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**Article**

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## Disinflation and monetary independence in Romania

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In this article, the issue of the monetary independence problem in view of the Romania's European Monetary Union accession is investigated empirically. It is frequently argued that for such a country, the main cost of participation in a currency area is the loss of monetary policy independence. This article raises the question of the actual possibility of monetary independence in a small open economy operating within highly liberalized capital flows and highly integrated financial markets. The main hypothesis of the article is verified using the vector error-correction mechanism model and several parametric hypotheses concerning the speed and asymmetry of adjustment to verify the risk premium and the nature of transmission of the Euribor interest rates on the Romanian Robor. The hypothesis of a one-to-one relationship between interest rates between Romania and the Eurozone cannot be rejected, despite the rapid disinflation at the beginning of the sample.

**Keywords:** EMU; inflation targeting; monetary policy independence; monetary union; small open economy

**JEL Classification:** E43; E52; E58; F41; F42; C32

### 1. Introduction

Designing a monetary policy framework is one of the primary challenges for small open economies. In these economies, a fear of an excess volatility discouraging trade, higher pass-through of exchange rate changes to prices, and balance sheet effects brought about by currency mismatches guide the monetary policy choices. In the best and worst of times, policy-makers face an impossible task of maintaining stability with appreciating currencies during global booms due to capital inflows and depreciations associated with sudden reversals and capital flights. The small open economies acceding to the EU, namely, Poland, the Czech Republic, Romania, and Hungary, moved towards more flexible exchange rate regimes at the beginning of the 2000s. In line with the inflation-targeting framework, this move should ensure an adequate credibility for their monetary policies and thus provide a more flexible response to external shocks (Baranowski, 2014; Masson, Savastano, & Sharma, 1997). Through the Mundell–Fleming

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open macroeconomics trilemma paradigm, this should translate itself into an independence of monetary policy with liberalized international capital flows and a floating exchange rate.

The Romanian case is particularly interesting in this context. In contrast to other inflation targeters, which moved into this monetary policy framework after the inability to maintain fixed exchange rates, the choice made by the National Bank of Romania (NBR) was a deliberate one. The NBR has pursued a successful policy of disinflation that resulted in a significant decrease in inflation at the beginning of the 2000. In 2005, the monetary policy of Romania moved into the inflation-targeting framework. During these times, a high degree of exchange rate flexibility was maintained for monetary authorities to maintain credibility and retain monetary independence. As argued by Daianu and Kallai (2008), this was in line with requirements imposed by the need to achieve nominal and real convergence with a view to joining the European Union in 2007 and monetary integration with the European Monetary Union (EMU).

In the context of monetary integration, the loss of independence in carrying out monetary policy is regarded as the single most serious cost of the accession of a country into a common currency area. However, the insights from empirical research surveyed in the article allow arguing that the actual extent of the freedom to conduct monetary policy in a small open economy is significantly limited, even in the case of a floating exchange rate.

The article discusses the results of an empirical analysis of monetary policy independence in Romania. The main hypothesis of the article is that Romanian interest rates are linked with a long-term cointegrating relationship with the rates prevailing in the euro zone. Verification of this hypothesis is essential to the analysis of costs of the Romanian accession to the EMU. The main hypothesis of the article is verified with a vector error-correction mechanism model and appropriate parametric hypotheses. This allows determining the actual degree of independence of monetary policy in Romania relative to the euro zone. This article is structured as follows. The next section reviews the literature; in the third, the empirical methodology is presented. An analysis of the obtained results follows in the fourth section, and the last section concludes with policy implications.

## 2. Review of the scientific literature

Monetary policy independence is understood as the ability of the central bank to set interest rates independently of international rates as defined by Aizenman, Chinn, and Ito (2013). This can be questioned especially in terms of small open economies with highly integrated financial markets. If a country has a credible fixed exchange rate and has liberalized financial flows, its domestic interest rate has to follow that of the anchor country. In view of the Mundell–Fleming paradigm, this implies giving up of monetary independence. Otherwise, an increase in the anchor country interest rate that is not matched by an increase in the domestic country's rates would lead to a shift in investors' funds to assets denominated in the higher interest rate-earning currency, which generates a depreciation of the exchange rate. Thus, monetary independence requires that a country must either allow the exchange rate to float or restrict international capital movement (Klein & Shambaugh, 2013). Consider the following Uncovered Interest Parity condition:

$$i_t = i_t^* + E_t(e_{t+1} - e_t) + \rho. \quad (1)$$

Taking it into first differences:

$$\Delta i_t = \Delta i_t^* + \Delta E_t(e_{t+1} - e_t) + \Delta \rho, \quad (2)$$

where  $\Delta$  is the difference operator,  $i$  is the domestic nominal interest rate,  $i^*$  is the foreign nominal interest rate,  $E$  is the expectation operator,  $e$  is the nominal exchange rate,  $\rho$  is the risk premium and  $t$  is the time index.

