EXTERNAL FACTORS INFLUENCE ON INFLATION: THE CASE OF ROMANIA

Căpraru Bogdan
"Al. I. Cuza" University of Iaşi, Romania, Faculty of Economics and Business Administration

Ihnatov Iulian
"Al .I. Cuza" University of Iaşi, Romania, Faculty of Economics and Business Administration

In this paper we try to assess the main external determinants of inflation dynamics in Romania. The literature in the field of measuring inflation dynamics is wealthy and various. There are many developing country - level studies that examine inflation dynamics: Blavy (2004) - Guinea, Duma (2008) - Sri Lanka, Gottschalk et al (2008) - Sierra Leone, Moriyama (2008) - Sudan, Mwase (2006) - Tanzania, Williams and Adedeji (2004) - Dominican Republic, Hossain (2005) - Indonesia, Almounsor (2010) - Yemen. The issue of Romanian inflation dynamics is present in many and various studies, like Hammermann (2007), Pelinescu and Dospinescu (2006), Budina et al (2006) etc. There are no other recent studies that analyze the external determinants on Romanian inflation dynamics.
In our paper we estimate an OLS single equation model, using a methodology derived from Almounsor (2010). The empirical analysis uses monthly data from August 2005 to January 2011. The start point of the data series is the moment of a major change in the National Bank of Romania (NBR) monetary policy: adoption of the inflation targeting regime. The independent variables used in our research are: harmonized consumer price index of EU-25 countries, EUR/RON exchange rate, crude oil price index (for analyzing the external shocks effect) and M2 monetary aggregate (intermediate money supply) as a control variable.
The outcomes suggest that inflation in Romania is driven mainly by international price shocks – harmonized consumer price index of EU-25 countries. The EUR/RON exchange rate depreciation has a small influence on domestic inflation. In the short run, the effect of the international oil price is insignificant. Money supply, used here as a control variable, is shown to have a very small effect on inflation in Romania when using OLS regressions. The results show that 66% of the domestic inflation variance is explained by the independent variables in our model.

Key words: inflation dynamics, external shock, international prices, exchange rate, Romania

JEL classification: E31, E52, E58

1. Introduction

In a world of fiat money inflation is a widely spread phenomenon that concerns both theorists and practitioners. The determinants of inflation can be split into two main categories: external and domestic factors. This paper assesses the main external determinants of inflation dynamics in Romania using an OLS single equation model. In this model, various regressions were performed to reach the benchmark regression, with the best fit and predictability. The period assessed is August 2005 – January 2011, highlighting the evolution of inflation under external shocks in a framework of inflation targeting monetary policy regime.

2. Literature Review

The literature in the field of measuring inflation dynamics is wealthy and various. Among them, there are many developing country level studies that examine inflation dynamics: Blavy (2004) - Guinea, Duma (2008) - Sri Lanka, Gottschalk et al (2008) - Sierra Leone, Moriyama (2008) - Sudan, Mwase (2006) - Tanzania, Williams and Adedeji (2004) - Dominican Republic, Hossain

(2005) - Indonesia etc. Almounsor (2010) studies the underlying determinants of inflation dynamics in Yemen using three different approaches: (i) a single equation model, (ii) a Structural Vector Autoregression Model, and (iii) a Vector Error Correction Model. The outcomes suggest that inflation dynamics in Yemen are driven by international price shocks, exchange rate depreciation, domestic demand shocks, and monetary innovations. Arratibel et al (2002) examine inflation dynamics in EU - accession countries in Central and Eastern Europe between 1990 and 2001, focusing particularly on the determinants of "dual inflation", diverging inflation rates for tradable and non-tradable goods.

Also, there are many country level empirical studies on the effects of the exchange rate regime on inflation. Ghosh et al. (1997) conducted one of the first studies of this kind in a wide cross section of countries. Their analysis uses a tripartite classification system ("pegs", "intermediate" and "float") and includes the experience of 140 countries over the time period 1960 to 1990, using annual data.

The issue of Romanian inflation dynamics is also present in many and various studies. Hammermann (2007) uses panel estimation based on ten Central and Eastern European countries allowing him to decompose the inflation differential between Romania and the EU-8. The decomposition suggests that neither the revenue, nor the balance of payments, nor the financial stability motives are driving inflation; rather structural differences are at play. Pelinescu and Dospinescu (2006) focus on the short-term impact of changes in money, foreign exchange and wage policies and controlled prices, as well as the impact of the external shocks (as international price of oil) on future inflation in Romania. Their research uses VAR models to analyze the impact of factors like oil price and exchange rate on inflation and builds a model for predicting the inflation level in Romania. Budina et al (2006) demonstrate that for the period of 1992 – 2000 inflation was largely a monetary phenomenon in Romanian economy.

