

## RELATIONSHIP BETWEEN INFLATION AND INFLATION UNCERTAINTY: THE CASE OF SERBIA

Zorica MLADENOVIĆ

*Faculty of Economics, University of Belgrade, Belgrade*  
[zorima@eunet.rs](mailto:zorima@eunet.rs)

Received: December 2007 / Accepted: May 2009

**Abstract:** The purpose of this paper is to examine the relationship between inflation and inflation uncertainty in the Serbian economy, being particularly vulnerable to shocks in inflation rate, during transition period 2001 – 2007. Based on monthly data several GARCH specifications are estimated to provide the measure for inflation uncertainty. Derived variables are then included into VAR model to test for Granger-causality between inflation and its uncertainty. Models that consider only permanent and transitory components of prices are also estimated to investigate the inflation-uncertainty relationship in the long and in the short run. The main conclusion of the paper is that high inflation invokes high uncertainty, while high uncertainty negatively affects the level of inflation at long horizon.

**Keywords:** GARCH model, inflation rate, the Cukierman-Meltzer hypothesis, the Friedman-Ball hypothesis, VAR model.

### 1. INTRODUCTION

The cost of inflation has been a subject of substantial interest in macroeconomy. Given that inflation uncertainty represents one of the major sources of this cost, the relationship between inflation and its uncertainty has attracted considerable attention of both applied and theoretical macroeconomists. The issue was first brought up by Friedman [17] who, in his well-known Nobel Prize speech, argued that increased inflation has a potential to create nominal uncertainty that subsequently lowers welfare and possible output growth. Friedman's idea was later formalized by Ball [3]. The relationship between inflation and inflation uncertainty was also considered in reverse direction, such that high inflation uncertainty may induce higher average inflation, as advocated by Cukierman and Meltzer [10], [11].

The relationship between inflation and inflation uncertainty has been investigated in a number of empirical papers, and in most of them the G7 and some Asian countries have been analyzed. However, the empirical results reached do not uniformly support either the Friedman-Ball or the Cukierman-Meltzer point of view.

The purpose of this paper is to econometrically find out what characterizes the inflation-uncertainty relationship in Serbia during the transition period 2001-2007. Given the previous history of high and even hyperinflation in Serbia, and the current transition process whose success depends largely on low and stable inflation rate, this econometric analysis may enable further insight into the dynamic structure of inflation, its uncertainty and their co-movements. Inflation rate based on consumer price index will be used. The permanent and transitory components of inflation rate will be extracted to examine the inflation-uncertainty relationship at long and short horizons. Apart from Serbia, some preliminary results for four other Balkan countries will also be provided.

The structure of the paper is as follows. Section 2 shortly reviews the theoretical background of the inflation-uncertainty relationship, and the existing empirical results. Section 3 discusses main methodological issues. Section 4 provides empirical results obtained for the Serbian economy. Preliminary results for some other Balkan countries are given in Section 5. Section 6 makes a summary.

## **2. THE THEORETICAL BACKGROUND OF THE RELATIONSHIP BETWEEN INFLATION AND INFLATION UNCERTAINTY**

The relationship between inflation and inflation uncertainty consists of a two-way causality. The one-way causality running from inflation to its uncertainty is known as the Friedman-Ball hypothesis, while the causality running in opposite direction, from inflation uncertainty to inflation, is taken as the Cukierman-Meltzer hypothesis.

As already emphasized, Friedman [17] was the first to point out that changes in inflation may induce erratic responses of monetary authorities, which may lead to more uncertainty about the future inflation. This conjecture was formally justified by Ball [3] who used the asymmetric information game model in which the public faces two types of policy-makers that differ in terms of their willingness to bear the economic costs of reducing inflation. Policy-makers stochastically alternate in office. Therefore, an increase in inflation raises uncertainty about the path of the future inflation, because it is not known how long it will be before the tough type gain power and takes measures against high inflation.

