THE INFLATION - INFLATION UNCERTAINTY NEXUS IN ROMANIA

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Abstract: *This study explores the causality between inflation and inflation uncertainty in Romania using monthly inflation data for the 1996:01-2012:12 period. If inflation uncertainty is defined as being the variance of unpredictable component of inflation then the use of autoregressive conditional heteroskedastic models can capture inflation uncertainty through the conditional variance of inflation. Inflation uncertainty is obtained from a GARCH model, while checking for any structural break in the series we find that there are possible structural breaks. The structural breaks in mean are captured using dummy variables in the AR-GARCH models and the best models are identified using the informational criterion. The influence between inflation uncertainty and inflation is tested using Granger causality. We find bidirectional causality between inflation and inflation uncertainty.*
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INTRODUCTION

High inflation represents a big challenges for economies giving rise to economical and social problems also another important aspect of inflation is it's uncertainty, Friedman (1977) shows that if the households and companies know the future level of inflation they can make adjustments in contract and expectations which will minimize the negative effect, actually inflation and inflation uncertainty have similar importance in the monetary economics. The causality between inflation and inflation uncertainty was laid out by Friedman (1977) whose hypotheses was that inflation generates uncertainty in output and reduces welfare while Cukierman & Meltzer (1986) imply that high inflation uncertainty can induce high inflation. Inflation uncertainty is express usually as the conditional volatility from the GARCH models (Engle, 1982), TGARCH (Bredin & Fountas, 2011), APARCH (Daal, Naka & Sanchez, 2005) and EGARCH (Jiranyakul & Opiela, 2010).

Evidence of structural breaks in inflation can be found in developed countries USA (Inclan & Tiao, 1994; Ahamada & Aissa, 2003) and European countries (Windberger & Zeileis, 2011), emergent countries (Korap, 2011).

This paper analyzes the relationship between inflation and inflation uncertainty in the presence of structural breaks in the mean in the case of Romania. The remaining of the article is organized as follows: Section 2 outlines the methodology; Section 3 describes the dataset, presents the unit-root test and structural break analysis ; Section 4 presents the results of GARCH models and the causality between inflation and inflation uncertainty; Section 5 concludes.

METHODOLOGY

The models used is an AR(p)-GARCH(1,1) model, with the following specification:

$$\pi_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \pi_{t-i} + \epsilon_t \quad (1)$$
$$h_t = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \beta_1 h_{t-1} \quad (2)$$

Where eq.(1) expresses the evolution of mean of inflation using an autoregressive part with the error term $\epsilon_t \sim N(0, \sigma^2)$, while eq.(2) express the evolution of the conditional variance and $\alpha_0 \geq 0, 0 \leq \alpha_1 \leq 1, \beta_0 \geq 0$.

In order to take into account any possible structural changes in the time-series characteristics we use the Zivot-Andrews unit-root test (Zivot & Andrews, 1992) which is an extension of the Dickey–Fuller test by allowing for a break in intercept, trend or both.

In order to capture the structural breaks in mean the following dummy variable will be introduce in the GARCH model equation:

$$\pi_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \pi_{t-i} + \beta_1 D_1 + \epsilon_t \quad (3)$$

where D_1 is a dummy variables which take the value 0 before the breakpoint and 1 after the breakpoint until the end of the period.

The causality between inflation and inflation uncertainty is done using Granger causality (Granger, 1969); in a VAR model with two variables the evolution of the inflation variable will be influenced by past values (lags) of inflation and past (lags) values of inflation uncertainty (Eq.5). Also, we assume that inflation uncertainty is affected by lagged values of himself, and previous values of inflation (Eq.4). For inflation and inflation uncertainty the Granger causality test is performed on the following equation:

$$h_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i h_{t-i} + \sum_{i=1}^{k} \beta_i \pi_{t-i} + \epsilon_t \quad (4)$$

$$\pi_t = \gamma_0 + \sum_{i=1}^{k} \gamma_i \pi_{t-i} + \sum_{i=1}^{k} \delta_i h_{t-i} + \eta_t \qquad (5)$$

The numbers of lags in the Granger causality tested are 2,4,6,8 lags.

DATA ANALYSES

The dataset consists of monthly Harmonised indices of consumer prices (*HICP*) from Eurostat Database for Romania, the HICP indicator are seasonally adjusted using X12 Arima methodology and it covers the period 1996:01 until 2012:12. The HICP is converted into monthly inflation using the following transformation:

$$\pi_t = ln\left(\frac{HICP_t}{HICP_{t-1}}\right) \qquad (6)$$

for $t = 1, 2, \ldots, T$; where: π_t is the monthly inflation at time *t* and $HICP_t$ is the harmonized consumer price index at time *t.*