3. Methodology and Data

The empirical analysis uses monthly data from August 2005 to January 2011 (Appendix 1). The start point of the data series is the moment of a major change in the National Bank of Romania (NBR) monetary policy: adoption of the inflation targeting regime. This moment concur, also, with the privatization of the PETROM national oil company, at the end of 2004, when Romanian authorities quit administering the domestic fuel prices (a major determinant of domestic inflation).

We used data series from the IMF International Financial Statistics database (harmonized consumer price index in Romania (100=2005) - 96864HZF series and the M2 monetary aggregate in Romania - 96859MBZF series), from the Eurostat database (harmonized consumer price index of EU-25 countries (100=2005) and EUR/RON monthly average exchange rate series), from the Indexmundi database (crude oil price index (100=2005)) and National Statistics Institute of Romania (monthly average of the fuel price index, IPC102A series, transformed to consider 2005 the base year).

We used the EU-25 countries consumer price index as the Romanian external trade with other EU countries is prevalent (the EU27 data series already includes the Romanian price dynamics and is available only after year 2007). The EUR/RON exchange rate was also used due to the structure of the external trade of Romania; in the same time, euro is the main reserve currency of NBR. The international oil price may be relevant to the domestic inflation dynamics as most of the energy carriers in Romania are imported. To increase the robustness of our model we used the M2 monetary aggregate (intermediate money supply) as a control variable.

All data series were transformed as natural logarithms. We tested the data with the ADF unit root tests and the results showed that all the series (except the crude oil price index) are first order integrated. Consequently we had to difference them once to obtain stationary data series (we also differenced the crude oil price index to may use the data in the regression).

The paper uses a methodology derived from the one used by Almounsor (2010). We have based our research on a single-equation model as follows:

$$\Delta p_t = \alpha + \beta_1 \Delta p_t^f + \beta_2 \Delta e_t + \beta_3 \Delta o + \beta_4 \Delta m_t + \phi z + \varepsilon_t \quad (1)$$

where Δ is the difference operator, p is the domestic HCPI, pf is the foreign (EU-25) HCPI, e is the EUR/RON exchange rate, o is the crude oil price index, m is the domestic M2 monetary aggregate (control variable), z is a set of binary variables controlling for outliers and ε is the error term.

Equation (1) states that inflation is driven by foreign inflation (pf), exchange rate (e) depreciation/appreciation, international oil prices (o) and growth of money supply (m), with the appropriate lags for the coefficients validation and AIC and SIC statistics minimization.

The model allows the analysis of the short term relationship of the variables with standard regression techniques. We tested for and eliminated the outliers (2007M8, 2007M9, 2010M1, 2010M7), based on the results of the RStudent test. To capture their impact, the paper uses four dummy variables. We tested the residuals' properties for checking the biasness, consistency and efficiency of the estimators.

As the domestic fuel price is an important component of the HCPI, we used the Johansen co-integration test for checking its long term relation with the international oil price.

4. Results

The results of equation (1) estimation are shown below:

$$\Delta p_t = \underset{(0.00)}{0.003} + \underset{(0.11)}{0.46^{***}} \times \Delta p_{t-1}^f + \underset{(0.02)}{0.05^{**}} \times \Delta e_{t-1} - \underset{(0.00)}{0.01^{***}} \times \Delta o_{t-2} + \underset{(0.01)}{0.03^{*}} \times \Delta m_{t-2} + \varepsilon_t \quad (2)$$

Note: values in parenthesis are the standard errors of the estimators; *** significant at 99%, ** significant at 95%, * significant at 90%; t-1 = one month lag, t-2 = two months lag

The outcomes of the single equation model show that Romania's inflation is driven mostly by international prices (with one month lag) and also by the exchange rate depreciation (pass-through). Empirically, a 1 percent increase in the EU-25 countries CPI amplifies the next month domestic prices by about 0.46 percent. The impact of exchange rate depreciation is significantly smaller: a 1 percent increase in the EUR/RON exchange rate is followed by a 0.05 percent increase of the next month domestic inflation.

The effect of international oil price is insignificant, a 1 percent increase driving to a decrease of about 0.01 percent of the domestic inflation (two months lagged). This result is quite surprising when observing the dynamics of the local fuel price and considering the weight of this component in the domestic HCPI. To confirm this outcome we have tested the two fuel price data series for co-integration and found out that the local fuel price is not driven by the international oil price, on a short run (Appendix 5).

