Inflation and inflation uncertainty: empirical evidences for inflation targeting countries

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Introduction

- higher non - forecastable inflation increases **inflation uncertainty** that induces significant economic costs (distorting allocation decisions, redistributing wealth and hindering long term nominal agreements) ;
- the central bank should be aware that few risks are calculable and therefore **analyzing a measure of uncertainty** is a must;
- **Inflation targeting** influences inflation and inflation expectations, reducing at the same time uncertainty regarding inflation;

Objectives(1)

- The main objective of this paper is to analyze the **relationship between inflation and inflation uncertainty** in Romania;
- Checking if **inflation targeting** adoption influences inflation uncertainty naturally became the complementary objective of my study;
- Sustaining and comparing the findings for Romania with the results obtained for another inflation targeting country, Poland;

Objectives(2)

- Testing for the **simultaneous feedback** between inflation and inflation uncertainty using GARCH in Mean models;
- Checking for eventual **asymmetries** from inflation shocks on uncertainty;
- Analyzing the effect of higher inflation on **long run inflation** uncertainty by decomposing uncertainty in short run uncertainty and long run uncertainty;

Literature review(1)

- Higher average inflation could result in higher inflation uncertainty because the process of forming expectations **(M. Friedman, 1977)** ;
- Friedman's idea was developed by creating a framework of two types of monetary policy stance **(M.L. Ball, 1992)**;
- A negative relationship between inflation and uncertainty with reference to investment in inflation forecasting methods **(Pourgerami and Maskus, 1987)**;
- The possibility of an inverse positive causality between inflation and inflation uncertainty **(Cukierman and Meltzer, 1986)**;
- The negative relationship between inflation uncertainty and inflation was analyzed by **Holland (1995)**;

Literature review(2)

- Impact of inflation uncertainty over economic activity showing that high uncertainty influences wealth redistribution, resources allocations, risk and long term agreements (**S. Fisher, 1978**);
- Inflation uncertainty and savings (**Dootsey 2000**);
- The macroeconomic importance of the concept is explained by the view of a monetary policy framework based on a risk management approach (**Greenspan, 2003**);
- Uncertainty and variability (**Evans, 1991**); uncertainty and risk (**Knight, 1921**);

Literature review(3)

- on the empirical side, different methodologies have been used to explore the relationship between inflation and uncertainty, with different measures for uncertainty:

  - surveys **(Johnson, 2002)**;
  - econometric framework of ARMA-GARCH type **(Kontonikas, 2004)**;AR-GARCH with time varying parameters **(Evans, 1991)**;
  - VAR approach **(G.M. Caporale, 2010)**;

Methodology: ARMA-GARCH model(1)

- Mean equation:

Romania: $$INF_t = \alpha_1 INF_{t-1} + \alpha_2 INF_{t-2} + \alpha_3 \varepsilon_{t-2} + \alpha_4 \varepsilon_{t-3} + \varepsilon_t \quad (1)$$

Poland: $$INF_t = \beta_1 INF_{t-1} + \beta_2 \varepsilon_{t-1} + \beta_3 \varepsilon_{t-2} + \varepsilon_t \quad (2)$$

- GARCH in Mean specification

Romania: $$INF_t = \alpha_1 INF_{t-1} + \alpha_2 INF_{t-2} + \alpha_3 \varepsilon_{t-2} + \alpha_4 \varepsilon_{t-3} + \alpha_5 \sigma_t + \varepsilon_t$$

$$\sigma^2{}_t = \omega + \alpha_R \varepsilon^2{}_{t-1} + \beta_R \sigma^2{}_{t-1} + \phi_R A$$

Poland: $$INF_t = \beta_1 INF_{t-1} + \beta_2 \varepsilon_{t-1} + \beta_3 \varepsilon_{t-2} + \beta_4 \sigma_t + \varepsilon_t$$

$$\sigma^2{}_t = \omega + \alpha_P \varepsilon^2{}_{t-1} + \beta_P \sigma^2{}_{t-1} + \phi_P A$$

Methodology: ARMA-GARCH model(2)

- Variance equation

-Threshold GARCH

$$\sigma^2{}_t = \omega + \alpha \varepsilon_{t-1}{}^2 + \beta \sigma_{t-1}{}^2 + \gamma \varepsilon_{t-1}{}^2 I_{t-1}{}^- + \phi A^*$$

$$I_{t-1}{}^- = 1 if \varepsilon_{t-1} < 0$$

-Exponential GARCH

$$\log(\sigma^2{}_t) = \omega + \alpha \log(\sigma_{t-1}{}^2) + \beta \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \gamma \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \phi A^*$$

