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A study of the impossible trinity in Romania

Bogdan BĂDESCU
Bucharest University of Economic Studies, Romania
bogdanbadescu82@yahoo.ro

Abstract. *Using a VECM and a Taylor type rule it was shown that the central bank kept the autonomy of the monetary policy as the policy rate was modeled primarily based on the evolution of the inflation rate. Forgoing the exchange rate stability is not possible due to the large volume of foreign currency loans and also to other factors. The inclusion in the central bank's objective function of a variable linked to the exchange rate may cause a conflict between inflation targeting and exchange rate management. Therefore, the best approach seems to be the use, in addition to the policy rate instrument, also of FX interventions. As for the liberalization of capital flows, the decision is at least questionable, given that, on one hand, foreign capital ended up holding a significant share in the economic activity and on the other, the macroprudential measures that authorities began to implement might have limited effects.*

Keywords: trilemma, monetary policy, exchange rate, policy rate, capital flows, Taylor rule.

JEL Classification: C12, E52, E58.

Introduction

The management of the national economy in a time of crisis is a difficult task, especially today when economies are interconnected. Empirically, it can be seen a noticeable development in the degree of financial integration as the dominant perception was that opening an economy to capital flows is the sure way to prosperity. Thus, two of the variables of the international financial system evolved as shown in the table below:

Table 1. *The evolution of exchange rate regimes and capital mobility*

The exchange rate regime	Gold Standard	Bretton Woods	Hybrid: Fixed and Flexible	Flexible
Capital flows	Free	Regulated	Regulated, but in a lesser degree	Free

As controls on capital mobility became more relaxed, practice has shown that one of the consequences was the emergence of conflicts between the fixed/stable exchange rates and monetary policy autonomy, so today exists the following constraint:

- maintaining the autonomy of monetary policy involves forgoing either the free capital flows or the exchange rate stability;
- maintaining exchange rate stability involves forgoing either the free capital flows or the autonomy of monetary policy;
- allowing free capital flows involves forgoing either the autonomy of monetary policy or the exchange rate stability.

This state of affairs became known as *the impossible trinity (or the trilemma)*.

1. The impossible trinity in Romania

Romania also faces this trilemma. According to the obligations accepted upon joining the European Union (EU), the country is obliged to allow free capital flows. In addition, the significant amount of liabilities denominated in EUR implies that the RON/EUR exchange rate needs to be stable. Finally, the objective of the central bank i.e. to ensure and maintain price stability requires the existence of an autonomous monetary policy. Since the free capital flows cannot be restricted, it should be made a choice between the autonomy of the monetary policy and exchange rate stability. In order to see what each choice implies, we will analyze each component of the trilemma.

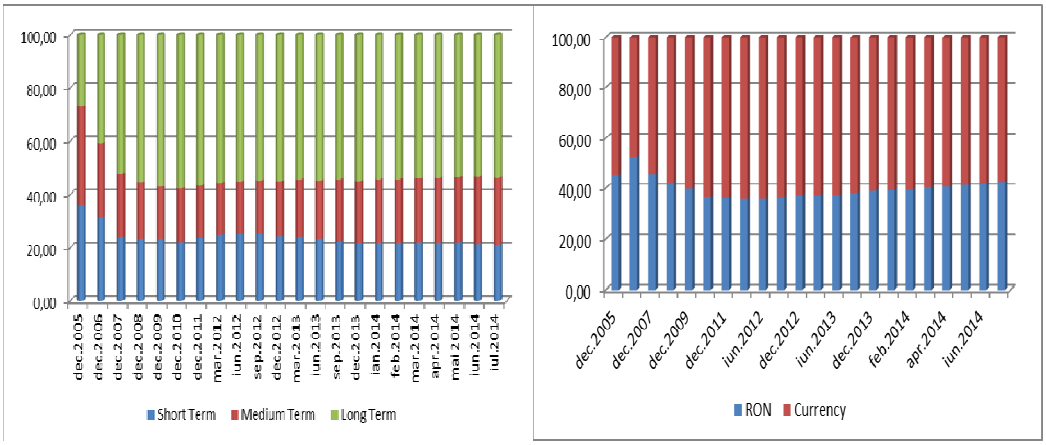
1.1. The exchange rate stability

The exchange rate raises the problem of determining when it deviates from the equilibrium value and what to do in that case. If the exchange rate is undervalued, then no interventions are required, because the capital inflows will assure the return to the equilibrium level. Moreover, Gala (2008, cited in Gabor 2010: p.13) shows that undervalued currencies allow investment-led growth models, which lead to the development of trade with the external sector. The typical examples in this respect are the countries from East Asia and, in particular, China. In the other case, however, an

overvaluation requires action. After Demir (2009: pp. 672-692), overvalued currencies can support growth episodes based on consumption and increased current account deficits, which will be financed through short-term debt. Gabor (2010: p. 14) shows that short-term foreign loans in Eastern Europe highlight the dangerous link between an overvalued exchange rate and credit booms.

