Optimal Rules for Monetary Policy: The Case of Romania

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Abstract. In this paper we estimated the reaction function of the Central Bank of Romania during the last ten years. Using targeting rules of the type proposed by Clarida, Gali, Gertler (1998a, 1998b) we model the evolution of interest rate in this period. Using Generalized Method of Moments estimation we found out a strong relationship between interest rate, output-gap and inflation rate.

1. INTRODUCTION

Based on theory and practice, a monetary policy is a strategy, a plan used by the central bank to pursue a specific purpose to ensure the performance of its functions.

Another discussion starts from the fact that the monetary policy is considered applicable only in the short term, but we all know that the instruments of action should have positive effects in the short term without creating imbalances in the long run.

Since the First World War, the monetary policy rules has been deemed necessary, especially when economic crises have had so strong effects on the economy in particular, and on the society in general. The rules must ensure the stability of the banking system, and most importantly they are the key of the credibility of the monetary policy which has the duty to perform the objectives used to coordinate as efficient as possible the economic and financial activity, such as for example, the price stability objective through anti-inflationary policies.

In this paper, we aim to study the monetary policy rules in order to follow which were the main strands of the central banks and to compare which version is considered more efficient, because the opinions are divided and even in opposition among the great economists in the world.

In order to perform our purpose, we chose a type of monetary policy rule, the instrument type, which however requires a forward-looking adjustment of the variables that compose the equation of the reaction function. We checked in terms of econometric and economic significance if it could be or not a fixed rule of monetary policy in Romania, and if not then, we considered a benchmark, a reference for the actions taken by the central bank.

2. LITERATURE REVIEW

Monetary policy rules were considered necessary, were studied and modified over time especially after important historical events that have led economists to reflect on new ways to ensure macroeconomic stability.

Miskin (2004) states that monetary policy can pursue goals such as: a high degree of labour employment, economic growth, price stability, interest rate stability, stability of financial markets, exchange rate stability. To achieve these objectives the central bank sets intermediate targets (targets interest rates or monetary aggregates) that lead to the desired level of the economy. These interim targets are achieved through monetary policy instruments that are: open market operations, credit facilities (refinancing from the central bank) and deposit rates or minimum reserves.

Khan, King and Wolman (2002) states that there are three popular conceptions of monetary policy optimality especially in terms of setting the nominal interest rate, prices and output: that of Fisher, Keynes and Friedman.

Fisher, studied the real interest rate and nominal interest rates and found that the interest rates "fluctuates" with economic cycles, described as a "dance" of the dollar, if monetary policy is doing its part to stabilize prices.

Keynes noted that, because the prices are "sticky", the economy does not always reach equilibrium, so fiscal and monetary policies should ensure economic stability, variation in interest rates in response to shocks, especially on the demand side, being seen as monetary tools for stability. However, Keynes said that the fiscal policy should prevail and take the economy at the level of full employment of labour, by holding investments.

Friedman said that the nominal interest rate should be maintained at levels as low as possible, even at zero, implying that the real interest rate can be controlled only through the expected inflation or deflation. He also believes that the most effective way to drive monetary policy is to stabilize the price level using constant annual growths of the nominal money supply.

It is famous the debate on how the central bank should conduct monetary policy, or by following a fixed rule, which would thus be known by the operators.

Clarida, Gali and Gertler (1999) argued that discretion involves a re-optimization conducted by the Central Bank on the instrument of monetary policy (the nominal interest rate on short-term) depending on the state of the economy, the objectives, but without taking into account

any decision from the past, without getting in line with the implementation of monetary policy in previous periods.

Barro and Gordon (1981) described how monetary policy is applied taking into account the decisions they make now, at the moment *t* , operators according to the held information at time *t*, based on their expectations on current information and policy-makers decisions (Central Banks).

Thereby, the discretionary policy, involves the optimization of the policy-makers decisions regarding the monetary policy applied, in each period, taking into account the expectations of economic agents.

Taylor (1993) is rather the adept of monetary policy rules. However, he says, that monetary policy rules are more effective in improving economic performance.

3. THE MODEL

Below we present a model of monetary policy instrument rule that subsequently estimate the Romanian case, to verify that the Central Bank of Romania could use as a reference such reaction function. In addition McCallum (2004) states that there are countries like Canada, even England, where it is adopted inflation targeting strategy, yet this does not mean for sure the use of a target rule; it is possible that the instrument type rules are references for the monetary policy implemented by the central banks of these countries.

Reaction function used is considered optimal even for the monetary policy where are used targeting rules of the type proposed by Clarida, Gali, Gertler (1998a, 1998b) this being an extra motivation we chose to estimate on the Romanian case. The authors of the model state that this rule can be derived from a minimization of a loss function and in this case we suppose that would be optimal.

Model assumptions are:
a) Central Banks have autonomy in making decisions on monetary policy;
b) The model is forward-looking, opposed to the Taylor's backward-looking approach when obtained the Taylor rule for the United States;
c) Nominal interest rate is used as a monetary policy instrument and changes in each period, depending on the state of the economy;
d) The existence of rigidity in nominal wage and price level in the short term, to see the way the central bank changes the nominal interest rate impacts on real interest rates and subsequently the pursued target variables.