-Component GARCH

$$\sigma^2{}_t = \omega_t + \alpha(\varepsilon^2{}_{t-1} - \omega_{t-1}) + \beta(\sigma^2{}_{t-1} - \omega_{t-1})$$

$$\omega = \mu + \xi_1(\omega_{t-1} - \mu) + \xi_2(\varepsilon^2{}_{t-1} - \sigma^2{}_{t-1}) + \xi_3 A^*$$

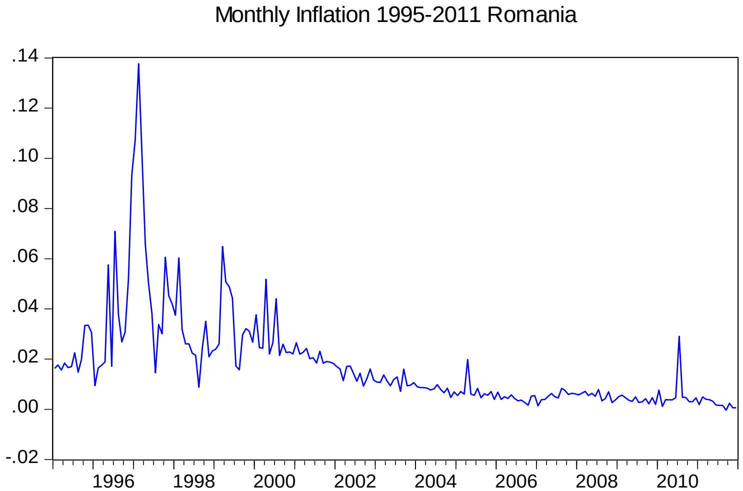
Data (1)

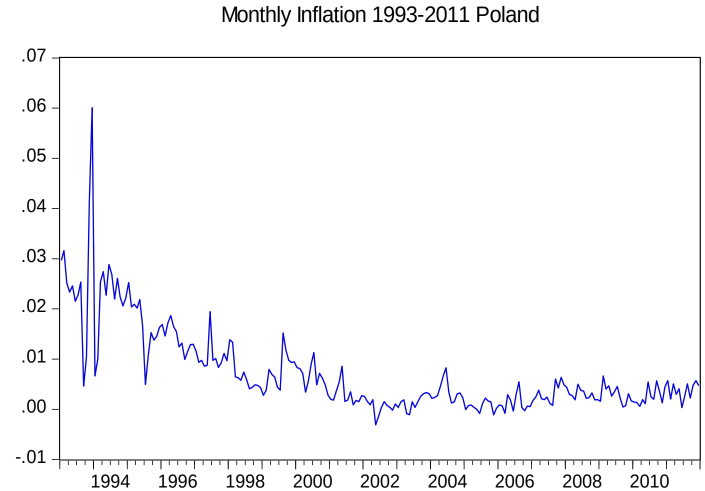
- Inflation is measured as the first difference of the seasonally adjusted log consumer price index;
- I used data from 1995-2011 for Romania and from 1993-2011 for Poland;
- Source:

  -Romania - TEMPO online INSSE database;

  -Poland – IMF International database;

Data (2)





Unit root tests of CPI first lag difference, seasonally adjusted, monthly data					
Romania			Poland		
d	ADF	PP	d	ADF	PP
SIC:4	-1.984659**	-	SIC:5	-2.568496***	-
BK:14	-	-2.859487***	BK:8	-	-3.698785***

- significant at 5% level, * - significant at 1% level

Results(1)

Romania		Poland	
Coefficients	Estimation	Coefficients	Estimation
INF(-1)	-0.383636***	INF(-1)	0.982007***
INF(-2)	-0.951381***	MA(1)	-0.475685***
MA(2)	0.939236***	MA(2)	-0.465269***
MA(3)	-0.417857***		
R^2	0.172698	R^2	0.755502
Resid standard error	0.010531	Resid standard error	0.004126
*the level of statistical significance is illustrated as: *** under 1%, ** under 5%, * under 10%;			

Results(2)

Romania			Poland		
order	F-statistic	Q^2	order	F-statistic	Q^2
1	41.72594***	35.473	1	97.50167***	69.745
4	20.53492***	134.47***	4	25.26839***	104.65***
8	13.32418***	228.6***	8	17.78853***	104.73***
*the level of statistical significance is illustrated as: *** under 1%, ** under 5%, * under 10%;					

Results(3)