Causality that runs from inflation uncertainty to inflation was first discussed by Cukierman and Meltzer [11]. This result is derived from a game-theoretic model of FED behavior under the assumption that FED dislikes inflation, but is willing to stimulate the economy growth by creating inflation surprises. Both the policy-maker's objective function and the money supply process are assumed to be random variables. Although the expectations are rational, information is imperfect due to imprecise monetary control mechanism. As a result, the public cannot make correct inference on future inflation. Consequently, an increase in inflation uncertainty raises the optimal average inflation rate by making the incentive for the policy-makers to produce inflation surprises. Hence, inflation uncertainty has a positive impact on inflation. By contrast, Holland [19] suggested that this link could be negative, such that high inflation uncertainty reduces level of inflation rate, due to the stabilization motive of the monetary authorities.

The analysis of the inflation-uncertainty relationship is additionally deepened when the decomposition of inflation into its permanent and transitory components is taken into account. As noted by Ball and Cecchetti [4], inflation may react differently to inflation uncertainty in the long-run and in the short-run. Vice versa, uncertainty may not be affected in the same way by the permanent and the transitory shocks of inflation. This decomposition may be relevant to evaluate the efficiency of monetary and fiscal policies, because the behavior of inflation in the long-run is usually associated with the monetary policy, while the short-run variations are often due to changes in fiscal policy.

Both the Friedman-Ball and the Cukierman-Meltzer hypotheses were frequently tested in numerous empirical analyses. Among papers we were able to find there are more in favor of the Friedman-Ball view [1], [7],[8], [12], [16], [18], [22], than those that do not support it [6], [9], [14], [20]. The validity of the Cukierman-Meltzer hypothesis has not been investigated as often, but most of the existing results do support this view [1], [2], [8], [12].

### 3. MAIN METHODOLOGICAL ISSUES

There are three key methodological issues in the econometric modeling of inflation-uncertainty relationship. The first one deals with the measure of inflation uncertainty. The second issue provides framework for making inference on direction of causality between inflation and uncertainty. The third issue considers approach followed to obtain permanent-transitory decomposition of inflation.

Some standard measure of inflation variability is often used to approximate its uncertainty. However, there could be a significant difference between variability and uncertainty of inflation depending on whether the variability is predictable in the model under consideration [18]. Therefore, the class of generalized autoregressive conditional heteroskedasticity models (GARCH models) emerges as a natural framework for this analysis for at least two reasons [6], [18], [24]. Firstly, GARCH models explicitly specify and estimate the variance of the unpredictable innovation in inflation. Secondly, based on GARCH models a time-varying conditional residual variance that is in accordance with the notion of uncertainty discussed in theoretical papers may be derived [18].

We will shortly overview GARCH models used in our empirical work. The simple GARCH (1,1) model reads as follows [6], [13], [24]:

$$\begin{aligned}\pi_t &= \beta_0 + \sum_{i=1}^p \beta_i \pi_{t-i} + \sum_{j=1}^m \delta_j D_j + \varepsilon_t, \quad \varepsilon_t = \sigma_t u_t, \quad u_t : iid N(0,1) \\ \sigma_t^2 &= \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2, \quad \alpha_0 > 0, \alpha_1 \geq 0, \alpha_2 \geq 0, \alpha_1 + \alpha_2 < 1.\end{aligned}\tag{3.1}$$

Mean equation for inflation,  $\pi_t$ , is expressed in the form of autoregressive model of order  $p$  in which dummy variables  $D_j$ ,  $j = 1, \dots, m$ , may be included to capture the effects of outliers. Volatility equation describes conditional variance,  $\sigma_t^2$ , of an error term  $\varepsilon_t$ , as a function of its own lagged-one value and the lagged-one value of the squared error term  $\varepsilon_t$ . Parameters of the model are:  $\beta_0, \beta_1, \dots, \beta_p, \delta_1, \dots, \delta_m, \alpha_0, \alpha_1, \alpha_2$ .

Among different modifications of GARCH models suggested in the literature the power GARCH model (PGARCH model) was also applied in our empirical analysis. The PGARCH (1,1) specification gives the volatility equation of the form:

$$\sigma_t^\eta = \alpha_0 + \alpha_1 |\varepsilon_{t-1}|^\eta + \alpha_2 \sigma_{t-1}^\eta, \quad \alpha_0 > 0, \alpha_1 \geq 0, \alpha_2 \geq 0, \alpha_1 + \alpha_2 < 1, \eta > 0. \quad (3.2)$$

PGARCH model allows for the explicit estimation of power  $\eta$ . Under the restriction  $\eta = 1$ , the conditional standard deviation is modeled within the volatility equation. This is the case of restricted PGARCH model.