In a fixed exchange rate system, because the exchange rate is constant, the third term becomes zero. Thus, assuming that the risk premium does not affect the change in interest rates and the expected future exchange rate remains the same, the domestic interest rate moves one on one with the foreign rate change, that is, there is a full transmission of foreign interest rates:

$$\Delta i_t = \Delta i_t^*. \quad (3)$$

However, the fundamental argument of target zone models made by Svensson (1994) is that a target zone allows for a temporary deviation of domestic from foreign interest rates if the target zone is credible. Interest rates may diverge for some time under a flexible exchange rate regime only if the domestic policies are credible and the monetary authority primarily targets domestic economic variables such as inflation and output. The size and the length of the deviation then can be used to measure the degree of monetary policy independence. In the long run, the central bank's monetary autonomy is lost, as it must introduce policies to keep the parity credible. In contrast, Ehrmann and Fratzscher (2002) reverse the argument to argue that a monetary authority may not enjoy monetary independence even under a more flexible exchange rate regime if it lacks credibility or if the economy is highly integrated financially with a larger monetary area such as the euro area.

Hausmann, Panizza, and Stein (2001) find that interest rates in countries with floating exchange rate regimes are as dependent on and responsive to US monetary policy shocks as are those countries with fixed currency regimes. Frankel (1999) examines a broad sample of countries in the sample of 1970–2000 and fails to detect a strong link between exchange rate flexibility and interest rate autonomy. Frankel, Schmukler, and Serven (2004) indicate that several large advanced countries can select their own rates in the long run, whereas the majority of other countries with flexible exchange rates react fully to international interest rates in the long run.

Based on these results, it can be therefore questioned if Central and Eastern European Countries (CEEC) with floating exchange rates are de facto monetary independent (Goczek & Mycielska, 2014). However, the CEEC region has not attracted much attention in this context. One of the exceptions is the paper by Căpraru and Ilnatov (2011), who indicate that interest rates in countries with fixed or intermediate exchange rate arrangements are less sensitive to the European Central Bank (ECB) interest rate than countries with floating exchange rate arrangements and that intermediate exchange rate arrangements can better preserve monetary autonomy. Hsing (2013) finds that in the long run, Latvia, Romania, and Hungary make small interest rate adjustments, while Bulgaria, Lithuania, and the Czech Republic make moderate adjustments. He argues that except for Poland, the other six countries possess some degree of monetary autonomy in the long run.

### 3. Research methodology

The interbank interest rates are the most fitting measures of monetary policy (Bernanke & Blinder, 1992). Reference rates based on interbank lending and borrowing have become foremost in monetary policy, because they facilitate the management of bank funding risk and have been successful to become the market standard. These rates are now deeply embedded in financial systems, especially in loan and interest rate derivatives contracts as more than 50% of all loans across the world are linked to just the two rates – LIBOR and EURIBOR (BIS, 2013).

In order to measure monetary policy independence, it is possible to investigate the comovement between the interbank rates. If the domestic interbank interest rates do not comove with international rates, this means that this country enjoys a large degree of monetary policy independence (Reade & Volz 2010). If, however, the interbank interest rates react in large part to foreign interest rate changes, as seen in close movements of their three-month interbank interest rates, it is unlikely that domestic monetary policy enjoys independence.<sup>1</sup> Based on this assumption in the empirical analysis, 3-month ROBOR and EURIBOR interest rates are used during the period 2001–2014 with daily frequency.

Under normal circumstances, three-month interbank interest rates comprise a good proxy for monetary policy rates. Nevertheless, the time span of the analysis envelops the outburst of the global financial meltdown during which there was virtually no transmission from policy rates (which were quickly cut to historically low levels) to interbank interest rates (which froze at elevated levels). This is visible in Figure 1 as peaks in the Romanian rate.<sup>2</sup> More importantly, however, the first period of 2001–2004 is characterized by a successful disinflation process in Romania. To take into account the possible impact of the Romanian period of disinflation on these results, especially during the run-up to establishing the inflation-targeting strategy as the monetary policy framework for Romania, two main approaches were used. The first approach entailed using detrending methods, and the second was based on using different sample windows to take into account different monetary strategies pursued by the Romanian Central Bank. The economic rationale for the detrending can be thought of as taking account of the disinflation in Romania and the confirmation of the lack of monetary policy independence hypothesis with a significant overreaction would show that the developing countries' central banks have to overreact to the developments in the dominant international interbank markets. In line with the first approach, the Hodrick–Prescott filter was applied with the lambda power of four suggested by Ravn and Uhlig (2002). All of the obtained results follow this separation into original and de-trended data. Figure 2 shows the two series.

The data-generating process for interest rates is commonly accepted to be integrated on the order of one according to the empirical literature on interest rates, although it might not be plausible from the economic–theoretical viewpoint (Moon & Perron, 2007). However, the treatment of processes close to non-stationarity as non-stationary in the econometric approach is more appropriate and less unsafe than acting upon a theoretical economic consistency.

