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Forecasting inflation in Montenegro using univariate time series models

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The analysis of price trends and their prognosis is one of the key tasks of the economic authorities in each country. Due to the nature of the Montenegrin economy as small and open economy with euro as currency, forecasting inflation is very specific which is more difficult due to low quality of the data. This paper analyzes the utility and applicability of univariate time series models for forecasting price index in Montenegro. Data analysis of key macroeconomic movements in previous decades indicates the presence of many possible determinants that could influence forecasting result. This paper concludes that the forecasting models (ARIMA) based only on its own previous values cannot adequately cover the key factors that determine the price level in the future, probably because of the existence of numerous external factors that influence the price movement in Montenegro.

JEL Classifications: C53, C32, E31

Keywords: Price index, inflation forecasting, AR(I)MA model, forecast error

Introduction

Observing the price level in order to achieve price stability is one of the most important economic tasks for the Government of any country, as one of the key indicators of overall economic performance in economy. Therefore, forecasting the future inflation trends represents an instrument for achieving such goal. In addition, awareness of the application of econometric models for the purpose of inflation forecasting and other significant economic indicators gains more significance.

High inflation rate in Montenegro in last decade is not a priority issue for Montenegrin economic authorities. However, the history of unstable economic performance cannot be forgotten, as well as quite volatile trends in the domain of inflation, influenced by political-economic developments (Yugoslavia falling apart, introduction of currencies such as the Mark, then the Euro and many structural changes in economy caused by transition). There are differences among economists considering the reasons for continued growth of a general price level. Some of them believe the reasons lie in successive balance of payments deficits; others think the reason is a huge government expenditures or change of fiscal policies. Whatever the reasons are, this paper is trying to analyze the performance of inflation forecasting in Montenegro by application of univariate autoregressive models. Extreme shocks caused by these events during the last ten years, have made the statistical basis for construction of econometric forecasting models insufficient and very unreliable until recently. However, the development of forecasting models has been discussed more and more lately, so this paper is one of the first using data from Montenegro.

The nature of price fluctuation in Montenegro is specific in many aspects. Most of the reasons are related to the fact it is a very small, open economy and highly dependent on imports. For instance, according to estimates of the IMF, the share of Montenegrin GDP in global GDP measured by purchasing power parity (PPP) for 2013 amounts to 0,009%, or less than one tenth of promile. Montenegrin GDP in 2013 (also by PPP) takes 151st position out of 189 countries for which details are available in the IMF's WEO[1] database[2]. Considering the openness, and according to the IMF data, ratio of total exports and imports of goods and services to GDP in Montenegro was 99.3% in 2010, which puts it on 49th position out of 139 countries for which data are available. Although the openness could be measured by indicators other than the basic one mentioned above, Montenegro undoubtedly belongs to the group of open economies.

One of the main purposes of constructed models of time series is forecasting, which is a quantitative evaluation of the probability of future events developed on the basis of past and present information. This information is incorporated in the model. Despite the fact there are numerous models used for forecasting, this paper analyzes possibilities and benefits of the simplest models of time series (from the ARIMA group) in forecasting inflation rate in Montenegro for the first six months of 2013. In other words, autoregressive models provide quick and easy prediction for a short period of time, and they often appear superior in comparison to the prognosis output of large econometric models. So, for example, Meyler and Terry (1998) successfully used ARIMA models for inflation forecasting of Ireland, while Sekine (2001) successfully forecasted inflation rate in Japan, and Salam and Feridun (2006) successfully forecasted inflation rate in Pakistan. Stockton and Glassman (1987) emphasize it is "quite surprising that such primitive models as ARIMA models achieve such results in inflation forecasting". When we look at studies in this field in the neighbouring countries, it is important to refer to the works of Krušec (2007), Stoviček (2007), Pufnik and Kunovac (2006), which have proven the benefits of the univariate ARIMA models for inflation forecasting. Inflation forecasting made by time series models is mentioned in Montenegro for the first time after a working paper of the Central bank of Montenegro. Today, the forecasting model for inflation is based on the ARIMA model with expert judgemental corrections (Kalezić, Cerović and Božović, 2007). Even though, there are a lot of sophisticated techniques for forecasting inflation nowadays, very low quality level of the data (short time series, different frequency of the data, lack of many important indicators etc) makes more difficult to implement that new techniques.

Generally, the utility of univariate models is reflected in the fact they are based on the past developments of the dependent variable, i.e. they presume that the future development will continue to follow established regime from the past. It means that just by using earlier values of the variable it is possible to encompass the entire spectrum of influences that continually determine the values of the analyzed series through the time. On the other hand, if such factors were required individually, they would be either neglected or their impact would be overrated in an attempt of a structural model forecasting. In addition, the reason for prevalence of the latter models lies in the fact that forecasting by multi-dimensional model includes accurate evaluations of the future values of all used variables (which is often impossible, while we have single variable here).