Romania				Poland			
Symetric Garch in Mean		Threshold Garch		Symetric Garch in Mean		Threshold Garch	
Mean equation				Mean equation			
Coeficients	Estimation	Coeficients	Estimation	Coeficients	Estimation	Coeficients	Estimation
sqrt(garch)	-0.092380***	sqrt(garch)	-0.144048***	sqrt(garch)	0.034443*	sqrt(garch)	0.034599**
INF(-1)	-0.484979***	INF(-1)	-0.727345***	INF(-1)	0.967149***	INF(-1)	0.969375***
INF(-2)	0.118979*	INF(-2)	-0.882925***	MA(1)	-0.464609***	MA(1)	-0.520272***
MA(2)	-0.412404****	MA(2)	0.415424***	MA(2)	-0.284049***	MA(2)	-0.252129**
MA(3)	0.005498	MA(3)	-0.584480***				
Variance equation – IGARCH(1,1)				Variance equation – GARCH(1,1)			
constant	-	constant	7.80E-07***	constant	6.53E-07**	constant	5.65E-07**
Resid^2	0.000908***	Resid^2	0.208927***	Resid^2	0.177171***	Resid^2	0.165422***
garch(-1)	0.999092***	garch(-1)	0.714549****	garch(-1)	0.393977**	garch(-1)	0.3666994
INF(-1)	0.002675***	INF(-1)	0.000851**	INF(-1)	0.000515***	INF(-1)	0.000619**
Threshold	-	Threshold	0.047083	Threshold		Threshold	0.090615
Q(1)	0.4493	Q(1)	0.5075	Q(1)	0.0133	Q(1)	0.31
Q(4)	2.5116	Q(4)	2.3208	Q(4)	3.9316	Q(4)	3.8432
Q(12)	9.7252	Q(12)	8.4834	Q(12)	16.569*	Q(12)	17.074*
the level of statistical significance is illustrated as: *** under 1%, ** under 5%, * under 10%; Q denotes the Ljung Box statistic							

Results(4)

Romania				Poland			
Mean equation				Mean equation			
Coeficients	Dummy	Dummy,INF(-1)	Dummy*INF(-1)	Coeficients	Dummy	Dummy, INF(-1)	Dummy*INF(-1)
sqrt(garch)	-0.165202***	-0.154337***	-0.169314***	sqrt(garch)	0.028445	0.035377	0.040249
INF(-1)	-0.713134***	-0.713849***	-0.771465***	INF(-1)	0.965748***	0.961324***	0.957681***
INF(-2)	-0.866204***	-0.868881***	-0.945579***	MA(1)	-0.448267***	-0.419731***	-0.436734***
MA(2)	0.434084***	0.428805***	0.494372***	MA(2)	-0.241537***	-0.263495***	-0.187554***
MA(3)	-0.565846***	-0.571124***	-0.654579***				
Variance equation – GARCH(1,1)				Variance equation – GARCH(1,1)			
constant	1.39E-06***	2.18E-06***	7.28E-07**	constant	7.33E-06***	-8.37E-07	3.11E-06***
Resid^2	0.294915***	0.255502**	0.422640***	Resid^2	0.236774**	0.143240**	0.414631***
garch(-1)	0.655083***	0.709802***	0.593077***	garch(-1)	0.304636*	0.312411**	0.280694***
INF(-1)	-	0.001901***	-	INF(-1)	-	0.000461***	-
Dummy	-9.66E-07**	-8.47E-07*	-	Dummy	-5.13E-06**	1.7E-06	-
Dummy*INF(-1)	-	-	0.000827*	Dummy*INF(-1)	-	-	-0.000203*
Q(4)	1.0536	2.5116	1.6676	Q(4)	6.2111	6.8498	8.6094**
Q(12)	7.4723	9.7252	8.3685	Q(12)	9.0045	18.805**	24.431**
the level of statistical significance is illustrated as: *** under 1%, ** under 5%, * under 10%; Q denotes the Ljung Box statistic							

Results(5)

Romania		Poland	
Mean equation			
Coeficients	Estimation	Coeficients	Estimation
sqrt(garch)	0.012034	sqrt(garch)	0.016407
INF(-1)	-0.472382***	INF(-1)	0.974312***
INF(-2)	-0.777757***	MA(1)	-0.368177***
MA(2)	0.650811***	MA(2)	-0.312685***
MA(3)	-0.142822		
Variance equation – EGARCH(1,1)			
ω	-0.842588***	ω	-24.115***
α	0.938049***	α	-0.908343***
β	0.248775***	β	-0.090676
γ	0.314598***	γ	0.381550***
INF(-1)	0.239602	INF(-1)	92.90
Q(4)	8.0270*	Q(4)	2.7473
Q(12)	14.195	Q(12)	15.145
the level of statistical significance is illustrated as: *** under 1%, ** under 5%, * under 10%; Q denotes the Ljung Box statistic			

Results(6)