No doubt that in an emerging economy like that of Romania, the exchange rate plays a more important role than in advanced economies, because of the mismatch between the currency denomination of a significant amount of debt and the incomes of the borrowers. This reality does not allow the central bank to ignore exchange rate movements. In particular, it presents interest the banking sector in Romania, and, according to the Financial Stability Report published by the National Bank of Romania, the credit structure is as shown in the charts below:

Figure 1. *Loans granted to the private sector by denomination and maturity*

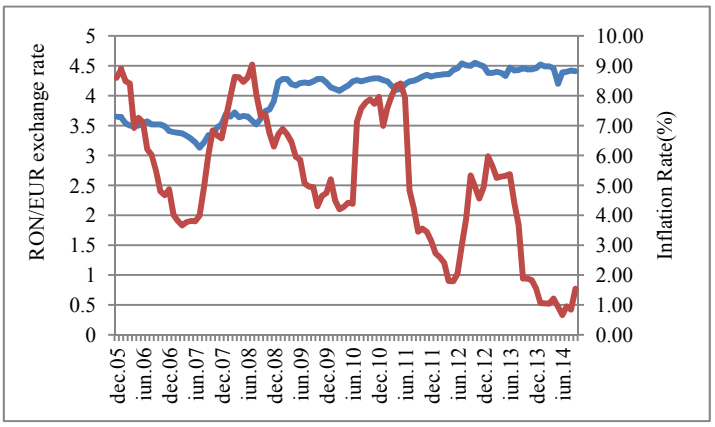


Source: NBR's Financial Stability Report data, 2014.

It can be seen that a significant share of these loans was given on medium or long term, so it becomes even clearer that ignoring the exchange rate movements cannot be an optimal approach, given the difficulties that borrowers would have with repaying the debt in the event of a depreciation. This observation is supported also by the fact that foreign currency lending was riskier than that in RON, as the NPL ratio of the loans denominated in foreign currency exceeded that of the loans denominated in RONs since August 2013 (23% versus 20.7% as of August 2014).

From the central bank's point of view, at least in the medium and long term, the consensus is that between exchange rate stability and inflation there is a correlation which involves a depreciation of the currency that registers a higher inflation as a result of the loss of purchasing power. In other words, exchange rate stability is also an anti-inflationary factor, as shown by the chart below:

Figure 2. *The evolution of the RON/EUR exchange rate and the inflation rate*



Source: NBR, author's calculations.

It can be seen that since late 2008, the exchange rate stability played an important role in anchoring the inflation expectations of the public, as the inflation rate registered a downward trend (excepting the shocks caused by measures such as the increase of the value added tax by 5%, from 19% to 24% in June 2010). In fact, this correlation is obvious, given that the Romanian economy is open, small and euroised.

The conclusion that these issues cannot be ignored by the central bank is supported also by Caraiani (2011: p. 36) who, after investigating several types of monetary rules that include a variable for the exchange rate, concluded on the basis of the estimated coefficients for that variable that the central bank has responded to its movements. The importance that the central bank attaches to the exchange rate can also be seen in the report drafted by the International Monetary Fund's experts at the completion of the first and second review missions of the standby agreement signed in 2013. The report states that "*the exchange rate remained largely stable, in part due to the central bank support for the currency*" and although "*the real exchange rate remains broadly in line with fundamentals ... the NBR should allow the exchange rate to adjust with market conditions and limit interventions in the support of the RON"* (2014: p. 7 and p. 15).

2.2. The free capital flows

The idea of free capital flows derived from the finding that the liberalization of the international trade was beneficial for the general welfare, so it was thought that a similar approach to capital movements will bring the same results. Estimations were that foreign capital will enter a country until profitable investment opportunities are exhausted so that there can be no excessive capital inflows or outflows. These potential benefits of the free capital flows became a pillar of the international politics since the 1980s, but the practical experience of developing countries raised more and more questions. The literature contains many studies regarding their effects and a summary is made by the International Monetary Fund. Thus, according to some, the free capital flows bring benefits (Edwards, 2001; Arteta, Eichengreen and Wyplosz, 2001 quoted by IMF, 2010: p.8) and it seems

that the economies more developed financially and institutionally benefit more than others, while others show that free capital flows do not lead to a stronger economic growth (Rodrik, 1998 quoted by IMF, 2010: p.8), while Prasad, Rajan and Subramaniam (2007 quoted by IMF, 2010: p.8) believe that countries which avoid foreign capital can enjoy a growth premium. Since 2010, even the IMF has begun to accept the need of certain tools and/or institutional mechanisms to manage the volatility of capital flows. Such tools are macroprudential measures and capital controls. Ostry et al. (2010: p. 15) consider that if prudential measures are not sufficient, then capital controls can be used to reduce the risks associated with their volatility. Nier et al. (2015) show that emerging economies have less means to control capital flows, so it would be more appropriate to implement prudential measures that improve the resilience of national financial systems.