Development of econometric forecasting models, even those from the group of non-structured models such as models from the ARIMA group, unambiguously requires knowledge and understanding of economic and social circumstances, as well as mutual connections and impacts among them. Monthly consumer price index for period between 2001 and 2013 is used in this paper as the measure of inflation. All data are taken from the Montenegro Bureau of Statistics (Monstat).

In order to comprehend the complexity of analysis and price trend forecasting, it is important to know main channels and directions of impacts on the change of price level. For that reason, the most important tendencies in macroeconomic trends in the last 13

[1] WEO - World Economic Outlook.

[2] It is clear that calculation of GDP by purchasing power parity assigns much higher portion to Montenegro in relation to simple comparison of GDP with market exchange rates, due to a difference in price levels in Montenegro and the USA, the currency and price levels of which serve as a benchmark in calculations done by the IMF.

years in Montenegro are presented in the text below. The rest of the paper contains a methodological review of univariate models, empirical results and a conclusion.

Determinants of inflation in Montenegro

If we had to select single key event, trend, or tendency in Montenegrin economy from the period between 2001 and 2013, it would certainly be the inflow of direct and other foreign investment during the midst of that period, which represented the crucial positive shock for the economic growth, and at the same time acted as a shock for many other macroeconomic variables.

Between 2001 and 2013, the inflation level in Montenegro was certainly influenced by increased inflow of foreign investment and growth of that inflow in the 2005 - 2008 – primarily through an increased level of wages and/or an increased credit growth. Growth of wages influenced the growth of prices of services much more than prices of goods, which fully complies with economic theory. It is important to say that significant part of the foreign capital inflow had been absorbed through the domestic stock and real estate markets. Nevertheless, it all had a feedback effect on the growth of aggregate demand and made a pressure on the price level due to 1) "wealth effect" and 2) increased credit supply (due to increased value of collateral).

Another internal factor influencing inflation, i.e. price level, are measures in the field of tax and excise policy. Tax policy may have huge influence on prices; e.g. change in the VAT rate, certain charges, or change in excise duties (that are themselves calculated for three important group of products: fuel, tobacco and alcohol beverages). Bearing in mind high public deficits and public debt, increases in budget revenues are, besides expanding the tax basis, achieved by an increase of tax or/and excise rates, which all leads to an increase of prices in general. Another important factor relates to administratively regulated prices. In Montenegro, prices of some products and services are regulated to a certain extent, such as the prices of: bread, water, power, drugs, post office services, etc.. Price changes for these products and services and the moment of change are very difficult to predict. Finally, each type of change which stimulates the competition and healthy competitive relationships in economy, results in a fall of the price level. Those are, among others: reduction of gray economy, corruption and organized crime, increased tax discipline, decreased barriers and creation of better business environment in general, destruction of monopoly or semi-cartel structures etc. [1]

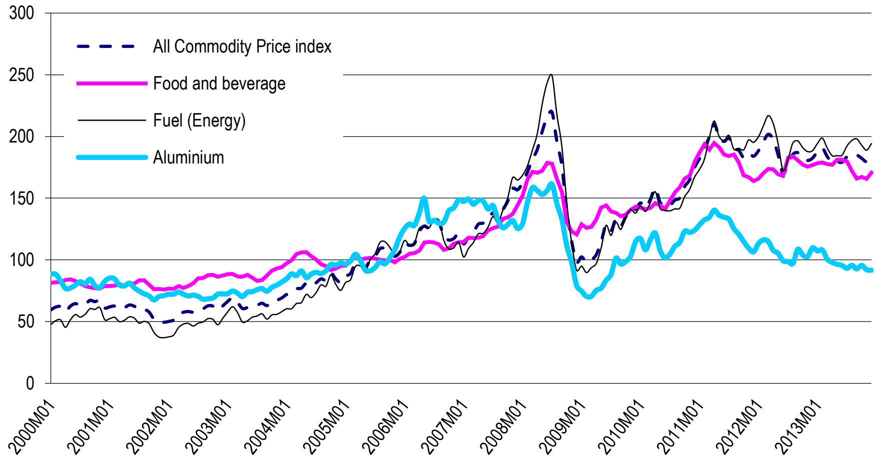
Overall trends in Montenegrin economy, as well as changes in the price level, are significantly influenced by trends from the outer environment. The most important reasons lie in the openness of Montenegrin economy, high dependency on imports, and the fact that Montenegro uses the Euro zone currency, so the euro inflation is transmitted simultaneously with the growth of import prices.