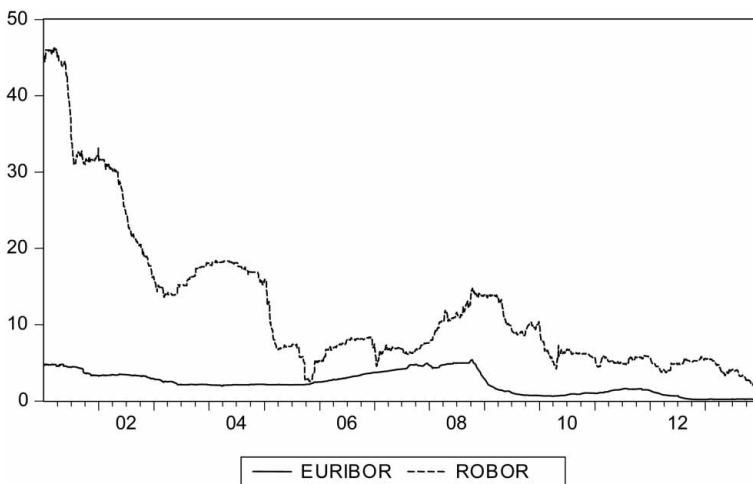


Figure 1. 3-month interest rates in Eurozone and Romania.  
Source: ECB and Romanian Central Bank.

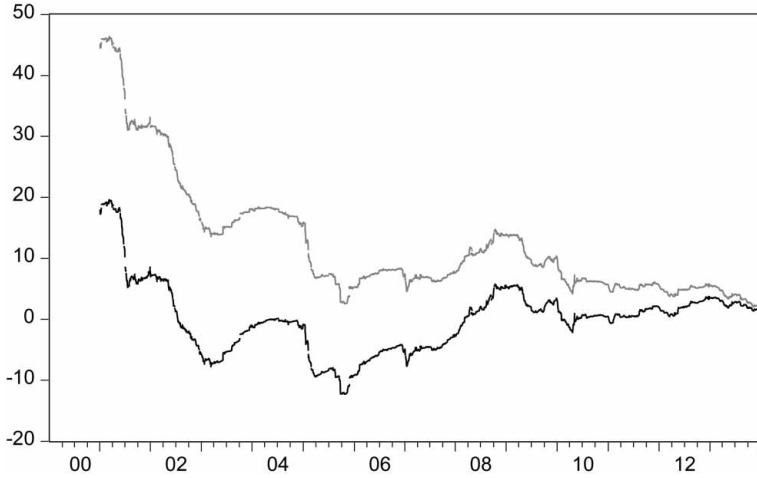


Figure 2. 3-month interest rates in Romania (detrended series in black).  
 Source: Own based on data from Romanian Central Bank.

Let us consider two time series for domestic and international interest rates that form a bivariate data vector  $\mathbf{X}_t$  given by

$$\mathbf{X}_t = \begin{pmatrix} i \\ i^* \end{pmatrix}_t \tag{4}$$

The ROBOR is denoted by  $i_t$ , and the EURIBOR is denoted by  $i_t^*$ . The two variables form a Vector Autoregressive (VAR) model described by:

$$\mathbf{X}_t = \Pi_0 + \Pi_1 t + \sum_{i=1}^K \Pi_i \mathbf{X}_{t-i} + \mathbf{u}_t, \tag{5}$$

where the error term  $\mathbf{u}_t \sim N(0, \sigma^2)$  is uncorrelated over  $t$ , the data vector  $\mathbf{X}_t$  is  $p \times T$  dimension,  $K$  is the number of lags, and  $\Pi_i$  is the deterministic coefficient matrix (constant and trend) of a dimension  $p \times p$ . If the data generation process is non-stationary in levels and stationary in first differences, the above equation can be rearranged to form a vector error correction mechanism:

$$\Delta \mathbf{X}_t = \Pi^* \mathbf{X}_{t-1}^* + \sum_{i=1}^{K-1} \Gamma_i \Delta \mathbf{X}_{t-i} + \mathbf{u}_t, \tag{6}$$

where  $\mathbf{X}_{t-1}^* = (\mathbf{X}_{t-1}, 1, t)'$ ,  $\Pi^* = (\Pi, \Pi_0, \Pi_1)$ ,  $\Pi = \sum_{i=1}^K \Pi_i - I$  and  $\Gamma_i = -\sum_{j=i+1}^K \Pi_j$ .

Under the assumption that  $\mathbf{X}_t \sim I(1)$  and  $\mathbf{u}_t \sim I(0)$ , the matrix  $\Pi$  is of reduced rank for the equation to be balanced. If  $\Pi$  is of reduced rank, there exists  $p \times r$  matrices  $\alpha$  and  $\beta$  such that  $\Pi = \alpha\beta'$ , and the Equation (3) is rewritten as:

$$\Delta \mathbf{X}_t = \alpha\beta' \mathbf{X}_{t-1}^* + \sum_{i=1}^{K-1} \Gamma_i \Delta \mathbf{X}_{t-i} + \mathbf{u}_t. \tag{7}$$

The term  $\beta' \mathbf{X}_{t-1}^*$  is the cointegrating vector indicating the steady-state relationship between the interest rates. In the context of interest rates, these are linear combinations, which themselves are non-stationary, but the relationship between them is stationary with a steady-state cointegrating vector.