Romania has committed to liberalize capital flows in accordance with those stipulated in Article 56 of the Treaty establishing the European Community, which prohibits any restriction on the movement of capital between Member States and between Member States and third countries. Consequently, in this regard there is no room for maneuver, so the analysis will be limited to a brief discussion of their effects.

In Romania, capital inflows were driven by the existing opportunities to purchase assets in the Romanian economy, the interest differential between local and home interest rates and the existence of an excess of liquidity in advanced economies.

The crisis has shown that these capitals are volatile, which questions how useful they can be to ensure the so-called sustainable growth, given that their purpose is to make profit and not necessarily to help the economy. Thus, after five years of net capital inflows, in 2009 they reduced significantly (outflows totaling EUR 8.8 billion), which forced the authorities to enter into a financing agreement with the IMF, EU and the WB. Capital inflows resumed in 2010 (up to EUR 2.3 billion), in 2013 totaled EUR 2.6 billion and in the first seven months of 2014 amounted to EUR 1.3 billion.

It is also important to see what role has the Romanian capital in generating economic activity. For instance, in the banking sector, which is the main source of financing the economy, foreign banks held constantly over 85% of banking assets between 2007 and 2013. As of end July 2014, this share fell to 81%. According to some data released on September 4, foreign investors have a vital position in determining the specialization trends in the Romanian economy, given that more than 72% of the turnover of large and very large companies in the industry is produced by the subsidiaries of multinationals. Moreover, out of the 100 largest exporters, which provide over 52% of total exports, 96 are foreign-owned companies and from the total 34 sub-branches of industry, 25 leading companies are with foreign capital. Under this conditions, Romania ended up being very dependent in many respects of the European markets (2/3 of economic flows, financial sector controlled by groups in the EU, etc.), making the industrial and economic activity subject to decisions "*which frequently are not taken here*" (Dăianu, 2014: p. 29). In terms of how the profits are divided between labor and capital, the remuneration of the employees accounts for only 37.1% of the gross value added at national level, being the

lowest percentage in the European Union, where the average is placed at 53.6% (Chirca, 2014).

Given these figures, the question is whether the acceptance of free capital flows was the right decision, as, after some authors, there is no reason for emerging economies to allow such freedom, opinion with which I tend to agree.

2.3. The autonomy of monetary policy

The autonomy of monetary policy will be judged based on how the central bank adjusted the policy rate to respond to inflation. To investigate how the central bank modeled the policy rate, the following data is used: NBR's policy rate, inflation deviation from the target, calculated as the difference between registered and targeted inflation and the economic sentiment indicator (ESI) as a measure of the deviation of GDP from its natural level. Using ESI as a benchmark for economic activity is supported by the correlation coefficient between ESI and GDP (quarterly averages), which has the value of 0.6 (Appendix 1). In short, the ESI is a combination of five indicators that measure the confidence of producers and consumers from five economic sectors: industry (40% weighting), services (30%), consumers (20%), construction (5%) and retail trade (5%). These weights are based on two criteria, namely the "representativeness" of the industry and the correlation with the reference variable, in this case GDP.

A Taylor-type relationship will be used:

$$i_t = \gamma + \rho \, x \, i_{t-1} + \alpha \, x \, (\pi_t - \pi^*) + \beta \, x \, (y_t - y^*) \quad (1)$$

where i_t is the interest rate in period t, ρ is the autoregressive coefficient, πt is the inflation rate, π^* is the desired rate of inflation, and ($yt - y^*$) is the GDP gap.

The key policy parameters α and β are both assumed to be greater than zero. They indicate how much the central bank allows the policy rate to respond to fluctuations in inflation and output. The larger the value of α, the more responsive the central bank is to the deviation of inflation from its target; the larger the value of β, the more responsive the central bank is to the deviation of GDP from its natural level. Traditionally, the focus is on inflation and for a change of 1% of its level the central bank should adjust the policy rate by α%. Thus, if inflation rises over the target or GDP over its natural level, which can be seen as an overheating of the economy, the policy rate increases. In the opposite situation, the policy rate decreases. The autoregressive coefficient ρ is calibrated at the value of 0.9. Thus, the analysis highlights the estimation coefficients for the ESI and inflation deviations and controls for a certain degree of persistence in the policy rate.