The period between 2001 and 2013 was marked by a noticeable growth of commodity prices, "turbulences" on financial markets, continued strong growth in the emerging economies compared to developed economies, growth of the standard of living (particularly in emerging economies), as well as the most severe financial crisis since the Great Depression, and the first negative growth rate in global economy since the Second World War (2009). The impact of global commodity prices to the Montenegro inflation is evident, whether the goods are imported in their "original" form, or partly processed (Figure 1). Of course, the impact is significant due to the fact that a small number (and quantity) of commodities are produced in Montenegro, although the situation would not be different even if more commodities were produced in Montenegro, because they would

[1] On other side, improvements under issues mentioned herein, generally lead to an increase of relative attractiveness of the country, and consequently to an increase in price level, but at the same time to a growth of nominal wages which is higher than the increase of price level, i.e. to a higher standard of living.

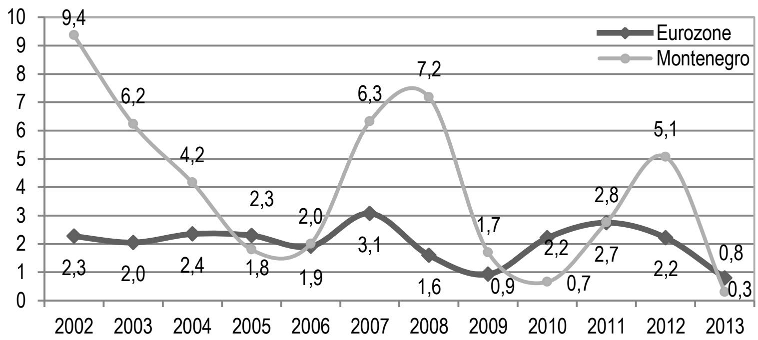
be offered and sold at the global market, as standardized products. At the same time, the impact to the prices in Montenegro is not straightforward due to a series of factors: tax (excise) policy in Montenegro, Euro-Dollar exchange rate, administrative regulation of prices for certain products and services, level of inventories, series of characteristic factors in the countries from which Montenegro imports "processed" commodities ("final" products), etc.

FIGURE 1. PRICE DEVELOPMENTS FOR CERTAIN GROUPS OF COMMODITIES*, 2005=100



Source: IMF statistics.
Note: * Aluminum is included in the Chart since it is the most important Montenegrin export product.

FIGURE 2. INFLATION RATE IN EUROZONE AND MONTENEGRO, %



Source: IMF statistics

Considering the inflation rates in Montenegro before the introduction of the Euro (March 2002), we could say the inflation in Montenegro broadly followed the inflation in Euro zone in the period 2002-2013. The convergence is reasonable, primarily due to (1) impact of (stock exchange) prices of energy products and food on both economies, as well as to (2) "import channel", since Euro zone is the second largest trade partner of Montenegro, after the countries from the region (considered indirectly, through trade and other relationships of countries of the region with the Euro zone, which in turn have strong ties with Montenegro, the import channel is even more important). Of course, the differences in inflation rates also derive from drastically different weight factors for food in the goods and services baskets through which the price changes are tracked, big differences in growth of average wages, methodological inconsistencies of Monstat regarding the calculation of the electricity price trends (in 2007)[1], specificity and possibility of substitution of goods imported in Montenegro, or due to other reasons. The divergence of inflation rates during the first years after Euro introduction in Montenegro (2002-2004) might have resulted from a slow fall in inflation expectations. Inflation rates in Euro zone and Montenegro are shown in Figure 2. Obvious variations of prices in Montenegro confirm the earlier comments that inflation is a consequence of other factors as well, apart from the imported inflation from the Euro zone. Also, it is important to say that the surge in 2007/2008 corresponds to the bubble created at the financial market, i.e. big financial inflows.

Having in mind the above mentioned, there is no doubt the inflation in Montenegro is very difficult to forecast, because of many relevant factors that influence the general price level. Therefore the selection of an adequate methodological framework, or a model, represents a special research challenge.

The methodology

Well known Box-Jenkins methodology, technically known as ARIMA methodology (autoregressive models of moving average of integrated series), is based on the analysis of stochastic properties of economic time series, not starting from theoretical presumptions on analyzed phenomenon. Therefore these models are often called non-structural and a theoretical (Gujarati, 2003) and are based on philosophy "let the data speak for themselves[2]". It means these models do not have ground in economic theory, unlike the model of simultaneous equations, for instance.

This portion of paper will emphasize univariate models, although the analysis also may be expanded to the models with several variables.