Parameters of GARCH and restricted PGARCH models are estimated by the method of maximum likelihood. In practice, the maximum of the likelihood function is found by the standard numerical optimization methods, among which the BHHH algorithm is the most commonly implemented [15], [24]. Estimated conditional variance ( $\hat{\sigma}_t^2$ ) from GARCH model or conditional standard deviations ( $\hat{\sigma}_t$ ) from restricted PGARCH model are taken as a measure of uncertainty [18].

In order to assess a direction of causality between inflation and its uncertainty the use of vector autoregressive model (VAR model) has been advocated in the literature. This is one of the most popular specifications in macroeconometric analysis, since it completely captures dynamic structure among variables of interest. VAR model of order  $k$  between inflation and inflation uncertainty derived from GARCH specifications is postulated in the following way:

$$\begin{aligned} \pi_t &= a_{10} + \sum_{i=1}^k a_{1i} \pi_{t-i} + \sum_{j=1}^k b_{1j} \hat{\sigma}_{t-j}^2 + e_{1t} \\ \hat{\sigma}_t^2 &= a_{20} + \sum_{i=1}^k a_{2i} \pi_{t-i} + \sum_{j=1}^k b_{2j} \hat{\sigma}_{t-j}^2 + e_{2t}, \end{aligned} \quad (3.3)$$

and  $e_{1t}$  and  $e_{2t}$  are Gaussian white noise processes uncorrelated at lags different from zero.

The Friedman-Ball hypothesis of causality running from inflation to uncertainty cannot be rejected if inflation Granger-causes uncertainty. This causality implies that the null hypothesis,  $H_0 : a_{21} = a_{22} = \dots = a_{2k} = 0$ , tested against the alternative that the null is not true, cannot be accepted.

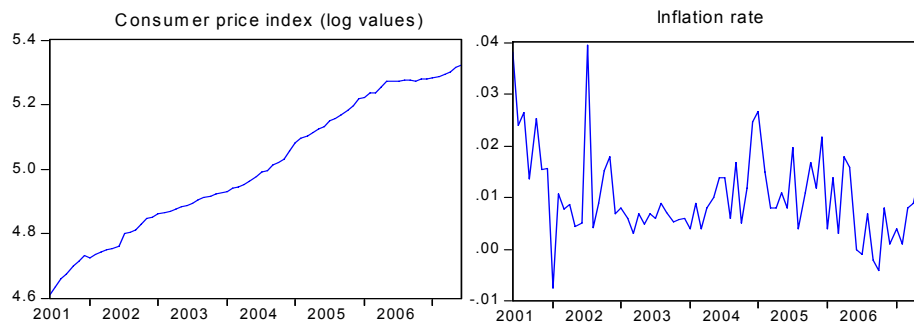
The Cukierman-Meltzer hypothesis of causality stemming from inflation uncertainty to inflation can be accepted if the null hypothesis,  $H_0 : b_{11} = b_{12} = \dots = b_{1k} = 0$ , tested against the alternative that this null hypothesis is not valid, can be refuted. This means that uncertainty Granger-causes inflation. If this is the case, then the sign of the sum  $\sum_{j=1}^k b_{1j}$  shows whether inflation uncertainty leads to increase or decrease in the level of inflation rate.

Decomposition of time series into its permanent and transitory components can be done in different ways. In this paper we follow the Beveridge-Nelson approach [5] based on the one of the key results from the unit-root literature that time-series with a unit-root can always be represented as a sum of permanent and transitory components. Permanent component accounts for the stochastic trend and thus explains the behavior in

the long-run. Transitory component is stationary and contains irregular variations. The Beveridge-Nelson approach is undertaken as follows [13]. The inflation is first estimated by ARIMA specification on given sample of size  $T$ . Using estimated parameters and in-sample forecasts of prices in periods  $T$  and  $T-1$  forecast errors in periods  $T$  and  $T-1$  are derived. The combination of estimated parameters and forecast errors enables estimation of irregular components for periods  $T$  and  $T-1$ . The replication of the same procedure for each observation in the sample recovers the transitory component of prices, which is then used to derive permanent component directly.