Two equations will be monitored:

$$Policy\_rate = 0.9 \, x \, Policy\_rate \, (-1) + \gamma + \alpha \, x \, Dev\_Infl \quad (2)$$

$$Policy\_rate = 0.9 \, x \, Policy\_rate \, (-1) + \gamma + \alpha \, x \, Dev\_Infl + \beta \, x \, Gap\_ESI \quad (3)$$

By moving the term *0.9 x Policy_rate (-1)* to the left side of the equations and using the Eviews software we obtain:

Figure 3. *Results for equations (2) and (3)*

Dependent Variable: POLICY_RATE-0.9*POLICY_RATE(-1)
Method: Least Squares
Date: 06/05/15 Time: 13:56
Sample (adjusted): 2006M01 2014M12
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEV_INFL	0.096387	0.013723	7.023668	0.0000
C	0.483877	0.035412	13.66440	0.0000

R-squared	0.317590	Mean dependent var	0.638194
Adjusted R-squared	0.311152	S.D. dependent var	0.347734
S.E. of regression	0.288608	Akaike info criterion	0.370853
Sum squared resid	8.829253	Schwarz criterion	0.420522
Log likelihood	-18.02608	Hannan-Quinn criter.	0.390992
F-statistic	49.33191	Durbin-Watson stat	1.188619
Prob(F-statistic)	0.000000		

Dependent Variable: POLICY_RATE-0.9*POLICY_RATE(-1)
Method: Least Squares
Date: 06/05/15 Time: 13:58
Sample (adjusted): 2007M01 2014M12
Included observations: 96 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEV_INFL	0.102527	0.012669	8.092760	0.0000
GAP_ESI	0.008926	0.003005	2.970761	0.0038
C	0.470033	0.034701	13.54541	0.0000

R-squared	0.434576	Mean dependent var	0.600812
Adjusted R-squared	0.422416	S.D. dependent var	0.339964
S.E. of regression	0.258369	Akaike info criterion	0.161898
Sum squared resid	6.208190	Schwarz criterion	0.242034
Log likelihood	-4.771118	Hannan-Quinn criter.	0.194291
F-statistic	35.73916	Durbin-Watson stat	1.442838
Prob(F-statistic)	0.000000		

For both equations the estimated coefficients have a positive sign and are significant at 1% level (t-test) and the null hypotheses of the coefficients are rejected (p-value less than 5%). Regarding the validation of the regression models, in both cases the probability associated with the F-test shows that the models adjust well the sample data. Since the coefficient of determination R^2 is higher in the second case (43% vs. 31%), we will check whether the second model used is valid by testing the errors' correlation, their heteroskedasticity and if they are normally distributed. The value of the determination coefficient is affected by the period under review, which includes both economic growth and recession and can be considered as a sign that the central bank also included in the objective function other variables than inflation deviation and GDP gap.

The errors' correlation was tested using a Breusch-Godffrey test and the p-value is less than 5%, indicating that it cannot be eliminated the hypothesis that correlation exists. The heteroskedasticity test calculates a p-value of 5.07%, which means that it can be accepted that the errors are not heteroskedastic. As for checking if the errors are normally distributed, a Jarque-Bera test was used and the result shows that this hypothesis can be rejected, as p value is less than 5%.

Figure 4. *Error correlation tests' results for equation (3)*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	973.2861	Prob. F(2,104)	0.0000
Obs*R-squared	102.5225	Prob. Chi-Square(2)	0.0000

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	3.079133	Prob. F(2,93)	0.0507
Obs*R-squared	5.962121	Prob. Chi-Square(2)	0.0507
Scaled explained SS	12.22120	Prob. Chi-Square(2)	0.0022

Jarque-Bera	25.86203
Probability	0.000002

These results imply the use of a more complex model, which makes use of the long-term relationship between the variables. In this respect, it was tested whether the relationship between the variables can be highlighted with a vector error correction model (VECM). For this, it was tested the stationarity of the series and if relations of cointegration are present. The assessment of the series' stationarity was based on the search for the presence of unit roots. In this respect, it was used an Augmented Dickey-Fuller test, which is based on a regression equation which includes a constant (intercept). Associated p-values (0.8353, 0.3117 and 0.2399) show that the hypothesis of a unit root existing

cannot be excluded for any series, so we can say that these series are non-stationary. The cointegration was tested using the Johansen test. Results show that the lack of cointegration hypothesis can be rejected on the basis of p-value (0.1% and 0.28%) which are both less than 5%. The results are presented in Appendix 2.