If the matrix  $\Pi$  is of rank one, it indicates that a single cointegrating vector exists, and  $\beta'$  is  $1 \times p + 2$  (constant and trend in the cointegrating relationship). In that case, the cointegrating

vector is as follows:

$$\beta' \mathbf{X}_{t-1}^* = (\beta_0, \beta_1, \beta_2, \beta_3) \begin{pmatrix} 1 \\ t \\ i_t \\ i_t^* \end{pmatrix} = \beta_0 + \beta_1 t + \beta_2 i_t + \beta_3 i_t^*. \quad (8)$$

If the rank is verified to be one, this means that there exists a single cointegration vector – a single steady-state relationship. This is an indication of monetary policy dependence in Romania. However, this relationship is unlikely to be of bilateral causality. In this sense, it is very probable that Romania's target zone is not sufficiently credible for domestic interest rate deviation from the international rates to hold over prolonged periods. In contrast, an opposite relationship is quite unlikely to hold, that is, the Romanian interest rates influence the interest rates of the currency area in orders of enormity larger than its economy.

The properties of these relationships can be verified using parametric tests concerning coefficients from the matrix  $\alpha$ . In this way, it is possible to specify which of the interest rates adjusts to the other and estimate at what speed and to what degree this takes place. This is testable through the hypothesis that the adjustment coefficient is insignificant in the EURIBOR equation and significant in the ROBOR equation.

The discrimination between deterministic components of the cointegrating equation allows for the investigation of the steady-state equilibrium with the two interest rates. It is natural to expect that the interbank market in the smaller economy exhibit a higher risk premium. This can be verified through testing the sign and significance of the intercept in the cointegrating equation. Because of the expected entry of Romania into the EMU and the intensifying financial integration of Romania into European capital markets since the early 1990s, this premium is expected to fall. This should be seen in the long-run convergence of the two interest rates. This phenomenon can be measured using a linear trend term coefficient in the cointegrating equation.

Summing up the argument, the parametric hypotheses can be outlined as follows:

1. H0:  $\Pi$  is of rank one – there exists a long-run steady-state relationship between the interest rates in Romania and the Eurozone.
2. H0:  $\beta_0 \leq 0$  – test of an existence of a constant positive risk premium in Romania.
3. H0:  $\beta_1 = 0$  – no long-run convergence in risk premium between the two areas.
4. H0:  $\alpha_1 < 0$  – limited monetary independence in Romania, adjustment to the steady-state relationship with the Eurozone.
5. H0:  $\beta_3 = -1$  – total homogeneity – the interest rates move jointly in a one-by-one manner.

Moreover, given the steady-state relationship between both interest rates, it is possible to verify which of the interest rates is exogenous to the other. Therefore, if only one country adjusts to this relationship while the other does not, this is evidence in favour of the monetary dependence of the adjusting country from the non-adjusting one.

#### 4. Results and discussion

To take into account of the possible impact of the Romanian period of disinflation on our results, especially during the run-up to establishing the inflation-targeting strategy as the monetary policy framework for Romania, two main approaches were used. The first approach entailed using detrending methods, and the second was based on using different sample windows to take into account different monetary strategies pursued by the Romanian Central Bank. The Hodrick–Prescott filter was applied to the first approach. All of the obtained results follow this separation into original and de-trended data.



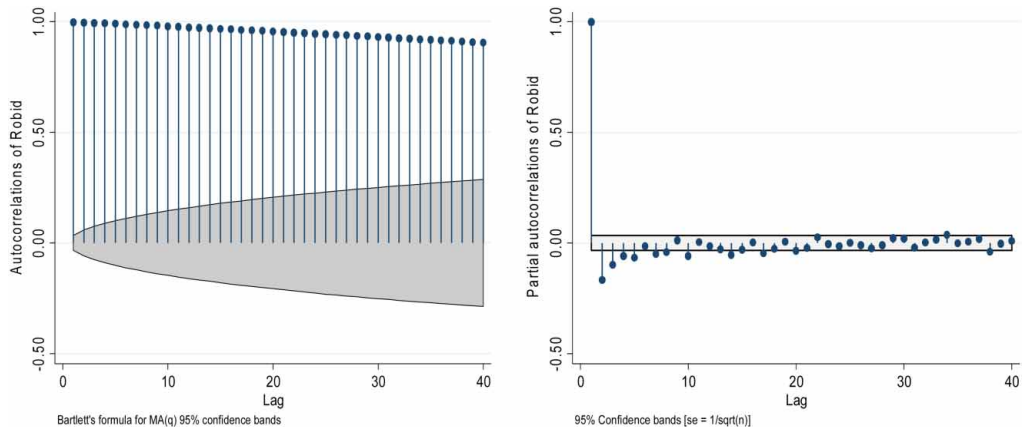


Figure 3. Autocorrelation (left) and partial autocorrelation (right) functions of Robor.  
Source: Own.