#### 4. EMPIRICAL RESULTS<sup>1</sup>

Monthly consumer price index (CPI index, 2001=100) in Serbia is considered for the period: June, 2001 – June, 2007 (73 observations). Data are obtained from the following internet addresses: [www.nbs.yu](http://www.nbs.yu) and [www.statserb.sr.gov.yu](http://www.statserb.sr.gov.yu). Inflation rate is calculated as the first difference of the logarithm of CPI ( $\pi_t = \log CPI_t - \log CPI_{t-1} = \Delta \log CPI_t$ ). Consumer price index has a strong upward trend which is described by the unit-root presence, while inflation rate appears to be stationary, but with the several outliers due to changes in economic policy (Graph 4.1).



**Graph 4.1** Consumer price index and inflation rate

One of the key features of time series in transition economies is the presence of structural breaks. They should be taken into account, because if they are neglected, then misleading statistical and invalid economic conclusions may be drawn [21]. Outliers in the level of inflation rate in Serbia occurred due to the following events: the administrative change of the price of electricity in July, 2002; the administrative change of communal utility prices in December 2004; the introduction of VAT in January, 2005 and of inflation targeting in September, 2006. The effects of these interventions are eliminated from inflation rate by including appropriate impulse dummy variables that take only non-zero value one for the month in which the change was detected. Such time series, which is corrected for outliers, is a subject of econometric analysis in this paper.

Ordinary (AC) and partial autocorrelation (PAC) functions are estimated in order to discover dynamic structure in the mean and variability of inflation rate. Values

<sup>1</sup> All empirical results are obtained using software EVIEWS 6.0 [15] and WINRATS 6.20 [23].

reported in Table 4.1 suggest that mean equation should probably contain autoregressive components up to order two. Also, variability appears to be unstable, which justifies the application of GARCH specification.

**Table 4.1** The correlation structure of the inflation mean and variance

Lag	1	2	3	4	5	6
Inflation rate						
AC	0.34	0.46	0.20	0.24	0.18	0.06
PAC	0.34	0.38	-0.04	0.04	0.07	-0.12
Squared inflation rate						
AC	0.21	0.32	0.05	0.20	0.02	0.01
PAC	0.21	0.29	-0.06	0.13	-0.03	-0.10

Note: The 95% confidence interval is [-0.23; 0.23].

Following PGARCH(1,1) models give the most satisfactory results:

Model I:

$$\begin{aligned}\hat{\pi}_t &= 0.008 + 0.266\pi_{t-1} + 0.360\pi_{t-2} \\ &\quad (0.001) (0.070) \quad (0.029) \\ \hat{\sigma}_t &= 0.0008 + 0.264|\varepsilon_{t-1}| + 0.618\sigma_{t-1} \\ &\quad (0.0005) (0.113) \quad (0.191) \\ \text{JB} &= 5.33(0.07), \text{ARCH}(4) = 3.20(0.53), \\ \text{Q}(12) &= 6.69(0.76), \text{Q}^2(12) = 13.15(0.22), \text{L} = 292.3276.\end{aligned}\tag{4.1}$$

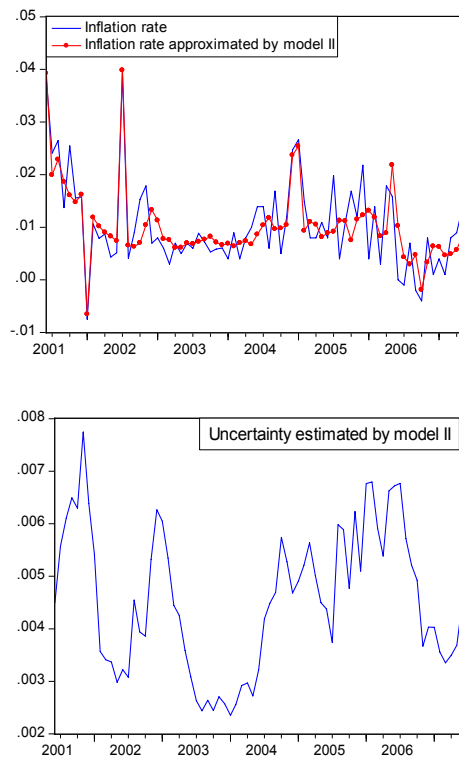
Model II:

$$\begin{aligned}\hat{\pi}_t &= 0.008 + 0.266\pi_{t-1} + 0.348\pi_{t-2} \\ &\quad (0.001) (0.081) \quad (0.030) \\ \hat{\sigma}_t &= 0.0002 + 0.204|\varepsilon_{t-1}| + 0.669\sigma_{t-1} + 0.057\pi_{t-1} \\ &\quad (0.0003) (0.091) \quad (0.134) \quad (0.019) \\ \text{JB} &= 4.60(0.10), \text{ARCH}(4) = 3.61(0.46), \\ \text{Q}(12) &= 5.98(0.82), \text{Q}^2(12) = 14.34(0.16), \text{L} = 293.7425.\end{aligned}\tag{4.2}$$

Note: The BHHH algorithm is used in the estimation. The Bollerslev-Wooldrige standard errors are calculated and given in (.) below the coefficient estimates. The mean equation contains dummy variables previously introduced. The following test-statistics are reported: JB is the Jarque-Bera test-statistic for normality of the residuals that under the null of normality has  $\chi^2(2)$  distribution; ARCH(4) is the Lagrange multiplier test statistic for testing the fourth-order autocorrelated squared residuals that under the null of no autoregressive heteroskedasticity has  $\chi^2(4)$  distribution; Q(12) is the Box-Ljung test-statistic for the residual autocorrelation of order 12 that under the null of no serial

correlation has a  $\chi^2$  (9) distribution and  $Q^2(12)$  is the Box-Ljung test-statistic for autocorrelated squared residuals that under the null of no autoregressive heteroskedasticity also has a  $\chi^2$  (9) distribution. The  $p$ -values are reported in (.) after a statistic.  $L$  denotes the final log-likelihood function value.

In Graph 4.2 mean inflation and uncertainty derived from model II are depicted. Mean inflation is approximated well by this model. Estimated volatility exhibits instability over time, and its surge seems to coincide with the increase in the level of inflation rate.



**Graph 4.2** Estimated mean inflation and volatility from Model II

To determine in which way the causality between inflation and its uncertainty runs the VAR models of inflation and inflation uncertainty, derived from estimated GARCH specifications, are postulated and estimated. The results of the Granger-causality tests are reported in Table 4.2. These results uniformly suggest one-way causality stemming from inflation to uncertainty. Hence, the Friedman-Ball hypothesis can be accepted as valid, while the Cukierman-Meltzer hypothesis cannot. This finding is supported by the specification (4.2) in which inflation lagged-one period appears as significant explanatory variable in volatility equation.

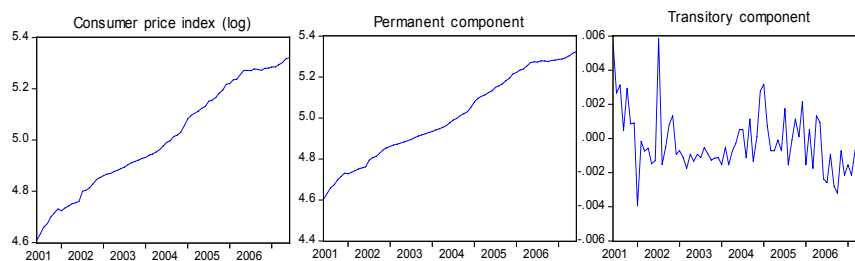
VAR model between inflation and uncertainty		Ho: Inflation does not Granger-cause uncertainty	Ho: Uncertainty does not Granger-cause inflation
Model I	$k=1$	2.99(0.08)	0.96(0.33)
	$k=4$	9.80 (0.04)	7.40 (0.12)
Model II	$k=1$	63.87(0.00)	1.81 (0.18)
	$k=4$	65.85 (0.00)	6.86 (0.14)

**Table 4.2** Granger-causality test between inflation and its uncertainty

Note: The number of lags ( $k$ ) in VAR model is chosen using information criteria and statistical properties of the model. VAR contains some of dummy variables discussed above that were needed to obtain normally distributed residuals. This is a vital assumption for the reliability of the Granger-causality test reported in the form of  $\chi^2(k)$  statistic with  $p$ -value given in parenthesis.