These models are described, through lag operator B, by the following form:

$$\underbrace{(1-\phi_1 B-\phi_2 B^2-\ldots-\phi_p B^p)}_{\phi(B)}(1-B)^d X_t=\theta_0+\underbrace{(1-\theta_1 B-\theta_2 B^2-\ldots-\theta_q B^q)}_{\theta(B)}e_t \quad , \tag{1}$$

The abbreviation mostly used for these models is ARIMA (п, d, q), where the series of autoregressive component line (*p*), level of integrated series (*d*) and the series of movement average component (*q*) are indicated in the brackets.

If presumed d=1, we have the ARIMA(*p, 1, q*) model to be written as follows:

$$\Delta X_t=\theta_0+\sum_{i=1}^{p}\phi_i\Delta X_{t-i}+e_t-\sum_{i=1}^{q}\theta_i e_{t-i}\,, \tag{2}$$

what is actually the ARMA(*p, q*) model, but for the time series ΔX_t which is previously transformed by differentiation in order to achieve its statitionary transformation.

[1] Monstat included in July 2007 the growth of prices of electricity which had occurred much earlier.
[2] This slogan is credited to Christopher Sims.

ARIMA models are mostly used for projection based on evaluation of the mechanism that generates the series. However, the important issue is selection of an adequate ARIMA model. The *Box-Jenkins* method offers a model selection procedure in several stages which will sufficiently describe the movement of a concrete data set of a time series.

The approach consists of three stages:

a) Identification of model: the objective of this stage is to select narrower classes of ARIMA model. Prior to that the series integration level should be tested as well as the method of reducing to stationarity. It is followed by determination of autoregressive and movement average by correlogram. As a rule, the law values п and q are used, in accordance with principle of frugality or maximising of number of degrees of freedom (Jovicic, Dragutinovic-Mitrovic, 2011).

b) Evaluation of parameters: Method of ordinary least squares is used in evaluation of parameters of AR model. Method of nonlinear least squares is used for evaluation of parameters of MA and ARMA models, which is based on application of different algoritms of numerical optimization (Mladenovic-Nojkovic, 2012).

c) Verification of model adequacy: this stage includes checking whether the model complies with data. Specification of a model should be checked whether it is adequate to dynamics of a random variable, the behavior of which is being explained by the model, as well as if parameters are properly evaluated. One of the basic tests in this stage includes analysis of residuals (normality tests, autocorrelation test, etc.) which should behave under the principle of white noise process. Information criteria are used in selection among different models. The procedure lasts as long as we obtain model specification that provides satisfactory test results.

Following these three stages, given model is used for forecasting. Selection between two competitive ARIMA models with similar properties involves criteria of more accurate prognosis. The purpose is to select a model that provides lower prognostic error variance.

Starting with the general form of ARIMA model given with (1), otherwise written:

$$\phi(B)(1-B)^d X_t = \theta(B)e_t , \tag{3}$$

Then the previous model may be written in the form of following differential equation:

$$\alpha(B)X_t = \theta\left(B\right)e_t \Leftrightarrow (1-\alpha_1 B-\alpha_2 B^2-...-\alpha_{p+d}B^{p+d})(1-\theta_1 B-\theta_2 B^2-...-\theta_q B^q)e_t , \tag{4}$$

By replacement $t=n+h$ we get as follows:

$$X_{n+h} = \alpha_1 X_{n+h-1} + \alpha_2 X_{n+h-2} + ... + \alpha_{p+d} X_{n+h-p-d} + e_{n+h} - \theta_1 e_{n+h-1} - ... - \theta_q e_{n+h-q} , \tag{5}$$

Determining of conditional expected value of the expression (5) gives a general expression based on which the prognosis for concrete forms of ARIMA models is calculated 1:

$$\begin{aligned} \hat{X}_n(h) = \alpha_1 \hat{X}_n(h-1) + ... + \alpha_{p+d}\hat{X}_n(h-p-d) \\ +\hat{e}_n(h) - \theta_1 \hat{e}_n(h-1) - ... - \theta_q \hat{e}_n(h-q) \end{aligned} , \tag{6}$$

[1] Procedure for calculation of forecast on the basis of ARIMA model is given according to Kovacic (1995).