As already mentioned, the objects of the empirical analysis are the interbank money market rates in Romania and the Euro zone. The study used time series of daily quotations for the three-month ROBOR, but weekly and monthly data have been investigated for robustness of the results, obtaining the same results.

First, the issue of stationarity of the data has been explored, given the results of autocorrelation and partial correlation functions of Robor shown in Figure 3. The unit root test results for the time series of interest rates in levels and differences are displayed in Table 1.<sup>3</sup> The first tests are a generalized version of the ADF test by Elliott, Rothenberg, and Stock (1996). Both the number of levels and the number of first differences in applying the Schwert criterion determined the selection of a maximum number of 18 lags. This is also the number of delays that was preferred by the information criteria of Ng and Perron (2001) and the sequential statistic  $t$  by Ng–Perron in the case of data in levels. For a number of different data, it was also suggested to select the test criteria of 18 lags. In both cases, the results gave no grounds for rejecting the hypothesis of the existence of a unit root. On this basis, it can be assumed that the stochastic process generating interest rates ROBOR is an I(1) process. In contrast, the results for the Phillips and Perron (1988) unit root tests were not entirely in line with other results; therefore, it was concluded that the negative autocorrelation of higher orders than 1 as seen in Figure 3 has influenced the results obtained from this test.

To confirm the degree of integration of the series, the interest rates were also tested using Kwiatkowski, Phillips, Schmidt, and Shin (1992) test (KPSS). The bandwidth of the KPSS was selected according to the Schwert criteria, and the Bartlett kernel was used to estimate the variance term. For this test, an alternative hypothesis was the presence of unit root. Based on the KPSS test results displayed in the lower rows of Table 1, it can be clearly stated that the stochastic process of interest rates is non-stationary. KPSS test results in terms of levels of the variable under consideration are clear, and the hypothesis of stationarity must be rejected. Nevertheless, the order of integration of the process is quite cumbersome due to the size of the test statistics, which is not clear on the stationarity of the first differenced de-trended series used for all standard levels of significance. In particular, the test statistic obtained locates between 1% and 5% of the critical value, and thus depending on the accepted level of significance of this process, is an I(1), or I(2).

The notion that the interest rate process is of the second order of integration is implausible from an economic standpoint. It could be that structural breaks in the data are responsible for

Table 1. Summary of unit root tests.

	Robor in levels	First differences of Robor	Detrended Robor in levels	First differences of Detrended Robor	Euribor in levels	First differences of Euribor
DF-GLS test						
DF-GLS tau statistic	-0.683	-9.441	-1.284	-2.084	-1.814	-6.380
1% Critical	-3.48	-3.48	-3.48	-3.48	-3.48	-3.48
5% Critical	-2.89	-2.89	-2.837	-2.834	-2.834	-2.834
10% Critical	-2.57	-2.57	-2.549	-2.547	-2.547	-2.547
Kwiatkowski–Phillips–Schmidt–Shin test						
KPSS statistic	4.641765	0.587635	4.641765	0.748656	3.868719	0.197712
1% Critical	0.739	0.739	0.739	0.739	0.739	0.739
5% Critical	0.463	0.463	0.463	0.463	0.463	0.463
10% Critical	0.347	0.347	0.347	0.347	0.347	0.347
Phillips–Perron test for unit root						
Z(rho)	-5.782	-3397.63	-7.826	-3407.317	0.164	-2874.447
Z(t)	-4.733	-50.561	-2.87	-50.364	0.138	-42.832
MacKinnon <i>p</i> -value	(0.0001)	(0.0000)	(0.0489)	(0.0000)	(0.9686)	(0.0000)
Zivot–Andrews unit root test with a break in intercept						
Minimum <i>t</i> -statistic	-4.154	-17.645	-3.981	-17.209	-4.124	-13.672
1% Critical	-5.43	-5.43	-5.43	-5.43	-5.43	-5.43
5% Critical	-4.80	-4.80	-4.80	-4.80	-4.80	-4.80
Zivot–Andrews unit root test with a break both in intercept and trend						
Minimum <i>t</i> -statistic	-3.280	-17.651	-3.321	-17.212	-3.295	-14.060
1% Critical	-5.43	-5.43	-5.43	-5.43	-5.43	-5.43
5% Critical	-4.80	-4.80	-4.80	-4.80	-4.80	-4.80

Source: Own.

this result. Therefore, inference on the existence of the unit root using the test by Zivot and Andrews (1992) with a structural break in the level plus breaks in both the level and trend followed. The Zivot–Andrews test for first-differentiated series of interest rates with the break of the constant indicates that this series is non-stationary, and the structural break took place in February of 2003. It seems that the  $t$ -statistic reaches a minimum at the precise moment that Romania successfully ends the disinflation process. This test result is similar to the previous test results; therefore, this indicates a lack of stationarity and the first level of integration of the stochastic process guiding the ROBOR.

The next step was to develop an unrestricted VAR model to determine the optimal number of lags using information criteria. The Schwarz-Bayes Information Criterion (SIC) has demonstrated the optimal number of lags to be five. Moreover, the lag exclusion testing provided the result that all of the lags are significantly different from zero. Thereafter, a Granger Block Exogeneity Test was run, and it was determined that the hypothesized relationship has the following as a unidirectional property: the ROBOR is endogenous, while EURIBOR is exogenous.