Romania			Poland		
Mean equation					
Coeficients	INF(-1)	INF(-1), Dummy	Coeficients	INF(-1)	INF(-1), Dummy
sqrt(garch)	-0.144214***	-0.114060*	sqrt(garch)	0.042047	0.018814
INF(-1)	-0.531818***	-0.723253***	INF(-1)	0.957205***	0.962734***
INF(-2)	-0.968691***	-0.877146***	MA(1)	-0.412584***	-0.368250***
MA(2)	0.769582***	0.432659***	MA(2)	-0.260646***	-0.234739**
MA(3)	-0.562207	-0.567306***			
Variance equation – Component GARCH					
α	0.237044*	-0.072962	α	-0.362797**	-0.332609
β	0.614158***	0.203778	β	0.291035	0.146689
μ	0.000113	3.53E-05	μ	2.11E-06***	-2.92E-06
ξ_1	0.993806***	0.9463***	ξ_1	0.329018***	0.364138
ξ_2	0.114206	0.228986***	ξ_2	0.465229***	0.386062***
INF(-1)	0.002963***	0.001313**	INF(-1)	0.000481***	0.000663**
Dummy	-	-1.00E-06***	dummy		3.42E-06*
Q(4)	2.2683	109.38***	Q(4)	4.3903*	7.1369**
Q(12)	9.7642	520.83***	Q(12)	16.679*	17.868*
the level of statistical significance is illustrated as: *** under 1%, ** under 5%, * under 10%; Q denotes the Ljung Box statistic					

Results(7)

GARCH in Mean			
Heteroskedasticity Test: ARCH	Romania		
F-statistic lag 1	0.106546	Prob	0.7445
F-statistic lag 4	0.146518	Prob	0.9644
Heteroskedasticity Test: ARCH	Poland		
F-statistic lag 1	0.008485	Prob	0.9267
F-statistic lag 4	0.941664	Prob	0.4407
GARCH in Mean with dummy			
Heteroskedasticity Test: ARCH	Romania		
F-statistic lag 1	0.059234	Prob	0.808
F-statistic lag 4	0.063638	Prob	0.9925
Heteroskedasticity Test: ARCH	Poland		
F-statistic lag 1	0.081988	Prob	0.7749
F-statistic lag 4	1.118008	Prob	0.3489

EGARCH			
Heteroskedasticity Test: ARCH	Romania		
F-statistic lag 1	0.129319	Prob	0.7195
F-statistic lag 4	0.098147	Prob	0.9829
Heteroskedasticity Test: ARCH	Poland		
F-statistic lag 1	0.010657	Prob	0.9179
F-statistic lag 4	0.561083	Prob	0.6912
Component GARCH			
Heteroskedasticity Test: ARCH	Romania		
F-statistic lag 1	0.098169	Prob	0.7544
F-statistic lag 4	0.114645	Prob	0.9772
Heteroskedasticity Test: ARCH	Poland		
F-statistic lag 1	0.123966	Prob	0.7251
F-statistic lag 4	0.242701	Prob	0.9139

Results(8)

Romania		
Number of lags=2		
Null Hypothesis:	F-Statistic	Prob.
GARCH01 does not Granger Cause DDCPI2	6.42262	0.002
DDCPI2 does not Granger Cause GARCH01	114.715	1.00E-33
Number of lags=4		
Null Hypothesis:	F-Statistic	Prob.
GARCH01 does not Granger Cause DDCPI2	3.51166	0.0086
DDCPI2 does not Granger Cause GARCH01	58.9865	3.00E-32
Poland		
Number of lags=2		
Null Hypothesis:	F-Statistic	Prob.
GARCH01 does not Granger Cause DCPI_SA	18.3031	4.00E-08
DCPI_SA does not Granger Cause GARCH01	46.1961	2.00E-17
Number of lags=4		
Null Hypothesis:	F-Statistic	Prob.
GARCH01 does not Granger Cause DCPI_SA	12.0781	7.00E-09
DCPI_SA does not Granger Cause GARCH01	84.8459	5.00E-43

Conclusions

- This paper focused on analyzing the relationship between inflation and inflation uncertainty in Romania and Poland and on the possible effects of inflation targeting adoption on uncertainty;
- My findings are supporting the views of Friedman and Ball, regarding the positive relation between inflation and uncertainty. Reversing the link, in Romania the results support Holland’s findings, while in Poland Cukierman-Meltzer hypothesis seems to be more appropriate;
- In both cases, inflation targeting reduces uncertainty regarding inflation;
- Monetary authorities should aim for reduced inflation rates; also, they may be able to eliminate much of the costs associated with high inflation by following well-understood policy rules;
- the study can be continued by considering time-varying in GARCH framework in order to have a better proxy for uncertainty from the structural variability of model parameters;

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Thank you!