pro.	4.3	0.7	4.3
Transport services	3.6	1.4	3.7

Monthly volatility of inflation and its components in the period January 2004 - September 2008			
	Standard deviation	Average monthly growth rate	St. deviation of components/st. deviation of total inflation ratio
Total inflation	0.6	1.0	1.0
Agricultural products	6.5	1.6	10.3
Fresh eggs	6.4	1.3	10.1
Liquid fuels and natural gas	6.2	1.5	9.7
Financial and other services	4.3	0.7	6.8
Ground and peeled wheat	3.9	1.0	6.1
Transport services	3.5	1.4	5.5
Liquid fuels and lubricants	3.3	1.4	5.2
Sugar	3.3	0.7	5.1
Social protection services	3.3	1.2	5.1
Fats	3.2	1.2	5.1
Fresh meat	3.1	0.9	4.9
Housing and public services	3.0	1.2	4.8

Za sva tri posmatrana perioda zajednička je visoka volatilnost cele grupe poljoprivrednih proizvoda, ili neke od podgrupa u okviru nje. Tako na primer, poljoprivredni proizvodi u periodu od 2004. do 2008. imaju 10 puta veću standardnu devijaciju u odnosu na ukupnu inflaciju. U svim posmatranim periodima izrazitu volatilnost su ostvarile i cene tehničkih goriva i gasa, električne energije, šećera, kao i usluga koje su pod nekim vidom regulacije (usluge društvene zaštite, PTT, saobraćajne...). Zanimljivo je da su cene finansijskih usluga veoma volatilne. U okviru njih se prate cene obaveznog osiguranja vozila i tehničkog pregleda vozila.



Najveći deo pomenutih proizvoda i usluga nije deo bazne inflacije obračunate metodom isključenja. Tako da na osnovu ovog pokazatelja možemo reći da je izabrana adekvatna lista proizvoda i usluga sa stanovišta volatilnosti proizvoda u okviru nje.

Volatilnost mesečnih stopa rasta cena otežava kreatorima monetarne politike da odrede dugoročni trend inflacije i predvide njeno dalje kretanje. Korišćenje metoda isključenja nekada ne može u većoj meri da umanjí volatilnost bazne inflacije. Zato se sve više koristi i TM metod.

Komponente indeksa cena se poređaju u opadajući niz i određeni procenat ekstremnih vrednosti (proizvoda sa najvišim i najnižim rastom cena) se isključuje iz obračuna. Pri ovom obračunu nije potrebno doneti prethodno odluku o tome koje komponente treba isključiti. Ipak, postavlja se pitanje koliki procenat treba odstraniti. U tu svrhu se koriste statistike RMSE³ i MAD⁴, koje mere odstupanje dobijenih serija od trenda inflacije (obično se koristi 24-mesečni pokretni prosek). Kao osnovni (*benchmark*) model, koji najbolje aproksimira kretanje inflacije na dugi rok, koristili smo centrirani 12-mesečni pokretni prosek indeksa cena na malo (CMA (12))⁵.

Serija sa minimalnom RMSE ili MAD u odnosu na trend inflacije predstavlja najbolju meru TM obračuna. Odsecanje krajeva može biti simetrično ili ne.

Analiza je rađena na osnovu podataka agregiranih na najnižem nivou (pojedinačni proizvodi i usluge) sa odgovarajućim tekućim ponderima⁶. Analiziran je procenat odsecanja krajeva od 11 do 27% i tako dobijene ocene

upoređivane su sa 12-mesečnim pokretnim prosekom. Najbolje ocene bazne inflacije su one dobijene odsecanjem 12% (najniža RMSE) i 19% (najniža MAD).

Zatim, u okviru pomenutih procenata urađena je analiza asimetričnog odsecanja krajeva. U našem slučaju, bolje su se pokazale asimetrične mere, baš zbog već pomenute distribucije cena koja nije simetrična, i ima duži desni kraj. Najbolji rezultati (najniža RMSE) za odsecanje od 12% je 6,5% sa gornje i 5,5% sa donje strane, dok je za odsecanje od 19% najbolje 10% sa gornje i 9% sa donje strane.

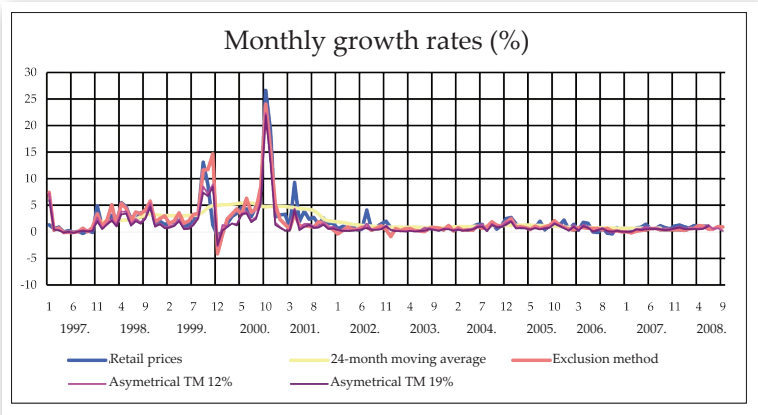
³ Root Mean Squared Error

⁴ Median Absolute Deviation

⁵ Opređelili smo se za 12-mesečni centrirani pokretni prosek zbog kratkog vremenskog perioda koji je analiziran.

⁶ Tekući ponderi predstavljaju pondere date od zvanične statistike modifikovane za relativnu promenu cena.