Subsequently, the Johansen Cointegration Test was performed in its three versions: choosing rank based on trace statistic, the maximum eigenvalue, and the minimization of an information criterion. All three methods are based on the Johansen's maximum likelihood estimator of the parameters of a cointegrating Vector Error Correction Mechanism (VECM), with different cointegrating equation assumptions and data trend specifications. During verification, the economic–theoretical meaning of each type of assumption was taken into account, which relates to the five hypotheses given earlier. A positive constant in the cointegrating equation relates to a positive risk premium in the Romania over international rates. The trend term relates to the expectations of Romania's participation in the EMU that should be visible in long-run interest rate convergence. This should be observable in the long-run fall of the interest rate risk premium in Romania (as argued in Goczek & Mycielska, 2014). These results in various specifications are summarized in Table 2.

In all analysed cases, except for the assumption of a linear trend in the data, intercept and trend in the cointegrating equation, the selected number of cointegrating equations was equal to one. As in the lag-length selection problem, choosing the specification of the cointegration equation that minimizes either the SIC or the Akaike information criterion (AIC) provides a consistent estimator of the steady-state equilibrium. Of the two criteria, SIC was the preferred measure; however, this suggests two models. Therefore, the AIC allows choosing the first assumption with no intercept and no trend in the Cointegrating Equation. Judging from the results in Table 2, it can be concluded that there exists a single long-run cointegrating relationship, and furthermore, it was determined that there is neither an intercept in the cointegrating equation nor a trend term.

Table 3 presents the results of the Johansen tests in the selected version. The results are highly statistically significant. This evidence is overwhelmingly in favour of a steady-state relationship between the ROBOR and EURIBOR. The obtained P-value for the hypothesis that there is no cointegration is at most 0.0001. This test outcome is very conclusive, and it is unlikely that any size distortions in the trace test could have sufficiently affected the test to bias this particular outcome. At this point, it can be argued that there exists a long-run steady-state relationship between the interest rates in Romania and the Eurozone, and thus, the monetary policy in Romania is not independent. This confirms the first hypothesis of the article.

Based on the above results, a VECM model was constructed to analyse the exact level of dependence of Romanian interest rates on the international rates. As indicated by the AIC value in Table 2, the VECM was specified without an intercept in VAR and no deterministic components in the cointegrating equation<sup>4</sup>. Then, the AR roots of the characteristic polynomial indicated that the VECM model was stable. The overall adjustment speed indicated by the estimated ECM coefficient is significant and of the correct negative sign; therefore, the system returns (corrects) to the steady-state equilibrium.

Table 2. Selected number of cointegrating relations by model.

Data trend	None	None	Linear	Linear	Quadratic
Test type	No intercept No trend	Intercept No trend	Intercept No trend	Intercept Trend	Intercept Trend
Trace	1	1	1	0	1
Max-Eig	1	1	1	1	1
Information criteria by rank and model					
Data trend	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No intercept No trend	Intercept No trend	Intercept No trend	Intercept Trend	Intercept Trend
Log likelihood by rank (rows) and model (columns)					
0	11233.88	11233.88	11235.67	11235.67	11236.85
1	11243.09	11243.70	11243.81	11245.65	11246.01
2	11243.39	11244.12	11244.12	11247.84	11247.84
AIC by rank (rows) and model (columns)					
0	-6.928564	-6.928564	-6.928437	-6.928437	-6.927926
1	-6.931780*	-6.931543	-6.930990	-6.931508	-6.931112
2	-6.929498	-6.928709	-6.928709	-6.929774	-6.929774
Schwarz-Bayes criteria by rank (rows) and model (columns)					
0	-6.890984*	-6.890984*	-6.887098	-6.887098	-6.882829
1	-6.886684	-6.884567	-6.882136	-6.880774	-6.878500
2	-6.876885	-6.872338	-6.872338	-6.869646	-6.869646

Source: Own.

Table 3. Unrestricted cointegration test for no intercept CE specification for the pair Robor, Euribor.

Data		Original			Detrended		
Hypothesized	Trace	0.05		Trace	0.05		
No. of CE(s)	Statistic	Critical value	Prob.	Statistic	Critical value	Prob.	
None	35.34582	12.32090	0.0000*	33.62499	20.26184	0.0000*	
At most 1	0.803325	4.129906	0.4265	0.533600	9.164546	0.5276	
	Max-Eigen	0.05		Max-Eigen	0.05		
	Statistic	Critical Value	Prob.	Statistic	Critical Value	Prob.	
None	34.54249	11.22480	0.0000*	33.09139	11.22480	0.0000*	
At most 1	0.803325	4.129906	0.4265	0.533600	4.129906	0.5276	

Source: Own

\*Rejection of the hypothesis at the 0.05 level.