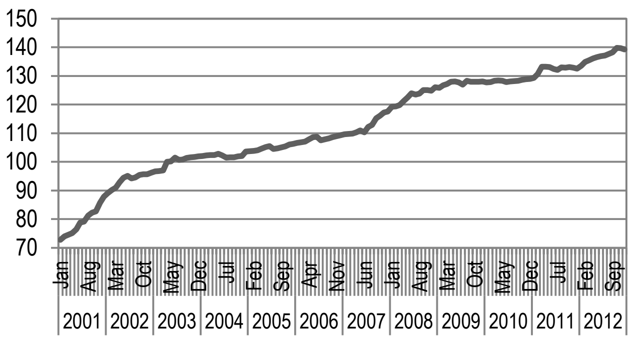
where, $\hat{X}_n(j) = \begin{cases} E(X_{n+j} | X_n, X_{n-1}, \ldots), & j > 0 \\ X_{n+j}, & j \leq 0 \end{cases}$ and $\hat{e}_n(j) = \begin{cases} 0, & j > 0 \\ e_{n+j}, & j \leq 0 \end{cases}$.

Based on expression (6), past expectations have to be replaced for calculation of the prognosis based on ARIMA models, when $j \leq 0$, by known values of series X_{n+j} and known values of shocks e_{n+j}, and future expectations when $j > 0$, by prognosis of series $\hat{X}_n(j)$ and the value of shocks with expected values in the future period equals zero.

Empirical analysis

The price index illustrated in Figure 3 shows a clear ascending trend, of non-stochastic character, confirmed by results of the unit root test with a linear trend given in Table 1.

FIGURE 3. PRICE INDEX IN PERIOD 2001-2012, 2003=100



Source: Monstat.

TABLE 1. UNIT ROOT TEST FOR PRICE INDEX, 2001-2012

The null hypothesis: Y has a unit root		
	t-statistic	p-value
ADF test results	-3.489399	0.0443

Source: Author's calculations.

Results of the extended *Dickey-Fuller* test indicate that null-hypothesis on existence of unit root may be rejected with a significance level of 5%, so it brings to the conclusion that the series is trend-stationary. Movement dynamics of this series may be better viewed by regressing the price index on the constant, trend and squared time, due to observed mild slowing down of growth trend. The results of such regression confirm the trend to be ascending with moderate acceleration, also indicated by a positive coefficient of the trend, and very low coefficient of squared time, along with negative prefix, points out the concavity of trend (existence of maximum). Explicit cyclic oscillations around the trend may be incorporated by model through autoregressive components in a model that also contains the trend. Evaluation of autocorrelation coefficients (AC) and partial autocorrelation coefficients (PAC) from Table 2 show necessity to include autoregressive component of the first series AR(1).

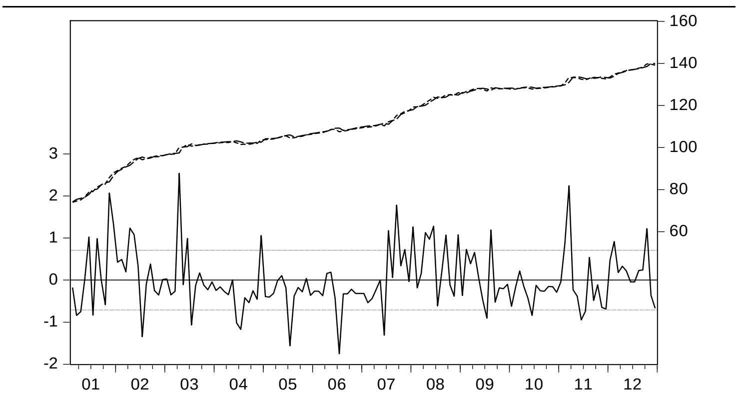
However, normality and autocorrelation tests of residuals are not satisfactory, although the model which on the right side of equation has a constant, trend and autoregressive factor of the first series indicates very high compliance of original and estimated price indexes. Hence, in selecting adequate specification of the model we should consider introduction of additional autoregressive factors, and/or potential factors of moving average.

TABLE 2. CORRELOGRAM FOR THE PRICE INDEX

No	AC	PAC	Q-Stat	Prob
1	0.971	0.971	138.58	0.000
2	0.942	-0.018	269.85	0.000
3	0.912	-0.027	393.76	0.000
4	0.882	-0.005	510.64	0.000
5	0.853	-0.005	620.82	0.000
6	0.826	0.010	724.81	0.000
7	0.798	-0.025	822.61	0.000
8	0.772	0.010	914.73	0.000
9	0746	-0.005	1001.4	0.000
10	0.720	-0.011	1082.8	0.000
11	0.697	0.033	1159.7	0.000
12	0.677	0.021	1232.7	0.000
⋮	⋮	⋮	⋮	⋮
23	0.474	0.014	1821.0	0.000
24	0.458	0.002	1857.7	0.000

Source: Author's calculations.

FIGURE 4. ORIGINAL AND ESTIMATED PRICE INDEX



Source: Author's calculations in EViews 7.