What all three observed periods have in common is the high volatility of the entire group of agricultural products, or one of the sub-groups within it. For instance, the agricultural products in the period 2004-2008 have a 10 times larger standard deviation in comparison to the total inflation. In all three observed periods a considerable volatility was also recorded in the case of the prices of liquid fuels and natural gas, electricity, sugar, as well as the services that are under some kind of regulation (social protection services, telecommunication, transport services, etc.). It is also interesting to mention that the prices of financial services are highly volatile. Within this category the prices of mandatory car insurance and technical inspection are also monitored.



Most of the mentioned products and services are not a part of the core inflation calculated by exclusion method. Therefore, based on this indicator we may say that the chosen list of products and services was adequate in terms of volatility of the products it contained.

Volatility of the monthly price growth rate hinders the monetary policy makers from determining the long-term inflation trend, and forecasting inflation fluctuations in the future. The use of exclusion method sometimes cannot reduce the core inflation volatility to a considerable extent. As a result, TM method has been increasingly used.

The price index components are sorted in

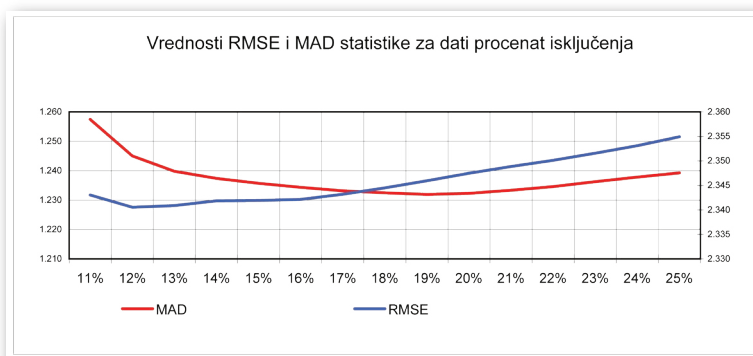
a descending order, and a certain percentage of extreme values (products with the highest and lowest price growth) is excluded from the calculation. Within this method it is not necessary to previously decide on which components are to be excluded. Still, the question arises as to which percentage should be excluded. To this end, RMSE³ and MAD⁴ statistics are used, measuring the deviation from the determined inflation trend series (typically, a 24-month moving average is used). Our basic benchmark model, which best approximates the long-term inflation fluctuations, was the centered 12-month moving average of the retail price index (CMA(12))⁵.

The series with the minimum RMSE or MAD in relation to the inflation trend represents the best measure of the TM calculation method. The tails can be cut off symmetrically or asymmetrically.

The analysis was conducted based on the data aggregated at the lowest level (individual products and services) with the appropriate current weights⁶. The percentage of tail cuts, ranging from 11 to 27%, was analyzed and thus calculated values compared with the 12-month moving average. The best values of core inflation were those calculated by cutting off 12% (the lowest RMSE) and 19% (the lowest MAD).

Within the mentioned percentage bands, we then conducted an analysis of asymmetric tail cut-off. In our case, asymmetric measures proved to be a better choice, due to the already mentioned price distribution which is asymmetric and has a fatter right tail. The best results (the lowest RMSE) for the 12% cut-off are 6.5% from the top and 5.5% from the bottom, whereas for the 19% cut-off the best results are 10% from the top and 9% from the bottom.

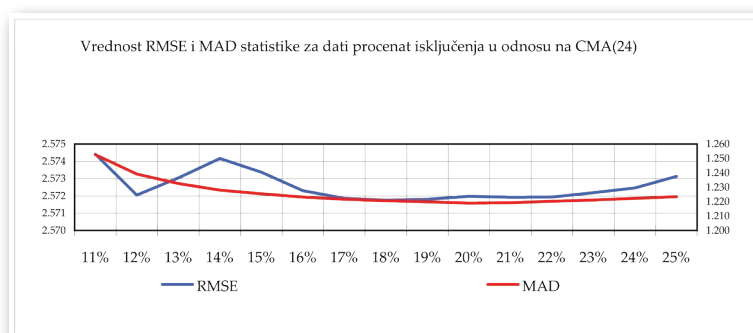
³ Root Mean Squared Error
⁴ Median Absolute Deviation
⁵ We decided to use the 12-month centered moving average due to the fact that the analyzed time period was relatively short.
⁶ Current weights are weights provided by the official statistics modified by the relative price change.



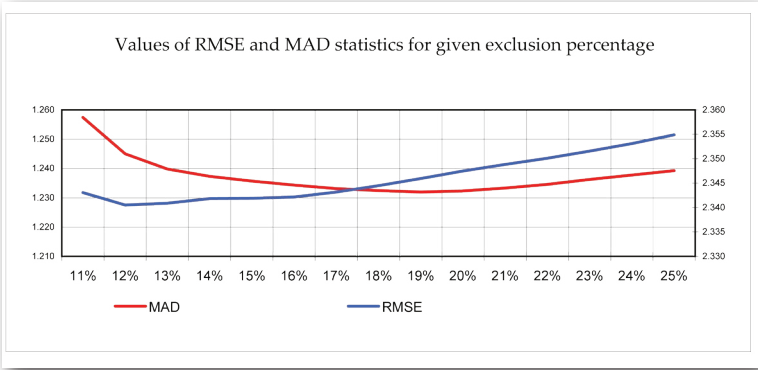
Nivo agregiranja podataka sa kojima se analiza vrši može da utiče dosta na dobijene rezultate kada je u pitanju metod limitiranog uticaja komponenata. Empirijske analize u drugim zemljama su pokazale da je distribucija cenovnih komponenata manje izdužena (manje *leptokurtic*) ako je nivo agregiranja podataka viši. Slični rezultati su dobijeni na primeru Srbije. Naime, prosečni koeficijent spljoštenosti dobijen na seriji podataka pojedinačnih proizvoda i usluga iznosi 71,20, dok ista statistika primenjena na viši nivo agregiranja (49 grupa proizvoda i usluga) iznosi 12,93. Takođe, asimetričnost u desno je znatno manje izražena u slučaju višeg nivoa agregiranja.