The estimated coefficient on EURIBOR suggests that the increase of this variable by one percentage point causes an increase in ROBOR by 2.65 percentage points. The obtained coefficient is quite large in economic terms, allowing to argue a significant overreaction to the changes in EMU interest rates. This behaviour can be explained either by the NBR's fear of volatile inflation expectations in the region that suffered from inflation in the 1990s or by behavioural monetary policy considerations that are common to small open economies, especially in the emerging economies realm.

Taking into account the successful disinflation policy in Romania, this result was investigated further in the detrended model. The detrended model indicated a coefficient that is not significantly different from unity, which suggests that Romania does not enjoy an independent monetary policy versus the ECB in the long run. The value of a one-to-one transmission lies within the confidence interval for daily data, and this gives no grounds to reject the null hypothesis of a full transmission.

The comparison between the two models gives very interesting results. It seems that this overreaction effect allows speaking about disinflation as the need to have a significant overreaction in managing interest rates in response to the external monetary policy change, while the more general relationship is still a one-to-one transmission (Table 4).

The obtained results were tested for their robustness. The potential critiques may concern the choice of the study period and the related problem of ignoring the exchange rate and its variations. The analysed sample starts during a time when the process of approaching the inflation-targeting framework had just begun in the CEE countries; however, the official move to the inflation-targeting framework in Romania took place only in 2005. This problem is illustrated with the

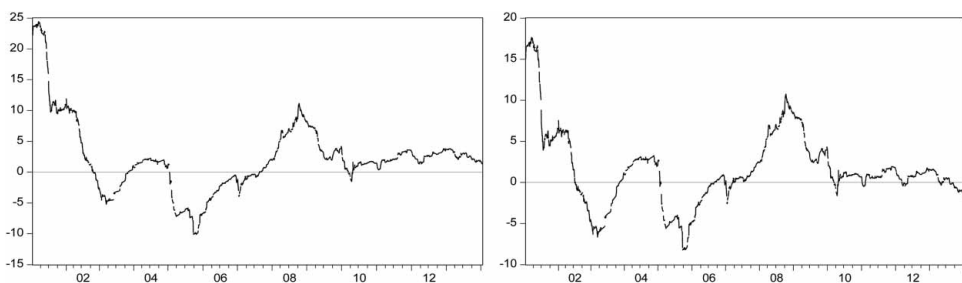


Figure 4. Cointegration graphs for original (left) and detrended data (right).

Source: Own.

Table 4. Full sample VECM results.

Data	Original		Detrended	
$\beta_3$ (EURIBOR)	2.654228 (0.60556) [4.38308]		1.006093 (0.46857) [2.14715]	
Error correction	$\alpha_1$	$\alpha_2$	$\alpha_1$	$\alpha_2$
	D(ROBOR)	D(EURIBOR)	D(ROBOR)	D(EURIBOR)
	-0.001425 (0.00027) [-5.33140]	-6.37E-05 (2.5E-05) [-2.54388]	-0.001222 (0.00041) [-2.99552]	-0.000140 (3.8E-05) [-3.63810]

Note: Standard errors in (), z-statistics in [ ].  
Source: Own.

figure relating to the residuals from the cointegrating relationship (Figure 4); in the initial period, the postulated relationship was only emerging. It could be that the adjustment to the shock in Eurozone interest rate was absorbed also by an adjustment on the side of the exchange rate (Goczek & Mycielska, 2016). It can therefore be presumed that the inclusion of 2001–2004 period could potentially influence the results. To test the robustness of the results to the choice of the study period, the same methodology was applied to the 2005–2014 period and the obtained Johansen test results clearly indicated cointegration showing a lack of monetary policy in Romania in each case considered. Table 5 summarizes the VECM model estimated analogously only to obtain very similar results. Again, there is a significant overreaction of the Romanian Central Bank to changes in Euribor in the original data. It can be seen that the hypothesis of a one-to-one transmission of the Eurozone interest rates in the detrended data is within the confidence band and therefore cannot be rejected. Similar investigation has been carried out using a structural break variable for the full period obtaining similar results.

Pursuing the methodology of the surveyed empirical studies of monetary policy independence, the Romanian study included only interest rates. In contrast, one could point to the fact that the international relationship between the interest rate corresponds to the theory of Uncovered Interest rate Parity (UIP) shown in Equation (1). Therefore, the analysis of the relationship between interest rates of two countries should take into account changes in the nominal exchange rate. As Juselius (2007) explains, each existing cointegration vector relates to a long-run relationship that will be preserved in the general specifications of the model (*sectoral specific-to-general property*). However, in order to take account of the policy changes, a similar investigation using

Table 5. VECM results for the period 2005–2014.

Data	Original		Detrended	
$\beta_3$ (EURIBOR)	-2.074013 (0.43358) [-4.78351]		-1.353993 (0.39681) [-3.41216]	
Error correction	$\alpha_1$	$\alpha_2$	$\alpha_1$	$\alpha_2$
	D(ROBOR)	D(EURIBOR)	D(ROBOR)	D(EURIBOR)
	-0.005245 (0.00104) [-5.05341]	-0.000181 (7.4E-05) [-2.45835]	-0.003945 (0.00105) [-3.75781]	-0.000319 (7.9E-05) [-4.05157]

Note: Standard errors in (), z-statistics in [ ].  
Source: Own.