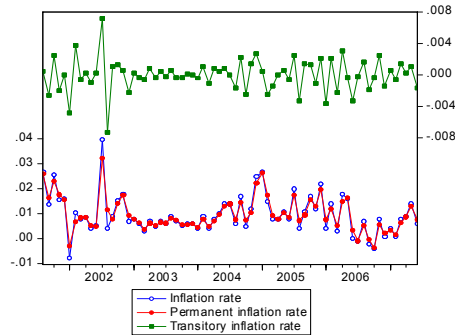
To find out how robust our results are to the behavior of inflation in the long and short run, the permanent-transitory decomposition of prices (log) is obtained under the assumption that its first difference, inflation, follows autoregressive process of order two. Both components are depicted together with the prices in Graph 4.3. We may notice a similar pattern of prices and its permanent component, while their difference, being a transitory component, describes only the short-run variability of prices.

The first difference of permanent and transitory components represents permanent and transitory inflation respectively (Graph 4.4). These two time series are considered separately. The results of modeling permanent inflation will be given in detail, while the findings for transitory inflation will be briefly summarized.



**Graph 4.3** Consumer price index, its permanent and transitory components





**Graph 4.4** Inflation rate, permanent and transitory inflation rate

Three GARCH specifications are used in order to explain the behavior of permanent inflation. These are: restricted PGARCH(1,1) model, restricted PGARCH(1,1) model with permanent inflation lagged-two period in volatility equation and GARCH(1,1) model with permanent inflation lagged-two period in volatility equation. Estimates are given below:

Restricted PGARCH(1,1)

(Model of permanent inflation I):

$$\begin{aligned}\hat{\pi}_{pt} &= 0.008 + 0.388\pi_{pt-1} + 0.280\pi_{pt-2} \\ &\quad (0.001) \quad (0.081) \quad (0.050) \\ \hat{\sigma}_t &= 0.0004 + 0.206|\varepsilon_{t-1}| + 0.723\sigma_{t-1}. \\ &\quad (0.0004) \quad (0.091) \quad (0.174)\end{aligned}\tag{4.3}$$

Restricted PGARCH(1,1) with permanent inflation lagged-two period  
(Model of permanent inflation II):

$$\begin{aligned}\hat{\pi}_{pt} &= 0.008 + 0.420\pi_{pt-1} + 0.259\pi_{pt-2} \\ &\quad (0.001) \quad (0.089) \quad (0.052) \\ \hat{\sigma}_t &= 0.0003 + 0.198|\varepsilon_{t-1}| + 0.713\sigma_{t-1} + 0.013\pi_{pt-2}. \\ &\quad (0.0003) \quad (0.086) \quad (0.153) \quad (0.008)\end{aligned}\tag{4.4}$$

GARCH(1,1) with permanent inflation lagged-two period  
(Model of permanent inflation III):

$$\begin{aligned}\hat{\pi}_{pt} &= 0.008 + 0.419\pi_{pt-1} + 0.264\pi_{pt-2} \\ &\quad (0.001) \quad (0.094) \quad (0.059) \\ \hat{\sigma}_t^2 &= 0.0000 + 0.214\varepsilon_{t-1}^2 + 0.654\sigma_{t-1}^2 + 0.00013\pi_{pt-2}. \\ &\quad (0.0000) \quad (0.118) \quad (0.182) \quad (0.00007)\end{aligned}\tag{4.5}$$

Note:  $\pi_{pt}$  denotes permanent inflation. The BHHH algorithm is used in estimation. The Bollerslev-Wooldrige standard errors are calculated and given in (.) below the coefficient estimates. The mean equation contains dummy variables previously introduced.

Models do not show the signs of misspecification as confirmed by various specification tests reported in Table 4.3. All three models provide similar results: the estimates of the mean equation do not differ significantly, while volatility equations capture almost identical effects of explanatory variables. Nevertheless, to make results more reliable we use all these models to generate uncertainty needed for Granger-causality testing.