Money supply, used here as a control variable, is shown to have a very small effect on inflation in Romania when using OLS regressions. Empirically, a 1 percent increase in the intermediate monetary aggregate adds two months lagged 0.03 percent to domestic inflation (however the coefficient is significant at 90% only).

The results show that 66% of the domestic inflation variance is explained by the independent variables in our model (Appendix 2).

5. Conclusions

The outcomes suggest that inflation in Romania is driven mainly by international price shocks – harmonized consumer price index of EU-25 countries. The EUR/RON exchange rate depreciation has a small influence on domestic inflation. In the short run, the effect of the international oil price is insignificant. Money supply, used here as a control variable, is shown to have a very small effect on inflation in Romania when using OLS regressions. The results show that 66% of the domestic inflation variance is explained by the independent variables in our model.

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Appendix 1: Data series

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							2005					
HCPIRO	--	--	--	--	--	--	--	100.6	101.2	102.1	103.3	103.9
HCPIEU25	--	--	--	--	--	--	--	100.3	100.7	101.0	100.8	101.0
EURRON	--	--	--	--	--	--	--	3.50	3.51	3.60	3.65	3.66
OIL	--	--	--	--	--	--	--	116.0	115.6	109.0	103.2	105.8
M2	--	--	--	--	--	--	--	76.7	80.2	81.1	81.4	86.3
COMBUSTIBILI	--	--	--	--	--	--	--	106.7	110.2	110.3	109.2	109.0
							2006					
HCPIRO	105.0	105.2	105.4	105.9	106.5	106.7	106.8	106.7	106.8	107.0	108.2	109.0
HCPIEU25	100.6	100.9	101.4	102.1	102.4	102.5	102.4	102.6	102.7	102.7	102.8	103.2
EURRON	3.64	3.54	3.51	3.49	3.51	3.55	3.57	3.53	3.53	3.52	3.50	3.41
OIL	117.1	112.1	114.3	127.6	128.9	128.2	136.0	134.8	116.6	108.8	109.2	114.5
M2	85.7	85.7	87.5	88.0	91.7	95.1	95.9	98.3	99.3	100.6	101.9	111.7
COMBUSTIBILI	109.6	109.4	109.2	109.4	110.8	111.1	111.9	112.6	113.1	112.3	110.9	110.5
							2007					
HCPIRO	109.2	109.3	109.4	109.9	110.6	110.8	111.2	112.1	113.3	114.4	115.5	116.3
HCPIEU25	102.7	103.1	103.7	104.3	104.6	104.7	104.4	104.5	104.9	105.4	105.9	106.4
EURRON	3.39	3.38	3.37	3.33	3.28	3.22	3.13	3.22	3.35	3.35	3.47	3.54
OIL	100.5	108.1	113.9	122.3	122.5	128.1	138.1	131.6	144.1	153.8	171.4	168.1
M2	106.3	109.2	112.4	112.9	112.7	116.1	119.9	124.3	126.5	128.7	136.1	147.9
COMBUSTIBILI	109.7	108.4	108.4	110.2	112.0	112.4	112.4	112.1	112.3	113.1	115.0	116.7
							2008					
HCPIRO	117.2	118.1	118.9	119.5	120.1	120.4	121.3	121.2	121.7	123.0	123.4	123.7
HCPIEU25	106.1	106.6	107.5	107.9	108.6	109.0	108.9	108.9	109.2	109.2	108.7	108.6
EURRON	3.69	3.66	3.72	3.64	3.66	3.66	3.58	3.53	3.62	3.75	3.78	3.92
OIL	170.3	175.3	191.1	204.2	230.5	247.0	249.7	215.3	187.1	136.3	101.2	77.7
M2	147.4	149.7	152.0	157.0	157.6	161.5	161.2	162.3	166.0	162.1	164.4	173.7
COMBUSTIBILI	117.5	119.0	121.8	124.2	127.0	128.6	130.4	129.3	129.3	128.9	124.6	119.9
							2009					
HCPIRO	125.2	126.2	126.9	127.2	127.2	127.5	127.4	127.2	127.6	128.2	129.1	129.5
HCPIEU25	107.8	108.4	108.8	109.1	109.4	109.6	109.1	109.4	109.4	109.6	109.8	110.1
EURRON	4.24	4.29	4.28	4.20	4.17	4.21	4.22	4.22	4.24	4.29	4.29	4.23
OIL	82.6	78.8	87.9	94.6	109.3	130.0	121.6	134.7	128.5	139.2	145.8	140.9
M2	175.8	175.8	174.9	175.8	176.2	179.5	180.4	182.8	182.5	182.6	184.1	188.0
COMBUSTIBILI	121.7	125.7	126.6	126.9	127.5	130.2	131.2	132.9	132.4	133.8	136.1	135.7
							2010					
HCPIRO	131.7	131.9	132.2	132.6	132.8	133.0	136.5	136.8	137.5	138.3	139.0	139.8
HCPIEU25	109.5	109.9	110.9	111.4	111.6	111.6	111.2	111.4	111.7	112.0	112.2	112.9
EURRON	4.14	4.12	4.09	4.13	4.18	4.24	4.26	4.24	4.27	4.28	4.29	4.29
OIL	145.0	140.4	148.9	158.1	142.2	140.4	140.0	142.6	143.1	153.6	158.9	169.3
M2	184.3	185.7	187.8	188.3	190.1	192.3	190.8	192.7	192.6	191.7	194.2	199.6
COMBUSTIBILI	140.3	140.1	142.9	144.3	144.9	145.5	148.9	147.9	149.9	150.9	152.1	156.5
							2011					
HCPIRO	140.9	--	--	--	--	--	--	--	--	--	--	--
HCPIEU25	112.4	--	--	--	--	--	--	--	--	--	--	--
EURRON	4.26	--	--	--	--	--	--	--	--	--	--	--
OIL	174.3	--	--	--	--	--	--	--	--	--	--	--
M2	196.0	--	--	--	--	--	--	--	--	--	--	--
COMBUSTIBILI	159.9	--	--	--	--	--	--	--	--	--	--	--