Table 6. UIP VECM results.

Data	Original			Detrended		
Cointegrating eq.	ROBOR	EURRON	ROBOR	EURRON	ROBOR	EURRON
$\beta_3$ (EURIBOR)	1.319778 (0.23580) [-5.59713]	0.016808 (0.00134) [12.5072]	1.422236 (0.70135) [2.02785]	0.017611 (0.00201) [8.74490]		
Error Correction	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_1$	$\alpha_2$	$\alpha_3$
	D(ROBOR)	D(EURRON)	D(EURIBOR)	D(ROBOR)	D(EURRON)	D(EURIBOR)
ROBOR	-0.006599 (0.00119) [-5.56046]	2.46E-05 (1.5E-05) [1.67949]	-0.000306 (8.5E-05) [-3.61701]	-0.004231 (0.00125) [-3.37659]	-2.62E-05 (1.6E-05) [-1.62200]	-9.73E-05 (9.4E-05) [-1.03221]
EURRON	-1.142597 (0.21025) [-5.43456]	0.000985 (0.00260) [0.37929]	0.057836 (0.01499) [3.85765]	-1.548150 (0.35681) [-4.33888]	-0.005930 (0.00460) [-1.28952]	0.027195 (0.02684) [1.01313]

Note: Standard errors in (), z-statistics in [ ].

Source: Own.

the same approach has already been carried out this time with the addition of the EUR/RON exchange rate in the shortened sample. The obtained Johansen Cointegration Tests pointed to the fact that UIP does not hold as a single long-run relationship. Rather the two cointegrating relations relate to the two channels of incorporating an international interest rate shock. One is the transmission onto the Robor rate; the second is the traditional exchange rate channel. However, these relations were not equally significant. As it can be seen in the Table 6 summarizing the results, the adjustment to the latter (exchange rate) equation was not significant in either of the two models. Only the adjustment of Robor to Euribor is significant in both cases, again showing no monetary policy independence on the part of the Romanian Central Bank – a result similar to the surveyed cases of the Czech Republic and Poland in Goczek and Mycielska (2014, in press), and supporting the results by Hsing (2013).<sup>5</sup>

Based on the above results, it can be concluded that the empirical verification has brought the following results:

- (1) There exists a long-run steady-state relationship between the interest rates in Romania and the EMU.
- (2) There is no constant risk premium for investing in Romania.
- (3) The risk premium for investing in Romania does not diminish in a steady state.
- (4) The degree of monetary independence in Romania is low, and the Robor adjusts to the changes in interest rates in the Eurozone for a given disequilibrium to the steady state.
- (5) The hypothesis of a one-to-one relationship between interest rates between Romania and the Eurozone cannot be rejected, despite rapid disinflation at the beginning of the sample.

## 5. Conclusions

This article has examined the independence of Romanian monetary policy to changes in the Eurozone interest rates. Based on the results obtained through VECM models, it seems that interest rates in Romania despite the floating exchange rate regime are sensitive to changes in the euro area interest rates. The results therefore indicate the importance of European financial integration and the existence of interest rate comovement and foreign interest rates transmission effects even for the countries outside the formal structures of the Eurozone. The results are broadly consistent

with expectations and provide additional and useful information about the monetary policy interdependence of monetary policy between countries, though these results are not in line with the dominant Mundell–Fleming paradigm. The economic explanation for the differences between original and detrended data during disinflation in Romania and the confirmation of the lack of monetary policy independence hypothesis with a significant overreaction show that the small open economies' central banks could be forced to overreact to the developments in the dominant international interbank markets during disinflation period possibly because their small economies are more prone to balance sheet effects caused by changes in interest rates in the dominant monetary policy centre than larger economies.

The exposition in the article is not meant to criticize the monetary policy conducted by NBR because it does not argue that this policy was not optimal in the period studied. These results could be a sign of the positive fact that the increasing financial integration and real convergence of Romania and the Eurozone require similar responses on the part of the NBR as from the ECB and point to the observation that the removal of the disinflationary trend generally shows a very similar monetary policy of the two banks. Therefore, the article merely notes the need to reassess the potential long-run costs of joining the EMU without an *a priori* approach to monetary policy independence. It could be thus argued that small open economies such as Romania, fully integrated financially with the EMU, do not lose monetary independence upon joining a common currency area, as they do not enjoy it in the first place.

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### Notes

1. An alternative to this approach would be to use the reference rates of the relevant central banks. These variables, however, change very infrequently and exhibit low variance.
2. To take account of the one week long peak in the October 2008 when the Robor doubled and went back to the previous value an average of the three-month Robid and Robid was calculated.
3. The applied unit root tests specification relates to the model with and intercept and no trend with the exception of the Zivot–Andrews unit root test shown separately for intercept and both trend and intercept.
4. An alternative would be to use Bayesian Averaging Method as in Próchniak and Witkowski (2014).
5. Using different methodology.

### Notes on Contributor

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