The presence of cointegration and the non-stationary nature of the series allow the use of a VECM. Using this model is justified because it will generate for the cointegrated variables series that will evolve together. Otherwise, the series will evolve independently, each according to its stochastic trend and, therefore, inconsistent with historical data. According to the estimation (Appendix 3), the relationship between the policy rate and the other variables is:

D(Policy_rate) = C(1) x (Policy_rate (-1) - 2.18305209268 x Dev_Infl(-1) - 0.313023976688 x Gap_ESI(-1) - 4.20276989541) + C(2) x D(Policy_rate (-1)) + C(3) x D(Policy_rate(-2)) + C(4) x D(Dev_Infl (-1)) + C(5) x D(Dev_Infl (-2)) + C(6) x D(Gap_ESI(-1)) + C(7) x D(Gap_ESI(-2)) + C(8). (4)

According to the VECM design, the equation has two components: the cointegration relation:

*C(1) x (Policy_rate(-1) - **2.18305209268 x** Dev_Infl(-1) - **0.313023976688** x Gap_ESI(-1) - 4.20276989541)*

and the modelling of the dependant variable according to its historical values and the evolution of the other variables: *C(2) x D(Policy_rate (-1)) +*

C(3) x D(Policy_rate (-2)) +
C(4) x D(Dev_Infl (-1)) +
C(5) x D(Dev_Infl (-2)) +
C(6) x D(Gap_ESI(-1)) +
C(7) x D(Gap_ESI(-2)) +
C(8).

Based on this design, the unit roots are eliminated and the VECM has integrated some persistence, which allows the discarding of the autoregressive coefficient.

The analysis reveals that the coefficient C(1) is significant (p-value below 5%) and negative, which indicates the presence of long-term correlation and that the two variables influence the dependent variable (Appendix 4). The Breusch-Godffrey test shows that the hypothesis of error correlation can be eliminated (p-value above 5%). Also the heteroskedasticity test calculates a p-value of 13.93%, which means that the errors are not heteroskedastic (see Figure 5).

Figure 5. *Error correlation tests' results for equation (4)*

Breusch-Godfrey Serial Correlation LM Test:

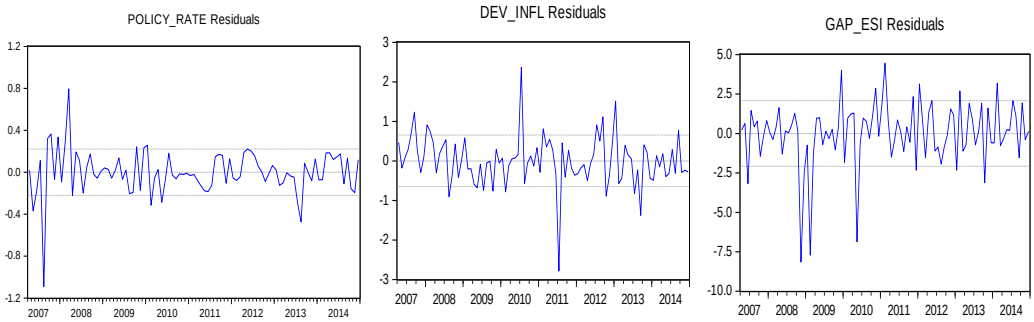
F-statistic	1.030663	Prob. F(2,83)	0.3613
Obs*R-squared	2.253708	Prob. Chi-Square(2)	0.3241

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.572579	Prob. F(9,83)	0.1370
Obs*R-squared	13.54818	Prob. Chi-Square(9)	0.1393
Scaled explained SS	54.47581	Prob. Chi-Square(9)	0.0000