Figure 1 Inflation evolution 1996-2012

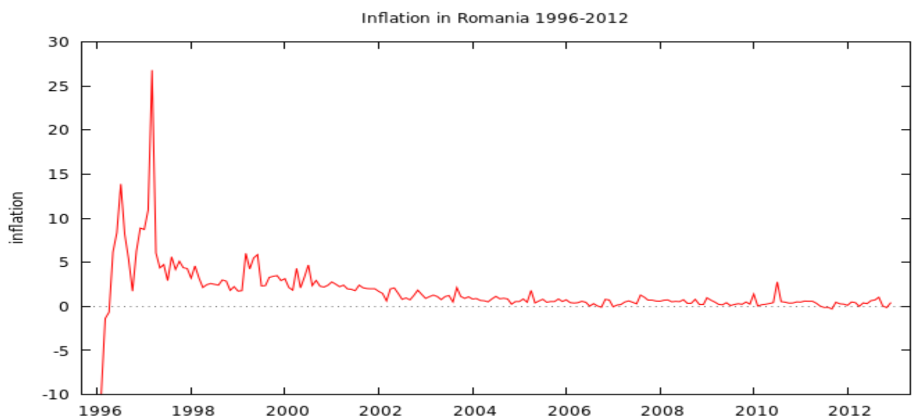

Table 1(a) presents the descriptive statistics of the monthly inflation, for the analyzed period, 1996:01 to 2012:12, the highest inflation period was observed before 2001. The inflation volatility, which can be measured through the standard deviation, is high in the case of Romania (2.84).

Table 1 Summary statistics

Summary statistics (a)			
Mean	1.7498	Standard deviation	2.8434
Minimum	-9.9989	Skewness	3.9645
Maximum	26.776	Ex. kurtosis	31.406
Unit-root tests (b)			
ADF	PP	KPSS	Zivot-Andrews**
-1.89	-7.42*	1.59	-11.65*

MacKinnon's 1% critical value is -3.46 for the ADF and PP tests, the critical value for the KPSS test is 0.739 at 1% significance level. The critical value for Zivot-Andrews test is -5.57 at 1% significance level. And * denote significance at 1% levels. ** The breakdate from the Zivot-Andrews test is in March 1997.

Table 1(b) present the result for the unit root test, based on the ADF and KPSS test we cannot reject the unit-root hypothesis, while the Phillips–Perron (PP) reject the unit-root hypothesis. Based on the contradictory results from the ADF, PP and KPSS we apply the Zivot-Andrews test, we reject the unit-root hypothesis and conclude that the series are stationary with a breakpoint in the mean equation in March 1997.

RESULTS

The inflation series is estimated using an AR(p)-GARCH(1,1) model, the Q statistics show that the residuals are white noise and the autocorrelation and partial-autocorrelation function show no autocorrelation. Also a GARCH in mean model is estimated but the model doesn't pass the specification test.

Table 2 Estimation results

	AR(7)-GARCH(1,1)		AR(7)-GARCH(1,1) in mean	
Variable	Coefficient	Prob.	Coefficient	Prob.
const	4.777782	0.0000	-3.448247	0.0014
log(GARCH)			0.112037	0.1949
dummy	-4.724535	0.0000	3.775237	0.0004
AR(1)	0.191101	0.0000	0.235979	0.0001
AR(2)	0.119970	0.0025	0.129230	0.0136
AR(3)	0.078225	0.0000	0.091967	0.1916
AR(5)	0.101295	0.0320	0.050144	0.5352
AR(6)	0.171013	0.0000	0.155588	0.0025
AR(7)	0.138954	0.0000	0.125501	0.0682
	Variance Equation			
C	0.005096	0.0025	0.011229	0.0000
ϵ_t	-0.052322	0.0000	-0.031923	0.0000
h_t	1.021275	0.0000	0.951249	0.0000
Akaike criterion	1.751136		1.825620	
Schwarz criterion	1.935112		2.02321	
Hannan-Quinn	1.825618		1.906873	
Q(6)	2.4409		1.5790	

Q(12)	9.0747	10.599
Q^2*(6)*	4.0345	2.5560
Q^2*(12)*	8.9254	5.0549

The parameters for AR-GARCG(1,1) are all significant at 5% level, while in the case of GARCH in mean model we find that log of inflation is not significant at 10% level. Next we test the Granger causality with different lags (2, 4, 6, 8) , Table 3 present the results and it can be observed that there is a bidirectional causality between inflation and inflation uncertainty regardless of the numbers of lags.

Table 3 Granger causality

Null Hypothesis:	F-Statistic	Lags
Inflation does not Granger Cause IU	118.19***	2
Inflation does not Granger Cause IU	90.03***	4
Inflation does not Granger Cause IU	75.66***	6
Inflation does not Granger Cause IU	36.42***	8
IU does not Granger Cause INF	55.87***	2
IU does not Granger Cause INF	53.05***	4
IU does not Granger Cause INF	69.618***	6
IU does not Granger Cause INF	5.84***	8

** * denote significance at 1% levels.

CONCLUSIONS

In order to understand the connection between inflation and inflation uncertainty (IU) in Romania we applied the Granger causality methodology on Romanian inflation for 1996-2012 period. Taking into consideration the possibility of structural breaks in inflation, using the Zivot-Andrews test, we find that for Romania the inflation is a stationary process with a breakpoint. The breakpoint is modeled using a dummy variable in the mean equation of inflation which is significant at the 5% level.

Testing the two hypotheses, (Friedman, 1977) and (Ball, 1992) that inflation generates uncertainty in output and reduces welfare and (Cukierman & Meltzer, 1986) hypotheses that high inflation uncertainty [IU] can induce high inflation, we find that for Romania there is a bidirectional causality between inflation and inflation uncertainty. Our results are similar to other studies on emergent economies (Jiranyakul & Opiela, 2010). This implies that the inflation targeting regime applied in Romania may stabilize the level of inflation and reduce inflation variability if effective.

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