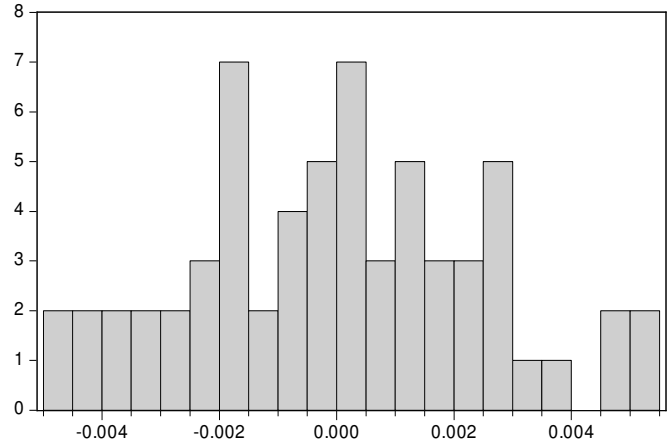
Note: HCPIRO = harmonized consumer price index in Romania, HICPEU25 = harmonized consumer price index in EU-25 countries, M2 = M2 monetary aggregate, EURRON = EUR/RON exchange rate, OIL = foreign crude oil price index
Source: IMF (International Financial Statistics), Eurostat, Indexmundi and Romanian National Statistics Institute

Appendix 2: Main regression statistics

Dependent Variable: DLOG(HCPIRO)
Method: Least Squares
Sample (adjusted): 2005M11 2011M01
Included observations: 63 after adjustments

R-squared	0.705091	Mean dependent var	0.005107
Adjusted R-squared	0.661401	S.D. dependent var	0.004563
S.E. of regression	0.002655	Akaike info criterion	-8.892853
Sum squared resid	0.000381	Schwarz criterion	-8.586691
Log likelihood	289.1249	Hannan-Quinn criter.	-8.772438
F-statistic	16.13840	Durbin-Watson stat	1.555438
Prob(F-statistic)	0.000000		

Appendix 3: Error-vector normality test results



Series: Residuals
Sample 2005M11 2011M01
Observations 63

Mean	-1.79e-19
Median	-8.67e-19
Maximum	0.005199
Minimum	-0.004653
Std. Dev.	0.002478
Skewness	0.134685
Kurtosis	2.439207
Jarque-Bera	1.016004
Probability	0.601697

Appendix 3: Error-vector autocorrelation test results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.812487	Prob. F(3,51)	0.1566
Obs*R-squared	6.069728	Prob. Chi-Square(3)	0.1083

Appendix 4: Error-vector heteroscedasticity test results

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.321230	Prob. F(8,54)	0.2530
Obs*R-squared	10.31287	Prob. Chi-Square(8)	0.2437
Scaled explained SS	5.452293	Prob. Chi-Square(8)	0.7083

Appendix 5: Domestic and international fuel price co-integration test

Sample (adjusted): 2005M11 2011M01
Included observations: 63 after adjustments
Trend assumption: Linear deterministic trend
Series: COMBUSTIBILI OIL
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.246054	26.75971	15.49471	0.0007
At most 1 *	0.132658	8.966305	3.841466	0.0028

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values