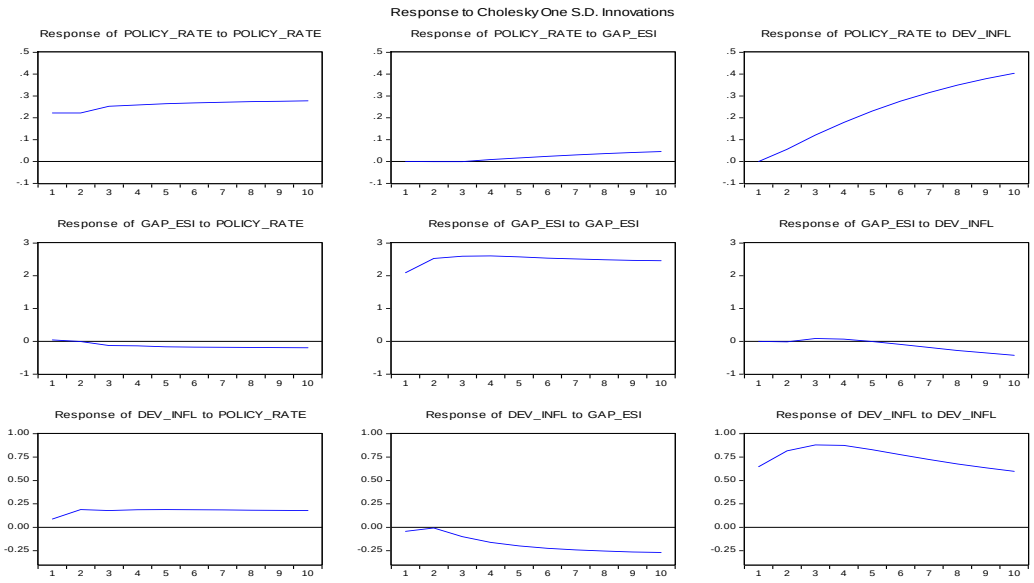
The visual inspection of the errors shows no signs of autocorrelation. With certain isolated exceptions, the lack of errors' autocorrelation is confirmed by the autocorrelation functions, i.e. by maintaining the estimated values within the confidence intervals of +/- 5% (Appendix 5).

Figure 6. *VECM equations' residuals*



The consistency of the relationship between the policy rate and the two explanatory variables is confirmed by the impulse response functions (positive sign, see Figure 7). The magnitude of the estimated response to the inflation deviation from the target is superior to the one corresponding to the proxy variable used for the economic activity (ESI), which shows that central bank's monetary policy was in line with its fundamental objective.

Figure 7. *The impulse response functions of the VECM*



3. Conclusions

The impossible trinity remains an actual issue. In the case of Romania, given that allowing free capital flows is a commitment assumed with the accession to the EU, the trilemma comes down to deciding what is discarded: the autonomy of monetary policy or the exchange rate stability. Research has shown that the central bank kept the autonomy of the monetary policy as the policy rate was modelled primarily based on the evolution of the inflation rate. Forgoing the exchange rate stability is not possible due to the large volume of foreign currency loans and also to other factors. Consequently, the central bank tried to achieve both goals most likely by including in its objective function a variable for the exchange rate. Such an approach may cause a conflict between inflation targeting and exchange rate management. If the central bank decreases the policy rate to counter deflationary pressures, the consequence is that this may depreciate the local currency, inducing the risks described in chapter 2.1. Further, these risks may not allow the central bank to cut the policy rate to the desired level, limiting the central bank's reaction. In contrast, if the cut of the policy rate is accompanied by a direct intervention on the exchange rate, then the former can be properly set. Therefore, an interim conclusion that can be drawn is that the best approach would be to use, in addition to policy rate instrument, foreign exchange interventions to increase the efficiency of the response to exchange rate fluctuations. The data presented in this article supports such a finding.

Due to the liberalization of capital flows, foreign capital ended up playing a decisive role in the economy, judging by its share in industry and exports. One of the consequences of this matter was a low wage level compared to the EU average. This raises the question whether the acceptance without many questions of the recommendation of allowing free capital flows was the right choice. Moreover, according to some authors, there is no reason for emerging economies to allow such freedom, opinion with which I tend to agree.

Overall, in Romania's case, the central bank can't forgo the autonomy of monetary policy or the exchange rate stability, so it should use, besides the policy rate instrument, also instruments to support the currency. As for the liberalization of capital flows, the decision is at least questionable, given that, on one hand, foreign capital holds a significant share in the economic activity and thus has the important decisions and on the other, the macro-prudential measures that authorities began to implement might have limited effects.

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References

Aizenman, J., Hutchison, M. and Noy, I., 2011. Inflation targeting and real exchange rates in emerging markets. *World Development*. 39(5). pp. 712-24.

Caraiani, P., 2011. Comparing monetary policy rules in the Romanian economy: a new Keynesian approach. *Romanian Journal of Economic Forecasting.* 14(4). pp. 30-46.

Chirca, C., 2014. Quoted by Mediafax. Available online at: http://www.mediafax.ro/economic/conferinta-mediafax-chirca-bnr-remunerarea-salariatilor-din-romania-are-cea-mai-mica-pondere-in-pib-din-tarile-ue-13701742

Daianu, D., 2014. Îndatorare şi creştere economică: ce se întâmplă cu finanţarea?. Available online at: http://www.bnro.ro/PublicationDocuments.aspx?icid=6885

Demir, F., 2009. Volatility of short-term capital flows and private investment in emerging markets. *Journal of Development Studies.* 45(5). pp. 672-692.