Jedan od mogućih izvora greške pri odabiru najbolje mere bazne inflacije može da bude i odabir benchmark modela. U našem slučaju korišćen je CMA (12) kao mera dugoročne inflacije. U literaturi se uglavnom koristi 24 ili 36-mesečni pokretni prosek. Iako smo se zbog relativno kratke serije podataka opredelili za CMA (12), testiranje optimalnog odsecanja krajeva smo uradili u odnosu na 24-mesečni centrirani pokretni prosek CMA (24).

Na osnovu RMSE statistike, ukupno 18% ekstremnih vrednosti bi trebalo odstraniti sa krajeva distribucije cena na malo, što je više od rezultata koje smo dobili kada smo kao osnovni model koristili CMA (12), kada je iznosio 12%. MAD statistika daje najnižu vrednost pri 20% odsecanja, što je skoro isto optimalno odsecanje kao kada smo koristili CMA (12), kada je minimum bio za 19% odstranjenih ekstremnih vrednosti.



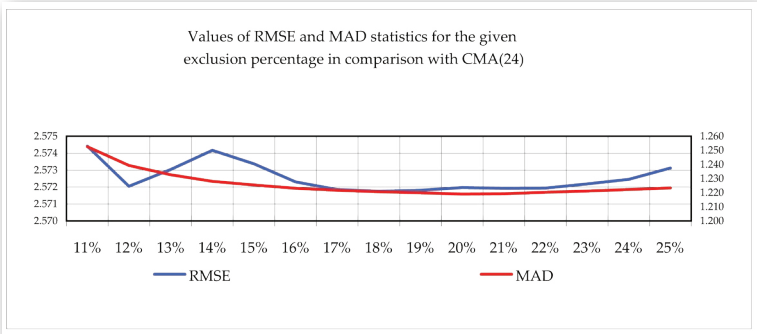
Specijalan slučaj TM obračuna predstavlja ponderisana medijana, koja se dobija odsecanjem 50% najviših i najnižih cena. Takođe smo uradili i modifikaciju postojećih pondera na osnovu volatilnosti u čitavom posmatranom periodu. U ovom slučaju nismo koristili pojedinačne proizvode i usluge, već smo analizirali kretanje 49 grupa proizvoda i usluga. Za viši nivo agregiranosti podataka smo se odlučili zbog izmena koje su liste proizvoda imale u proteklih 11 godina.



The level of aggregation of data used in the analysis can have a significant impact on the received results when it comes to the method of limited influence of components. Empirical analyses in other countries have shown that the distribution of price components is less leptokurtic if the level of data aggregation is higher. The results received in Serbia are similar. Namely, the average kurtosis ratio received on a series of data of individual products and services amounts to 71.20, whereas the same statistics applied to the higher aggregation level (49 groups of products and services) amounts to 12.93. In addition, skewness to the right is considerably less prominent in case of the higher aggregation level.

One of the possible sources of error when choosing the best core inflation measure may be the selection of the benchmark model. We used CMA (12) as our long-term inflation measure. The reference books on the subject usually use 24- or 36-month moving average. Even though we opted for CMA (12) due to the relatively short data series, we conducted the testing of the optimum tail cut-off based on the 24-month centered moving average - CMA (24).

Based on the RMSE statistics, 18% of extreme values in total were to be cut-off from the retail price distribution tails, which is higher than the result we received when CMA (12) was used as our basic model - which amounted to 12%. The MAD statistics provides the lowest value at the 20% cut-off, which is almost the same optimum cut-off as in the case of CMA (12), when the minimum for cut-off extreme values amounted to 19%.



The special case of TM calculation is the weighted median, which is calculated by cutting-off 50% of the highest and lowest prices. We also conducted the modification of the existing weights (double-weighting) based on the volatility in the entire observed period. In this case we did not use individual products and services, but analyzed the trends of 49 groups of products and services. We opted for the higher data aggregation level due to the changes recorded in the lists of products in the last 11 years.

Da li je bazna inflacija volatilnija od ukupne inflacije?

Sve serije bazne inflacije dobijene pomenutim metodama osim metoda modifikovanih pondera u periodu 2004-2008 imaju znatno manju volatilnost od originalne serije. U tome prednjači ponderisana mediana.

Racio standardna devijacija bazne inflacije/standardna devijacija ukupne inflacije			
	Jan 1997 - jun 2008	Jan 2004 - jun 2008	Jan 2004 - Septembar 2008
Metod isključenja	0.8	0.6	0.7
Metod modifikovanih pondera	0.9	1.1	0.9
TM metod, 12 % simetrično	0.8	0.6	0.7
TM metod, 19% simetrično	0.8	0.5	0.6
TM metod, 19% asimetrično	0.8	0.5	0.6
TM metod, 12% asimetrično	0.8	0.6	0.7
Ponderisana mediana	0.7	0.5	0.5

Takođe, koeficijent varijacije može da bude dobar pokazatelj varijabilnosti. U prikazanoj tabeli se vidi da sve mere bazne inflacije imaju manji koeficijent varijacije od ukupne inflacije. Izuzetak su podaci u periodu 2004-2008 dobijeni metodom modifikovanih pondera.