Normality of residuals may be achieved through introduction of dummy variables in the model. As the Figure 4 clearly shows the existence of extreme compliance between the original series of data and the one evaluated by the model, with jump in prices above the line of two standard errors from the model regular dynamic only for two observations, April 2003 and March 2011. Analyzing the historic conditions in given months, we conclude the reasons for such sudden changes are:

1) The shock from April 2003 occurred because of VAT introduction. So the highest monthly price increase was recorded in that month and it was 3.2%.

2) Sudden increment in March 2011 was to a significant extent a consequence of the increase of prices for certain group of products. Out of those products, very sensitive category "food and soft drinks" recorded a monthly growth of 3.4% compared to February 2011. Also, increase of excises and oil prices directly caused a growth of transportation prices (5.6% in this month compared to the previous one).

As a result of the above mention, we introduce two dummy variables. APRIL03 takes the value one for April 2003 and zero for other months, while MARCH11 is series that has all zeros, except March 2011 when it takes the value one.

Selection of the best model in order to eliminate mentioned problems includes alternative autoregressive factors with longer lag apart from the first lag, and the best results were brought by two models in the sense of statistical significance, residual tests and information criteria. In addition, in selecting the optimal model, in the sense of incorporated AR and MA components we were led by logic that the simpler model the better (in accordance with principle of parsimony) (Enders, 2004).

The first of two models, very well illustrating the correlation structure of the series, is given in Table 3.

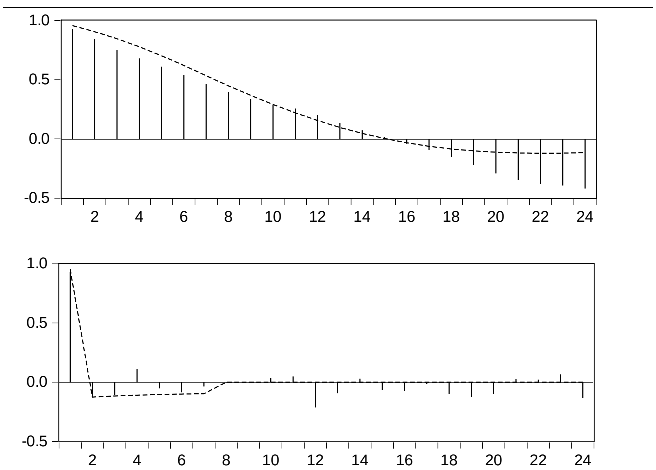
TABLE 3. AR7 MODEL SPECIFICATION

Variables	Coeficient	t-statistics	p-value
Constant	86.42130	50.92589	0.0000
Trend	0.367969	19.87405	0.0000
AR(1)	1.017482	33.63366	0.0000
AR(7)	-0.098130	-4.193374	0.0001
APRIL03	1.404329	3.150918	0.0020
MARCH11	1.316100	2.953312	0.0037

Source: Author's calculations.

Residual tests results do have all desirable features, so this model may be used in further analysis. The chart of auto-correlation function (Figure 5) shows the correlation structure relatively well incorporated by the model, especially until 15th lag.

FIGURE 5. ORDINARY AUTO-CORRELATION (THE PICTURE ABOVE) AND PARTIAL AUTO-CORRELATION FUNCTION (PICTURE BELOW) OF THE MODEL AR7



Source: Author's calculations in EViews 7.

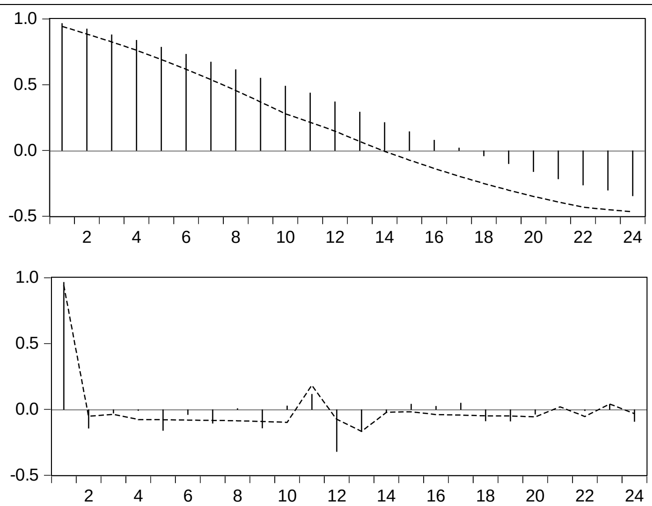
For the purpose of better specification of negative auto-correlation coefficients, meaning for longer forecasts, the expanded model with satisfactory statistical criteria is shown in Table 4. That is the model which, besides auto-regressive factors, contains two factors of movement averages.