Gabor, D., 2010. Paradigm shift? A critique of the IMF's new approach to capital controls*.* Available online at: http://carecon.org.uk/DPs/1109.pdf

Gala, P., 2008. Real exchange rate levels and economic development: theoretical analysis and econometric evidence. *Cambridge Journal of Economics.* 32(2). pp. 273-288.

Klein, M. and Shambaugh, J., 2013. Rounding the corners of the policy trilemma: sources of monetary policy autonomy. *NBER Working Paper.* 19461. Available online at: http://www.nber. org/papers/w19461;

National Bank of Romania, 2009-2014. *Financial Stability Reports*. Available online at: http://www.bnr.ro/Publicatii-periodice-204.aspx.

Nier, E. and Seddik, S., 2015. *Determinants of capital flows to emerging markets and the global financial cycle*. Available online at: http://www.voxeu.org/article/capital-flows-emerging-markets-and-global-financial-cycle.

Ostry, J. Ghosh, A. and Chamon, M., 2010. Capital Inflows: The role of Controls. *IMF Staff Position Note*. Available online at: https://www.imf.org/external/pubs/ft/spn/2010/spn1004.pdf.

Economic Sentiment Indicator, 2007-2014. *EU database and Indicators Time Series*. Available online at: http://ec.europa.eu/economy_finance/db_indicators/surveys/time_series/index_en.htm.

International Monetary Fund, 2010. *The Fund's Role regarding cross-border capital flows.* Available online at: http://www.imf.org/external/np/pp/eng/2010/111510.pdf.

International Monetary Fund, 2014. *First and second reviews under the stand-by arrangement and requests for waiver of nonobservance of a performance criterion, modification of program conditionality, and rephasing of the availability dates of purchases; staff report; press release; and statement by the executive director for Romania*. Available online at: http://www.imf.org/external/pubs/ft/scr/2014/cr1487.pdf.

Mediafax, 2014. *România se va axa pe zece sectoare economice pentru a creşte competitivitatea până în 2020*. Available online at: http://www.mediafax.ro/economic/romania-se-va-axa-pe-zece-sectoare-economice-pentru-a-creste-competitivitatea-pana-in-2020-13211765.

Appendix 1

ESI & GDP correlation = 0.6 (using Excel)

Quarter	AVG ESI	Dev_ PIB
2007Q1	10,70	1,49
2007Q2	9,63	1,40
2007Q3	9,93	1,43
2007Q4	10,03	3,01
2008Q1	9,13	3,51
2008Q2	8,40	1,97
2008Q3	7,07	0,45
2008Q4	0,30	-1,54
2009Q1	-14,00	-6,13
2009Q2	-17,73	-0,81
2009Q3	-17,67	0,54
2009Q4	-16,40	-0,23
2010Q1	-13,03	-0,70
2010Q2	-14,73	0,26
2010Q3	-16,20	-0,94
2010Q4	-12,30	1,16
2011Q1	-5,77	0,24
2011Q2	-4,93	-0,19
2011Q3	-6,07	1,33
2011Q4	-7,27	-0,31
2012Q1	-4,57	-0,57
2012Q2	-2,37	1,62
2012Q3	-5,07	-0,96
2012Q4	-5,33	0,19
2013Q1	-4,97	1,28
2013Q2	-4,43	1,40
2013Q3	-3,47	0,92
2013Q4	-4,70	0,89
2014Q1	-3,33	0,73
2014Q2	-2,57	-0,37
2014Q3	0,13	1,76

Appendix 2

The Augmented Dickey-Fuller test results for *Policy_rate*, *Gap_ESI* and *Devl_Infl*

Null Hypothesis: POLICY_RATE has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.723611	0.8353
Test critical values:	1% level	-3.494378	
	5% level	-2.889474	
	10% level	-2.581741	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: GAP_ESI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.942504	0.3117
Test critical values:	1% level	-3.501445	
	5% level	-2.892536	
	10% level	-2.583371	

Null Hypothesis: DEV_INFL has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.113465	0.2399
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

The Johansen cointegration test results for *Policy_rate*, *Gap_ESI* and *Devl_Infl*

Date: 02/18/15 Time: 13:38
Sample (adjusted): 2007M03 2014M12
Included observations: 94 after adjustments
Trend assumption: Linear deterministic trend
Series: POLICY_RATE DEV_INFL GAP_ESI
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.268030	42.52037	29.79707	0.0010
At most 1	0.117385	13.19085	15.49471	0.1080
At most 2	0.015343	1.453404	3.841466	0.2280