Koeficijent varijacije (standardna devijacija/aritmetična sredina)			
	Jan 1997 - Jun 2008	Jan 2004 - Jun 2008	Jan 2004 - Septembar 2008
Ukupna inflacija	3.10	0.98	0.63
Metod isključenja	2.56	0.60	0.47
Metod modifikovanih pondera	2.89	1.06	0.59
TM metod, 12 % simetrično	2.56	0.60	0.47
TM metod, 19% simetrično	2.46	0.53	0.40
TM metod, 19% asimetrično	2.42	0.52	0.39
TM metod, 12% asimetrično	2.56	0.60	0.47
Ponderisana mediana	2.23	0.48	0.32

Veoma je važno da bazna inflacija ne potcenjuje ili ne precenjuje ukupnu u dugom roku. Prikazani rezultati govore da bazna inflacija dobijena TM metodom (12% asimetrično, 19% asimetrično i ponderisana mediana) konstantno potcenjuju rast ukupne inflacije u svim posmatranim periodima. Metod modifikovanih pondera se pokazao najbolje, a zatim sledi metod isključenja. Zbog asimetričnosti distribucije cena u desno, ne čudi činjenica da mediana potcenjuje aritmetičku sredinu u svim periodima. To bi moglo da se izbegne uzimanjem percentila distribucije cena preko 50. Ipak, treba se fokusirati na najduži posmatrani period, mada je i tada dosta kraći od „dugog roka“. U 11 posmatranih godina, metod isključenja daje prosečan međugodišnji rast veoma blizak ukupnom cenovnom rastu.

Prosečne međugodišnje stope rasta u različitim periodima						
	Ukupna inflacija	Metod isključenja	TM metod, 12% asimetrično	TM metod, 19% asimetrično	Ponderisana mediana	Metod modifikovanih pondera
Jan 1997 - Sept. 2008	30.7	28.9	19.8	16.5	11.7	31.7
Jan 2002 - Sept. 2008	13.2	8.5	8.0	6.1	3.5	13.1
Jan 2003 - Sept. 2008	11.5	8.3	7.6	5.9	3.5	11.6
Jan 2004 - Sept. 2008	11.5	9.0	8.2	6.4	4.0	11.4

Is core inflation more volatile than total inflation?

All series of core inflation calculated by the mentioned methods except for the double-weighting method in the period 2004-2008 have a significantly lower volatility than the original series. The weighted meridian excels in this respect.

Standard deviation of core inflation / standard deviation of total inflation ratio			
	Jan 1997 - jun 2008	Jan 2004 - jun 2008	Jan 2004 - September 2008
Exclusion method	0.8	0.6	0.7
Double - weighting method	0.9	1.1	0.9
TM method, 12 % simmetrical	0.8	0.6	0.7
TM method, 19% simmetrical	0.8	0.5	0.6
TM method, 19% asimmetrical	0.8	0.5	0.6
TM method, 12% asimmetrical	0.8	0.6	0.7
Weighted median	0.7	0.5	0.5

Also, variation coefficient can be a good indicator of variability. In the enclosed table one can see that all measures of core inflation have a lower variation coefficient than total inflation. The exceptions are the data in the period 2004-2008 calculated by double-weighting method.

Variation coefficient (standard deviation/arithmetic mean)			
	Jan 1997 - Jun 2008	Jan 2004 - Jun 2008	Jan 2004 - Septembar 2008
Total inflation	3.10	0.98	0.63
Exclusion method	2.56	0.60	0.47
Double - weighting method	2.89	1.06	0.59
TM method, 12 % simmetrical	2.56	0.60	0.47
TM method, 19% simmetrical	2.46	0.53	0.40
TM method, 19% asimmetrical	2.42	0.52	0.39
TM method, 12% asimmetrical	2.56	0.60	0.47
Weighted median	2.23	0.48	0.32

It is very important for the core inflation not to underestimate or overestimate total inflation in the long run. The presented results show that the core inflation calculated by TM method (12% asymmetrically, 19% asymmetrically and weighted meridian) constantly underestimates the growth of total inflation in all observed periods. The double-weighting method proved to be the best, followed by the exclusion method. Due to the skewness of price distribution to the right, it is no wonder that the median underestimates the arithmetic mean in all periods. This could be avoided by taking the percentiles of price distribution over 50. Still, one should focus on the longest observed period, though it is still considerably shorter than the ‘long run’. In the observed 11-year period, the exclusion method provided an average year-to-year growth very close to the total price growth.

Average year-to-year growth rates for different periods						
	Total inflation	Exclusion method	TM method 12% asymmetrical	TM method 19% asymmetrical	Weighted median	Double weighting method
Jan 1997 - Sept. 2008	30.7	28.9	19.8	16.5	11.7	31.7
Jan 2002 - Sept. 2008	13.2	8.5	8.0	6.1	3.5	13.1
Jan 2003 - Sept. 2008	11.5	8.3	7.6	5.9	3.5	11.6
Jan 2004 - Sept. 2008	11.5	9.0	8.2	6.4	4.0	11.4

Da li bazna inflacija pomaže u predviđanju trenda ukupne inflacije?

Mnogi analitičari se slažu da dobra mera bazne inflacije treba da pomogne u predviđanju budućeg kretanja ukupne inflacije. Da bismo ispitali mogućnost predviđanja, prvo smo ispitali prostu korelaciju između posmatranih mera bazne inflacije i ukupne inflacije za 6, 12 i 18 perioda unapred.