TABLE 4. AR13-MA12 MODEL SPECIFICATION

Variables	Coeficient	t-statistics	p-value
Constant	83.78952	102.3629	0.0000
Trend	0.398039	43.04056	0.0000
APRIL03	1.405671	3.347661	0.0011
MARCH11	1.288729	3.266827	0.0014
AR(1)	0.942421	40.27612	0.0000
AR(12)	0.499872	4.395440	0.0000
AR(13)	-0.542572	-5.094271	0.0000
MA(10)	-0.281286	-3.788438	0.0002
MA(12)	-0.460217	-3.933110	0.0001
R-squared	0.998491	F-statistic	10089.46
Durbin-Watson stat.	1.781368	Prob(F-statistic)	0.000000

Source: Author's calculations.

FIGURE 6. ORDINARY AUTO-CORRELATION (THE PICTURE ABOVE) AND PARTIAL AUTO-CORRELATION FUNCTION (PICTURE BELOW) OF THE MODEL AR13-MA12



Source: Author's calculations in EViews 7.

All residual tests results (normality, heteroskedasticity test and auto-correlation), for the models in Tables 3 and 4, in accordance with theoretical assumptions, are available upon request. For the purpose of better illustration of the previous two univariate models, evaluated equation from Tables 3 and 4 may be shown in the following way.

AR 7 model:

$$Y_i = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-7} + \beta_3 D_{1t} + \beta_4 D_{2t} + \beta_5 T + \varepsilon_t ,$$

AR13-MA12 model:

$$Y_i = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-12} + \beta_3 Y_{t-13} + \beta_4 \varepsilon_{t-10} + \beta_5 \varepsilon_{t-12} + \beta_6 D_{1t} + \beta_7 D_{2t} + \beta_8 T + \varepsilon_t ,$$

where t=1,2,...144, and used variables are:

Y = price index in Montenegro, 2003=100;

D1 = 1 for 2003:4, and 0 for the rest of the period;

D2 = 1 for 2011:3, and 0 for the rest of the period;

T = 1,2,3,...,144 (trend for period from 2001:1 to 2012:12).

In practice, examination of the prognostic model power means the testing of differences between forecasted and real values of the series out of sample. We shall examine the quality of the previous two inflation forecasting models for the first six months 2013. However, based on evaluated models AR7 and AR13-MA12 in the period 2001 - 2012, the inflation forecast for the next six months had been made, as well as comparison of available real and forecasted results. Comparing the values of the root mean square error (RMSE), mean absolute error (MAE), Theil'scoefficient of inequality, as well as information criteria of two previously selected models, we can conclude that for simulated period from 2011m1 to 2012m12, model AR7 has better forecasting properties within the sample, because each of the indicators has a lower value in relation to model AR13-MA12.

So, according to Table 5 illustrating the values of the most used statistics for evaluation of the forecast quality, for forecasting horizon from one to six steps ahead, it could be concluded that model AR7 provides significantly better forecasting results for each horizon.

TABLE 5.STATISTICS FOR THE EVALUATION FORECAST OF CHOSEN AUTOREGRESIVES MODELS

Statistics	Model	Forecast Horizon					
		1	*2*	*3*	*4*	*5*	*6*
MSE	*AR7*	0.287	0.466	0.445	0.420	0.400	0.823
	AR13-MA12	0.784	1.494	1.965	2.510	3.278	5.177
RMSE	*AR7*	0.536	0.682	0.667	0.648	0.632	0.907
	AR13-MA12	0.886	1.222	1.402	1.584	1.811	2.275
MAE	*AR7*	0.536	0.669	0.658	0.640	0.625	0.807
	AR13-MA12	0.886	1.185	1.358	1.528	1.726	2.077
MAPE	*AR7*	0.385	0.481	0.472	0.459	0.447	0.577
	AR13-MA12	0.637	0.851	0.974	1.094	1.234	1.485

Source: Author's calculations

Review of interval forecasts and errors for both models is given in Tables 6 and 7.

TABLE 6. INTERVAL PROGNOSIS FOR TWO CHOSEN MODELS AND THE ACTUAL PRICE INDEX FOR THE FIRST 6 MONTHS OF 2013

	Interval prognosis (model AR7)		Interval prognosis (model AR13-MA12)		Actual data
Period	*Lower bound*	*Higher bound*	*Lower bound*	*Higher bound*	
2013m1	138.340	140.876	138.834	141.082	139.072
2013m2	138.205	141.823	139.149	142.242	139.212
2013m3	138.168	142.639	139.636	143.312	139.768
2013m4	138.170	143.379	140.160	144.286	140.188
2013m5	138.095	143.971	140.744	145.232	140.468
2013m6	138.092	144.587	141.064	145.848	139.625

Source: Author's calculations.