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.268030	29.32952	21.13162	0.0028
At most 1	0.117385	11.73745	14.26460	0.1209
At most 2	0.015343	1.453404	3.841466	0.2280

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix 3

Vector Error Correction Estimates
Date: 02/27/15 Time: 11:46
Sample (adjusted): 2007M04 2014M12
Included observations: 93 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
POLICY_RATE(-1)	1.000000
GAP_ESI(-1)	**-0.313024**
	(0.10281)
	[-3.04466]
DEV_INFL(-1)	**-2.183052**
	(0.47744)
	[-4.57241]
C	-4.202770

Error Correction:	D(POLICY_RATE)	D(GAP_ESI)	D(DEV_INFL)
CointEq1	-0.026062	0.016514	0.027531
	(0.00692)	(0.06524)	(0.02042)
	[-3.76732]	[0.25313]	[1.34806]
D(POLICY_RATE(-1))	-0.007603	-0.253109	0.318280
	(0.10194)	(0.96131)	(0.30094)
	[-0.07458]	[-0.26330]	[1.05762]
D(POLICY_RATE(-2))	0.092444	-0.594739	-0.177246
	(0.10197)	(0.96162)	(0.30104)
	[0.90656]	[-0.61848]	[-0.58879]
D(GAP_ESI(-1))	-0.006709	0.214348	0.031581
	(0.01147)	(0.10815)	(0.03386)
	[-0.58499]	[1.98197]	[0.93280]
D(GAP_ESI(-2))	-0.008330	-0.003913	-0.044627
	(0.01156)	(0.10897)	(0.03411)
	[-0.72093]	[-0.03591]	[-1.30823]
D(DEV_INFL(-1))	0.029293	0.003842	0.320932
	(0.03605)	(0.33995)	(0.10642)
	[0.81259]	[0.01130]	[3.01566]
D(DEV_INFL(-2))	0.024840	0.234804	0.060739
	(0.03708)	(0.34964)	(0.10946)
	[0.66997]	[0.67156]	[0.55492]
C	-0.052987	-0.116695	-0.001196
	(0.02487)	(0.23457)	(0.07343)
	[-2.13019]	[-0.49749]	[-0.01629]
R-squared	0.318061	0.062076	0.152621
Adj. R-squared	0.261901	-0.015164	0.082836
Sum sq. resids	4.178669	371.5953	36.41722
S.E. equation	0.221722	2.090863	0.654552
F-statistic	5.663509	0.803673	2.187037
Log likelihood	12.30993	-196.3734	-88.36484
Akaike AIC	-0.092687	4.395126	2.072362
Schwarz SC	0.125171	4.612984	2.290220
Mean dependent	-0.057312	-0.089247	-0.014301
S.D. dependent	0.258079	2.075188	0.683472
Determinant resid covariance (dof adj.)		0.089927	
Determinant resid covariance		0.068659	
Log likelihood		-271.3288	
Akaike information criterion		6.415673	
Schwarz criterion		7.150944	

Appendix 4

Equation (3) coefficients

System: UNTITLED
Estimation Method: Least Squares
Date: 02/23/15 Time: 15:11
Sample: 2007M04 2014M12
Included observations: 93
Total system (balanced) observations 279

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	**-0.026062**	**0.006918**	**-3.767318**	**0.0002**
C(2)	-0.007603	0.101941	-0.074578	0.9406
C(3)	0.092444	0.101973	0.906558	0.3655
C(4)	-0.006709	0.011468	-0.584992	0.5591
C(5)	-0.008330	0.011555	-0.720930	0.4716
C(6)	0.029293	0.036049	0.812592	0.4172
C(7)	0.024840	0.037077	0.669967	0.5035
C(8)	-0.052987	0.024874	-2.130189	0.0341
Determinant residual covariance		0.068659		

Equation: D(POLICY_RATE) = C(1)*(POLICY_RATE(-1) - 0.313023976688*GAP_ESI(-1) -
- 2.18305209268*DEV_INFL(-1) - 4.20276989541) + C(2) *D(POLICY_RATE(-1)) + C(3)*D(POLICY_RATE(-2))
+ C(4)*D(GAP_ESI(-1)) + C(5)*D(GAP_ESI(-2)) + C(6)*D(DEV_INFL(-1)) + C(7)*D(DEV_INFL(-2)) + C(8)
Observations: 93

R-squared	0.318061	Mean dependent var	-0.057312
Adjusted R-squared	0.261901	S.D. dependent var	0.258079
S.E. of regression	0.221722	Sum squared resid	4.178669
Durbin-Watson stat	2.070184		

Appendix 5

Corellogram for equation (4)