Korelacija međugodišnjih stopa bazne inflacije sa budućim kretanjem cena na malo, period januar 1997 - septembar 2008				
	Ukupna inflacija			
	(t+0)	(t+6)	(t+12)	(t+18)
Metod isključenja	0.93	0.85	0.58	0.34
Ponderisana mediana	0.98	0.75	0.38	0.14
Metod modifikovanih pondera	0.99	0.77	0.44	0.19
TM metod, 12% asimetrično	0.97	0.81	0.48	0.23
TM metod, 19% asimetrično	0.98	0.74	0.42	0.19

Korelacija međugodišnjih stopa bazne inflacije sa budućim kretanjem cena na malo, period januar 2001 - septembar 2008				
	Ukupna inflacija			
	(t+0)	(t+6)	(t+12)	(t+18)
Metod isključenja	0.71	0.37	-0.01	-0.37
Ponderisana mediana	0.64	0.25	-0.15	-0.41
Metod modifikovanih pondera	0.99	0.35	-0.05	-0.36
TM metod, 12% asimetrično	0.82	0.41	-0.01	-0.38
TM metod, 19% asimetrično	0.78	0.31	-0.09	-0.41

Korelacija međugodišnjih stopa bazne inflacije sa budućim kretanjem cena na malo, period januar 2004 - septembar 2008				
	Ukupna inflacija			
	(t+0)	(t+6)	(t+12)	(t+18)
Metod isključenja	0.96	0.51	-0.06	-0.43
Ponderisana mediana	0.91	0.40	-0.22	-0.50
Metod modifikovanih pondera	0.99	0.57	-0.08	-0.45
TM metod, 12% asimetrično	0.99	0.57	-0.02	-0.39
TM metod, 19% asimetrično	0.94	0.43	-0.13	-0.44

Prva tabela prikazuje korelaciju u čitavom posmatranom periodu. Prikazani koeficijenti

su visoki. To nam sugerise da obračuni bazne inflacije sadrže u sebi informacije o budućem kretanju ukupne inflacije. Metod isključenja se najbolje pokazao u svim horizontima predviđanja. Npr, za 18 meseci u napred, korelacija između bazne inflacije dobijene metodom isključenja i ukupne inflacije iznosi 0,34 i znatno je viša u odnosu na ostale. Ako pogledamo drugi posmatrani period, koeficijenti korelacije su nešto niži, ali i dalje

značajni. Za horizont predviđanja od 12 i 18 meseci, svi koeficijenti su negativni. Za period od 2004, za koji možemo reći da karakteriše neštostabilnije kretanje ukupne inflacije, vеоma je visoka korelisanost sa ukupne i bazne inflacije. Pad korelacije tokom vremena govori o tome da postoje šokovi koji su isključeni iz bazne inflacije, a

postoje i dalje u ukupnoj inflaciji.

Does core inflation help forecast total inflation trends?

Many analysts agree that a sound measure of core inflation should help forecast the future trends of total inflation, too. In order to examine the possibility of prediction, we first examined a simple correlation between the observed measures of core inflation and total inflation for a period of 6, 12 and 18 months in advance.

Correlation of year-to-year core inflation rates with the future retail proces trends in the period January 1997 - September 2008				
	Total inflation			
	(τ+0)	(τ+6)	(τ+12)	(τ+18)
Exclusion method	0.93	0.85	0.58	0.34
Weighted median	0.98	0.75	0.38	0.14
Double - weighting method	0.99	0.77	0.44	0.19
TM method, 12% asimmetrical	0.97	0.81	0.48	0.23
TM method, 19% asimmetrical	0.98	0.74	0.42	0.19

Correlation of year-to-year core inflation rates with the future retail proces trends in the period January 2001 - September 2008				
	Total inflation			
	(τ+0)	(τ+6)	(τ+12)	(τ+18)
Exclusion method	0.71	0.37	-0.01	-0.37
Weighted median	0.64	0.25	-0.15	-0.41
Double - weighting method	0.99	0.35	-0.05	-0.36
TM method, 12% asimmetrical	0.82	0.41	-0.01	-0.38
TM method, 19% asimmetrical	0.78	0.31	-0.09	-0.41

Correlation of year-to-year core inflation rates with the future retail proces trends in the period January 2004 - September 2008				
	Total inflation			
	(τ+0)	(τ+6)	(τ+12)	(τ+18)
Exclusion method	0.96	0.51	-0.06	-0.43
Weighted median	0.91	0.40	-0.22	-0.50
Double - weighting method	0.99	0.57	-0.08	-0.45
TM method, 12% asimmetrical	0.99	0.57	-0.02	-0.39
TM method, 19% asimmetrical	0.94	0.43	-0.13	-0.44

The first table shows the correlation in the entire observed period. The presented ratios

are high. This suggests that the core inflation calculations contain the information on the future total inflation trends. The exclusion method proved to be the best in all prediction horizons. For instance, for the period of 18 months in advance, the correlation between the core inflation calculated by exclusion method and total inflation amounts to 0.34 and is significantly higher than the other correlations. If we look at another observed period, the

correlation ratios are somewhat lower, but still considerable. For the prediction horizon of 12 and 18 months, all ratios are negative. In the period from 2004, characterized by the somewhat more stable trends of total inflation, the correlation of total and core inflation is rather high. The decrease of correlation in time indicates that there are shocks

excluded from core inflation, but still present in total inflation.