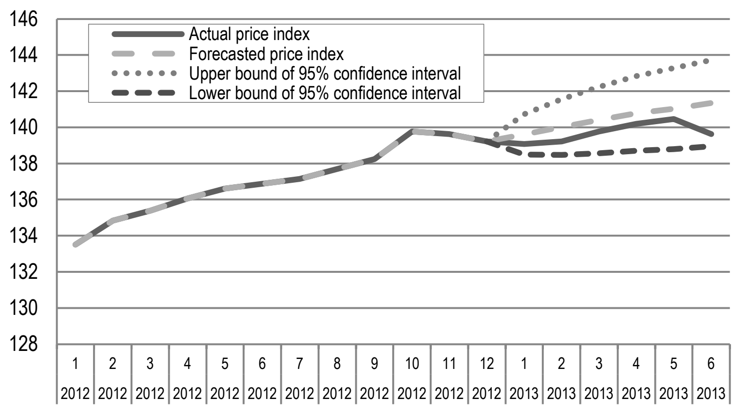
Finally, diagram of forecasted and actual inflation on the basis of the better autoregressive model is given in Figure 7.

TABLE 7. THE COMPARATIVE REVIEW OF THE FORECASTED AND ACTUAL PRICE INDEX FOR THE FIRST 6 MONTHS OF 2013

Forecast horizon	Forecasted index (AR13-MA12)	Forecasted index (AR7)	Actual index	Forecast error (AR13-MA12)	Forecast error (AR7)
2013m1	139.958	139.608	139.072	0.886	0.536
2013m2	140.696	140.014	139.212	1.484	0.803
2013m3	141.474	140.403	139.768	1.705	0.635
2013m4	142.223	140.775	140.188	2.036	0.587
2013m5	142.988	141.033	140.468	2.520	0.565
2013m6	143.456	141.339	139.625	3.831	1.714

Source: Author's calculations.

FIGURE 7. THE COMPARATIVE REVIEW OF THE FORECASTED AND ACTUAL PRICE INDEX FOR THE FIRST 6 MONTHS OF 2013



Source: Author's calculations.

Conclusion

According to this analysis, we can undoubtedly conclude that inflation in Montenegro is very difficult to forecast, since there are various relevant factors influencing the trend of general price level. Accordingly, the forecast is easier to make if as many as possible premises are introduced; however, due to a large number of factors, introduction of a various premises undermine the accuracy of forecasts. On the other hand, exclusion of premises inevitably leads towards uncertainty and inaccuracy in forecasting. Forecasts regularly require a group of premises on future movements, which have to be taken into account in forecasting and should be clearly indicated in presentation of forecasting results.

Besides obvious advantages provided by univariate models in inflation forecasting, confirmed in theory and practice, it is important to emphasize their limitations. Hence, the univariate models are completely incapable of discovering deviations from the regular trend or cycle, and the previous period in Montenegro was overloaded of such situations. When users are interested in how a change in economic policy or a sudden shock will affect the forecast, only the structural multidimensional models will give the answer. In order words, the key limitation of the analyzed models is reflected in the fact that they will not provide explanations of results, particularly in the case of foreseen changes in regular movements; even such explanations are required by the business community, economic analysts and other forecast users. Additionally, they provide good prognostic performances only in a short period of time, and weaker ones in longer periods. Finally, forecasting based on its own dynamics does not make much sense under conditions of unstable and administratively regulated economies. But, regardless of limitations, they have imposed themselves as unavoidable tool in forecasting, because of their simplicity.

This paper raises some new issues which will be interesting for further analysis. For example, in construction of an autoregressive model, we can ask ourselves if it is better to forecast individual components of the consumer price index, and then aggregate them into the forecast of total index, or the alternative, which deals with the forecast of the total price index, is better? However, such analysis requires more quality data than those available to us, especially because it penetrates in the structure of the index itself. There is another question: would a seasonal autoregressive model improve the forecast of this univariate model? How well the price index may be forecasted by the simplest model of random walk?

In the end, taking into account various internal and external factors which determine price trends in Montenegro, forecast models based only on earlier values of the variable cannot adequately include key factors which define future price trends. Still, there are enough reasons to believe that, considering characteristics of the Montenegrin economy, including evident uncertainty and many relations not strictly defined, and bearing in mind insufficiently developed statistical base, more reliable forecasts may be achieved by nonstructural models such as ARIMA or VAR, despite the above mentioned limitation.By the time, with a more complete statistical basis and data that would be methodologically adapted and available in larger frequencies, it will be more reasonable and purposeful to analyze structural macroeconomic models, or at least include intuitive methods which can be used for forecasting of shocks and shifts in economic activities.

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