Model	Q(12)	Q <sup>2</sup> (12)	JB	ARCH(4)	L
I	5.9(0.82)	12.6(0.25)	4.9(0.09)	3.0(0.54)	308.94
II	6.0(0.82)	14.5(0.15)	4.8(0.09)	4.3(0.37)	309.42
III	5.4(0.89)	14.1(0.17)	5.1(0.08)	4.1(0.40)	309.33

**Table 4.3** Specification tests for estimated models of permanent inflation

Note: Test-statistics are explained in note below equation (4.2).

The results of the Granger-causality test between permanent inflation and associated uncertainty are presented in Table 4.4. The results strongly support causality running from permanent inflation to its uncertainty, suggesting that the Friedman-Ball hypothesis is relevant for the long-run inflation as well. There is some supporting evidence of causality running from uncertainty to permanent inflation. In the two models the null hypothesis that uncertainty does not Granger-cause permanent inflation cannot be rejected for  $p$ -values greater than 8%. When standard inflation rate was considered the corresponding  $p$ -values were between 12% and 33% (Table 4.2). Thus, we may conclude that the Cukierman-Meltzer hypothesis has some empirical content for the permanent inflation in Serbia. The sum of estimated coefficients on lagged uncertainty in the equation for permanent inflation is negative. This implies that inflation uncertainty has a negative impact on the level of inflation at long horizon. Since the behavior of prices in the long-run is primarily determined by monetary policy, we may argue that monetary policy in Serbia has been relatively efficient during period of 2001-2007.

VAR model of order 4	Ho: Permanent inflation does not Granger-cause uncertainty	Ho: Uncertainty does not Granger-cause permanent inflation
Model I	19.17 (0.00)	7.73 (0.10)
Model II	25.73 (0.00)	8.27 (0.08)
Model III	30.33 (0.00)	8.37 (0.08)

**Table 4.4** Granger-causality test between permanent inflation and its uncertainty

Note: See note below Table 4.2.

Transitory inflation was modeled within a similar framework. Only one-way causality is detected, stemming from short-run inflation to its uncertainty. In the short-run higher inflation invokes higher uncertainty, but uncertainty does not influence the inflation significantly. Tentatively speaking, fiscal policy, responsible for the short-run variation in prices, has not been as efficient as monetary policy in stabilizing level of inflation.

## 5. PRELIMINARY ANALYSIS FOR SOME OTHER BALKAN COUNTRIES

Some Balkan countries have experienced high inflation in recent history suggesting sensitivity of their economies to shocks in prices. Thus, the issue of inflation-uncertainty relationship seems to be economically relevant for the whole Balkan region. We empirically investigated the dynamics of mean and volatility of monthly inflation rates in Bulgaria, Greece, Romania and Turkey for the period: January, 2001 – October, 2006. The data are taken from IFS CD-ROM Version 1.1.64. Table 5.1 summarizes the basic descriptive statistics and the results reached.

Country	Average inflation rate	Standard deviation	Maximum value	Minimum value	Causality detected
Bulgaria	0.40	1.02	2.97	-2.18	No causality found
Greece	0.27	1.23	2.84	-2.10	No causality found
Romania	1.09	0.78	3.62	-0.07	From inflation to uncertainty
Turkey	1.68	1.85	9.83	-0.57	In both directions

**Table 5.1** Descriptive statistics (of inflation in %) and results of Granger-causality test

We have not detected unstable the variability of inflation in Bulgaria and Greece. However, a time-varying uncertainty of inflation found in Romania and Turkey was well captured by a simple ARCH(1) model. Furthermore, one way causality running from inflation to its uncertainty is determined for Romania, and in both directions for Turkey. Our analysis of the Turkish inflation partly concurs with the findings previously reported for a different sample [12], [22]. Although this is just a preliminary study, results obtained so far highlight the importance of investigating the inflation-uncertainty relationship in the Balkan region.

## 6. CONCLUSION

This paper employs standard approach of GARCH modeling and VAR setup to consider the relationship between inflation and inflation uncertainty in Serbia in the period 2001-2007. The novelty introduced in this study is the application of the Beveridge-Nelson decomposition of prices in order to find out what characterizes this relationship in the long and short run. There is a strong evidence of causality running

from inflation to its uncertainty that holds for both long and short horizons. However, causality in reverse direction was found only for the permanent component of prices, so that increasing uncertainty reduces the level of inflation in the long-run. Therefore, we may argue that monetary policy in Serbia has been relatively efficient in recent years.