Da bismo odredili da li različiti obračuni bazne inflacije sadrže informacije koje mogu da poboljšaju prosto autoregresivno (AR) predviđanje ukupne inflacije, ocenili smo sledeću regresiju

$$\pi_t = \alpha_0 + \alpha_1 \pi_{t-12} + \alpha_2 \pi_{t-1}^{core}$$

gde π_t predstavlja međugodišnje stope rasta ukupne inflacije, dok π_{t-1}^{core} predstavlja međugodišnje stope rasta bazne inflacije.

Rezultati regresije za period 1998-2008				
	α_0	α_1	α_2	$\overline{R}^2$
Ukupna inflacija	19.81	0.33		0.10
Metod isključenja	0.94	0.10	0.92	0.91
Ponderisana mediana	3.96	0.08	1.97	0.97
Metod modifikovanih pondera	-0.30	-0.03	0.99	0.96
TM metod, 12% asimetrično	-1.90	0.07	1.50	0.96
TM metod, 19% asimetrično	1.35	0.03	1.66	0.92

S obzirom na visinu $\overline{R}^2$ prikazanu u tabeli, možemo zaključiti da svaka od mera bazne inflacije značajno doprinosi moći predviđanja prikazanim prostim AR modelom.

Sledeće smo ispitivali da li su bazna inflacija i komponente koje su isključene iz njenog obračuna nezavisne. Na osnovu analize Cogley (1998), testirali smo da li isključenja precenjuju ili potcenjuju kratkoročnu/varijabilnu komponentu ukupne inflacije. Ova regresija je urađena metodom najmanjih kvadrata. Rezultati su prikazani u tabelama na kraju rada.

$$\pi_{t+h} - \pi_t = \alpha + \beta (\pi_t^{core} - \pi_t) + \varepsilon_t$$

U slučaju da su $\alpha=0$ i $\beta=1$ to znači da su isključene komponente dobre za predviđanje kratkoročnih/varijabilnih kretanja u ukupnoj inflaciji. U slučaju da je β manje od jedan, onda je potcenjeno kretanje varijabilne komponente; u slučaju kada je veće od jedan, precenjeno je kretanje.

Zato smo za sve horizonte predviđanja u svim posmatranim periodima uradili Wald-ov test ograničenja na parametre iz prikazane regresije. Zaključci su prilično loši. Naime, u čitavom posmatranom periodu, ne postoji ni jedna mera bazne inflacije koja bi u bilo kom ispitanom horizontu predviđanja isključila sve tranzitorne elemente iz ukupne inflacije. Takođe, za period predviđanja od 12 meseci ne postoji adekvatna mera bazne inflacije. Pozitivni rezultati dobijeni su za metod modifikovanih

pondera za period predviđanja od 6 meseci, a na osnovu uzorka od 2004. godine. Verovatnoća ne odbacivanja nulte hipoteze o restrikcijama na parametrima je preko 40%. Neodbacivanje nulte hipoteze sa verovatnoćom od 10% dobijamo i kod metoda isključenja pri horizontu predviđanja od 18 meseci, a na

osnovu uzorka od 2001. godine. Na osnovu ovog testa možemo reći da samo metod isključenja i metod modifikovanih pondera mogu da služe u predviđanju bazne inflacije, s tim što su pomenute mere krajnje osetljive na promenu horizonta predviđanja kao i perioda na osnovu kojeg se ocenjuju parametri.

Bazna inflacija kao cilj monetarne politike

Urađena je analiza osobina koje je potrebno da poseduje mera bazne inflacije da bi bila dobra smernica kreatorima monetarne politike. Bez obzira da li služi kao operativni ili osnovni cilj, bazna inflacija je mera inflacije koja je javna, i stoga je potrebno da zadovoljava i sledeće osobine:

- mera bazne inflacije ne bi trebalo da isključuje previše elemenata iz potrošačke korpe, jer bi u tom slučaju mogla suviše da odstupa od troškova života
- metodologija za obračun ne bi trebalo da se menja prečesto

In order to determine whether various core inflation calculations contain certain information that can facilitate the simple autoregressive (AR) prediction of total inflation, we estimated the following regression:

$$\pi_t = \alpha_0 + \alpha_1 \pi_{t-12} + \alpha_1 \pi_{t-1}^{core}$$

where π_t represents year-to-year rates of total inflation growth, and π_{t-1}^{core} year-to-year rates of core inflation growth.

Results of the regression for the period 1998-2008				
	α_0	α_1	α_2	$\overline{R}^2$
Total inflation	19.81	0.33		0.10
Exclusion method	0.94	0.10	0.92	0.91
Weighted median	3.96	0.08	1.97	0.97
Double - weighting method	-0.30	-0.03	0.99	0.96
TM method, 12% asymmetrical	-1.90	0.07	1.50	0.96
TM method, 19% asymmetrical	1.35	0.03	1.66	0.92

Given the level of $\overline{R}^2$ shown in the table, we may conclude that each measure of core inflation significantly contributes to the power of prediction of the above presented simple AR model.

The next thing we examined was whether core inflation and the components excluded from its calculation are independent. Based on the analysis by Cogley (1998), we tested whether the exclusions overestimate or underestimate the short-term/variable component of total inflation. This regression was calculated by the least squares method. The results are shown in the tables at the end of this paper.

$$\pi_{t+h} - \pi_t = \alpha + \beta (\pi_t^{core} - \pi_t) + \varepsilon_t.$$

If $\alpha=0$ and $\beta=1$, this means that the excluded components are good for predicting short-term/variable movements of total inflation. If $\beta<1$, then the movements of the variable component are underestimated; if $\beta>1$, the movements are overestimated.

Therefore, we conducted the Wald test

for limitations on the parameters from the presented regression, for all prediction horizons in all observed periods. The conclusions were quite appalling. Namely, in the entire observed period, there is no measure of core inflation that would, in any of the examined prediction horizons, exclude all transitory elements from total inflation. In addition, for the 12-month prediction period, there is no adequate measure of core inflation. Positive results were obtained only for the double-weighting method in the 6-month prediction period, based on the 2004 sample.

The probability of non-dismissal of the null hypothesis on parameter limitations is over 40%. Non-dismissal of the null hypothesis with the probability of 10% is also recorded in case of the exclusion method with the 18-month prediction horizon, based on the

2001 sample. Based on the results of this test, we may claim that only exclusion method and double-weighting method may serve in core inflation prediction, bearing in mind that the mentioned measures are extremely sensitive to the changes in prediction horizons, and the periods based on which the parameters are evaluated.

Core inflation as the goal of the monetary policy

We conducted an analysis of the characteristics a core inflation measure needs to possess in order to be a sound indicator for the monetary policy makers. Regardless of whether it serves as an operational or basic objective, core inflation is a public inflation measure; hence it must feature the following characteristics, too:

- a core inflation measure should not exclude too many elements from the consumer basket, since thus it may digress too much from the cost of living;

- javnost treba da bude upoznata sa činjenicom da obračun nije pod kontrolom monetarnih vlasti
- trebalo bi da bude jasno da monetarne vlasti imaju instrumente pomoću kojih je moguće ostvarivati zadati cilj (bazna ili ukupna inflacija).

Dosta toga upućuje na korišćenje metoda isključenja kao mere bazne inflacije. Ova mera je najbolje prihvaćena od strane javnosti i računa se od strane nezavisne institucije, Republičkog zavoda za statistiku. Takođe, manje je varijabilna u odnosu na druge mere.

Bilo bi veoma korisno uključiti u analizu i meru neto inflacije, pokazatelja koja se dobija isključenjem uticaja fiskalne politike i poreskih propisa na ukupnu inflaciju. Problem

predstavljaju akcizni proizvodi, za koje je potrebna struktura maloprodajnih cena da bi se isključio uticaj promena akciza. Za naftne derivate struktura je poznata, ali se struktura cena cigareta i kafe još uvek utvrđuje.

Analiza je pokazala da sve prikazane mere imaju svoje prednosti i mane i da svaka daje dodatne informacije o kretanju ukupne inflacije. Zbog toga je bolje ne vezivati se za jednu meru, već pratiti kretanje nekoliko njih. Pošto trend inflacije ne može precizno da se oceni, onda treba imati čitav set ocena. U trenutku kada sve mere budu pokazivale istu tendenciju, realno je prihvatiti ih kao dobar putokaz u vođenju monetarne politike. U slučaju da se mere razilaze, potrebno je sa pažnjom proučiti razloge za to.

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- the calculation methodology should not be changed too often;
- the general public should be aware of the fact that the calculation is not controlled by the monetary authorities;
- it should be made clear that the monetary authorities have certain instruments which may help them achieve the set goal (core or total inflation).

Many things point to the preference of using the exclusion method as a core inflation measure. This measure is best accepted by the general public and is calculated by an independent institution, Statistical Office of the Republic of Serbia. Also, this measure is less variable in comparison to others.

It would be very useful to include the net inflation measure into the analysis, an indicator calculated by excluding the impact of fiscal policy and tax regulations on total inflation.

The problem lies with the excise products, for which one needs the retail price structure in order to exclude the impact of excise changes. This structure is known for oil derivatives, but is still being determined for cigarettes and coffee.

The analysis has shown that the presented measures have their strengths and weaknesses, and that each of them adds information about the total inflation trends. Therefore, it is better not to adhere to just one measure, but instead monitor the fluctuations of several of them. Since it is impossible to provide a precise estimation of the inflation trend, it is recommendable to have a whole set of estimations. At the point when all measures indicate the same tendency, it is realistic to accept them as a sound guideline in conducting the monetary policy. If, however, the measures are uncorrelated, it is necessary to carefully examine the underlying causes.

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Prilog

Rezultati regresije za 6 meseci unapred, period 1997-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.62	0.21	0.56	0.38	0.21
α	2.86	12.48	-5.66	12.40	10.78
β	1.67	0.67	3.60	1.17	0.78
Chi ² statistika	32.53	97.01	81.45	37.95	51.38
p-vrednost	0.00	0.00	0.00	0.00	0.00

Rezultati regresije za 6 meseci unapred, period 2001-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.52	0.52	0.27	0.62	0.52
α	2.61	5.76	-1.54	3.99	4.64
β	0.94	0.73	2.67	1.00	0.84
Chi ² statistika	66.22	400.98	18.46	109.97	187.08
p-vrednost	0.00	0.00	0.00	0.00	0.00

Rezultati regresije za 6 meseci unapred, period 2004-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.01	0.13	0.05	0.24	0.08
α	-1.65	3.06	-0.78	3.40	1.62
β	-0.30	0.54	1.66	1.25	0.50
Chi ² statistika	10.94	114.28	1.799	20.26	46.49
p-vrednost	0.00	0.00	0.41	0.00	0.00