Preliminary analysis of inflation in four Balkan countries (Bulgaria, Greece, Romania and Turkey) suggests that the inflation-uncertainty relationship plays an important role in some of these economies. A more detailed discussion of this relationship in the Balkan region needs further investigation.

## REFERENCES

- [1] Apergis, N., "Inflation, output growth, volatility and causality: evidence from panel data and G7 countries", *Economics Letters*, 83 (2004) 185-191.
- [2] Baillie, R., Chung, C., and Tieslau, M., "Analyzing inflation by the fractionally integrated ARFIMA-GARCH model", *Journal of Applied Econometrics*, 11 (1996) 23-40.
- [3] Ball, L., "Why does high inflation raise inflation uncertainty", *Journal of Monetary Economics*, 29 (1992) 371-388.
- [4] Ball, L., and Cecchetti, S.G., "Inflation and uncertainty at short and long horizons", *Brookings Papers on Economic Activity*, 1 (1990) 215- 245.
- [5] Beveridge, S., and Nelson, C., "A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement of the business cycle", *Journal of Monetary Economics*, 7 (1981) 151-174.
- [6] Bollerslev, T., "Generalized autoregressive conditional heteroskedasticity", *Journal of Econometrics*, 31 (1986) 307-327.
- [7] Caporale, T., and McKiernan, B., "High and variable inflation: Further evidence on the Friedman hypothesis", *Economics Letters*, 54 (1997) 65-68.
- [8] Chen, S.W., Shen, C.H., and Xie, Z., "Nonlinear relationship between inflation and inflation uncertainty in Taiwan", *Applied Economics Letters*, 13 (2006) 529-533.
- [9] Cosimano, T., and Jansen, D., "Estimates of the variance of US inflation based upon the ARCH model", *Journal of Money, Credit and Banking*, 20 (1988) 409-421.
- [10] Cukierman, A., *Central Bank Strategy, Credibility, and Independence*, MIT Press, Cambridge, 1992.
- [11] Cukierman, A., and Meltzer, A.H., "A theory of ambiguity, credibility, and inflation under discretion and asymmetric information", *Econometrica*, 54 (1986) 1099-1128.
- [12] Daal, E., Naka, A., and Sanchez, B., "Re-examining inflation and inflation uncertainty in developed and emerging countries", *Economics Letters*, 89 (2005) 180-186.
- [13] Enders, W., *Applied Econometric Time Series*, 2nd edition, Wiley, New York, 2004.
- [14] Engle, R.F., "Estimates of the variance of U.S. inflation based on the ARCH model", *Journal of Money, Credit and Banking*, 15 (1983) 286-301.
- [15] *EViews6 User's Guide*, Quantitative Micro Software, CA, 2007.
- [16] Fountas, S., "The relationship between inflation and inflation uncertainty in the UK: 1885-1998", *Economics Letters*, 74 (2001) 77-83.
- [17] Friedman, M., "Nobel lecture: Inflation and unemployment", *Journal of Political Economy*, 85 (1977) 451-472.
- [18] Grier, K.B., and Perry, M.J., "On inflation and inflation uncertainty in the G7 countries", *Journal of International Money and Finance*, 17 (1998) 671-689.
- [19] Holland, A.S., "Inflation and uncertainty: Tests for temporal ordering", *Journal of Money, Credit and Banking*, 27 (1995) 827-837.
- [20] Hwang, Y., "Relationship between inflation rate and inflation uncertainty", *Economics Letters*, 73 (2001) 179-186.

- [21] Mladenovic, Z., "Modelling economies in transition: Econometrics of structural break" in: B. Cerovic (eds.), *Privatization in Serbia: Evidence and Analysis*, Faculty of Economics, Belgrade, 2006, 107-122.
- [22] Nas, T. F., and Perry, M. J., "Inflation, inflation uncertainty, and monetary policy in Turkey: 1960-1998", *Contemporary Economic Policy*, 18 (2000) 170-180.
- [23] *RATS User's Guide, Version 6*, ESTIMA, Evanston, IL, 2006.
- [24] Tsay, R., *Analysis of Financial Time Series*, 2<sup>nd</sup> edition, Wiley, New York, 2005.