Appendix

Results of the regression for 6 month in advance, period 1997-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.62	0.21	0.56	0.38	0.21
α	2.86	12.48	-5.66	12.40	10.78
β	1.67	0.67	3.60	1.17	0.78
Chi ² statistics	32.53	97.01	81.45	37.95	51.38
p-value	0.00	0.00	0.00	0.00	0.00

Results of the regression for 6 month in advance, period 2001-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.52	0.52	0.27	0.62	0.52
α	2.61	5.76	-1.54	3.99	4.64
β	0.94	0.73	2.67	1.00	0.84
Chi ² statistics	66.22	400.98	18.46	109.97	187.08
p-value	0.00	0.00	0.00	0.00	0.00

Results of the regression for 6 month in advance, period 2004-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.01	0.13	0.05	0.24	0.08
α	-1.65	3.06	-0.78	3.40	1.62
β	-0.30	0.54	1.66	1.25	0.50
Chi ² statistics	10.94	114.28	1.799	20.26	46.49
p-value	0.00	0.00	0.41	0.00	0.00

Rezultati regresije za 12 meseci unapred, period 1997-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.66	0.38	0.64	0.60	0.45
α	2.59	25.12	-11.23	22.91	23.41
β	2.59	1.37	5.80	2.03	1.73
Chi ² statistika	84.04	46.12	143.49	67.6	40.05
p-vrednost	0.00	0.00	0.00	0.00	0.00

Rezultati regresije za 12 meseci unapred, period 2001-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.48	0.44	0.33	0.59	0.55
α	3.19	8.39	-2.72	5.56	6.78
β	1.14	1.52	4.21	1.41	1.23
Chi ² statistika	14.99	149.4	29.43	38.01	67.66
p-vrednost	0.00	0.00	0.00	0.00	0.00

Rezultati regresije za 12 meseci unapred, period 2004-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.51	0.54	0.21	0.75	0.52
α	7.76	8.46	-2.70	8.85	6.59
β	4.87	1.07	5.92	3.31	1.88
Chi ² statistika	20.78	32.81	15.01	44.87	14.94
p-vrednost	0.00	0.00	0.00	0.00	0.00

Results of the regression for 12 month in advance, period 1997-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.66	0.38	0.64	0.60	0.45
α	2.59	25.12	-11.23	22.91	23.41
β	2.59	1.37	5.80	2.03	1.73
Chi ² statistics	84.04	46.12	143.49	67.6	40.05
p-value	0.00	0.00	0.00	0.00	0.00

Results of the regression for 12 month in advance, period 2001-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.48	0.44	0.33	0.59	0.55
α	3.19	8.39	-2.72	5.56	6.78
β	1.14	1.52	4.21	1.41	1.23
Chi ² statistics	14.99	149.4	29.43	38.01	67.66
p-value	0.00	0.00	0.00	0.00	0.00

Results of the regression for 12 month in advance, period 2004-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.51	0.54	0.21	0.75	0.52
α	7.76	8.46	-2.70	8.85	6.59
β	4.87	1.07	5.92	3.31	1.88
Chi ² statistics	20.78	32.81	15.01	44.87	14.94
p-value	0.00	0.00	0.00	0.00	0.00

Rezultati regresije za 18 meseci unapred, period 1997-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.40	0.41	0.23	0.55	0.48
α	0.02	29.88	-10.48	24.60	27.32
β	2.22	1.64	3.92	2.41	2.03
Chi ² statistika	21.59	39.07	20.6	53.86	39.72
p-vrednost	0.00	0.00	0.00	0.00	0.00

Rezultati regresije za 18 meseci unapred, period 2001-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.39	0.57	0.39	0.53	0.54
α	2.67	10.99	-3.78	6.14	8.32
β	1.18	1.34	5.13	1.59	1.49
Chi ² statistika	4.53	95.94	39.9	19.84	39.74
p-vrednost	0.10	0.00	0.00	0.00	0.00

Rezultati regresije za 18 meseci unapred, period 2004-2008					
	Metod isključenja	Ponderisana mediana	Metod modifikovanih pondera	TM metod, 12% asimetrično	TM metod, 19% asimetrično
$\overline{R}^2$	0.14	0.44	-0.04	0.76	0.59
α	0.21	10.23	-6.28	10.03	6.77
β	2.65	1.92	-0.36	3.90	2.20
Chi ² statistika	15.84	12.6	29.81	55.99	10.39
p-vrednost	0.00	0.02	0.00	0.00	0.01

Results of the regression for 18 month in advance, period 1997-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.40	0.41	0.23	0.55	0.48
α	0.02	29.88	-10.48	24.60	27.32
β	2.22	1.64	3.92	2.41	2.03
Chi ² statistics	21.59	39.07	20.6	53.86	39.72
p-value	0.00	0.00	0.00	0.00	0.00

Results of the regression for 18 month in advance, period 2001-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.39	0.57	0.39	0.53	0.54
α	2.67	10.99	-3.78	6.14	8.32
β	1.18	1.34	5.13	1.59	1.49
Chi ² statistics	4.53	95.94	39.9	19.84	39.74
p-value	0.10	0.00	0.00	0.00	0.00

Results of the regression for 18 month in advance, period 2004-2008					
	Exclusion method	Weighted median	Double weighting method	TM method, 12% assymetrical	TM metod, 19% assymetrical
$\overline{R}^2$	0.14	0.44	-0.04	0.76	0.59
α	0.21	10.23	-6.28	10.03	6.77
β	2.65	1.92	-0.36	3.90	2.20
Chi ² statistics	15.84	12.6	29.81	55.99	10.39
p-value	0.00	0.02	0.00	0.00	0.01