The reaction function takes the following form:

$$r^* = \bar{r} + \beta \left(E_t \left[\pi_{t+p} | \Omega_t \right] - \pi^* \right) + \gamma (E \left[y_{t+q} | \Omega_t \right] - y_t^*) \tag{1}$$

where r_t^* is the nominal interest rate, periodicaly seted by the central bank according to the

way in which are evolving the signifiant variables for the state of the economy, $\bar{r}$ is the nominal

interest rate at equilibrium for the long term, $E_t\{\pi_{t+p}|\Omega_t\}$ is the present espectation of the

inflation realized for the curent period and the period after *q* quarters (the database has a quarterly frequency); the difference $(E[y_{t+q}|\Omega_t] - y_t^*)$ is the output gap, meaning the difference

between the real GDP and the real potential GDP, measured as an average of the registered values in the analyzed quarters, between *t* and *t+q* period.

Using the first relation, we can support the fact that the interest rate is the instrument that „responds" to the deviations from the estimated inflation target (from the equilibrium values), respective to the deviations of the GDP from the potential GDP. Thereby, if is expected an increase of the inflation with one percentage point above his equilibrium value, the central bank will increase the level of the intereset with β percents; β has to be above to achieve a

positive level of real interest rate, which will be used to conduct such further transmission mechanism, with the ultimate goal of bringing inflation to baseline levels steady. An increase in GDP over his potential value is not always desirable because the economy may overheat, leading to inflationary pressures. Such positive deviation of GDP from its potential level by one percentage will increase the interest rate with λ percents. The GDP drop below its potential

level will be accompanied by a decrease in interest rate. Next we compute ex-ante real rate, subtracting the expected inflation from considered target value:

$$rr_t^* = r - E_t\left[\pi_{t+p}|\Omega_t\right] \qquad (2)$$

and the inflation target from inflation estimation over *p* periods, where:

$$rr_t^* = \bar{r} - \pi^* + \pi^* - E_t\left[\pi_{t+p}|\Omega_t\right] + \beta\left(E_t\left[\pi_{t+p}|\Omega_t\right] - \pi^*\right) + \gamma\left(E\left[y_{t+q}|\Omega_t\right] - y_t^*\right)rr_t^*$$

$$= \overline{rr} + (\beta - 1) * \left(E_t\left[\pi_{t+p}|\Omega_t\right] - \pi^*\right) + \gamma\left(E\left[y_{t+q}|\Omega_t\right] - y_t^*\right) \qquad (3)$$

The third relationship indicates that the β parameter should be greater than one, because

at one percent increase of the expected inflation, the nominal interest rate must increase by more than that to maintain positive real interest rate.

The interest rate, however, deviates from the target value due to the smoothing phenomenon:

$$r_t = (1 - \rho) * r_t^* + \rho * r_{t-1} + v_t \qquad (4)$$

with ρ below being less than one and describing the degree of smoothing. The higher ρ is, the

more the current rate links from the past and less from the target.

The phenomenon of smoothing of the variable r_t occurs because the Central Bank can not

substantially alter the rate of interest where this would be necessary in response to changes in inflation, GDP respectively from the target, whereas through such an action it would lose credibility or could affect the financial markets. v_t is a shock normal distributed.

Real interest rate on long-term requires additional calculations that may affect the significance of the parameters and the model itself, that is why it is introduced into a constant, which proved to be unsignificant neither in author's estimates nor in the estimates that we have achieved in this study case.

If we consider
$$\alpha = \bar{r} - \beta \pi^* \qquad (5)$$

be obtained a possible inflation target in this form:
$$\pi^* = (\overline{rr} - \alpha)/(\beta - 1) \qquad (6)$$

We introduce (6) in (1) and we obtain the following target function:
$$r^* = \alpha + \beta * E_t\big[\pi_{t+p}|\Omega_t\big] + \gamma * E\big[x_{t+q}|\Omega_t\big] \qquad (7)$$

From (4) and (6), results the reaction function to estimate:
$$r_t = (1 - \rho)\alpha + (1 - \rho)\beta E_t\big[\pi_{t+p}|\Omega_t\big] + (1 - \rho)\gamma E\big[x_{t+q}|\Omega_t\big] \qquad (8)$$

with x_t being the gap output and:

$$\varepsilon_t = -(1 - \rho)\{\beta(\pi_{t+n} - E[\![\pi_{t+n}|\Omega_t]\!] + \gamma(x_t - E[\![xt|\Omega_t]\!])\} + vt$$

which is the error that incorporates inflation and the output gap, both weren't included in the expectations (the errors that are maid in the expectations over the two variables).

Woodford (2007) sustains that the decisional process to establish the monetary policy instrument has to be reliable, more exactly intertemporaly consistent. The projected policy to a certain period has to be exactly like the policy which the Central Bank will recomend from that

period for the future; using that, the practicioner's expectations would be more realistic and the variables would reach the projected levels (it refers to another set of rules: forecast targeting). The problem of time inconsistency can be brought into question in the examined model, but correcting these errors can be done by GMM method, which is based on orthogonal conditions between expectations and errors of instrumental variables and based on the assumption that economic agents are rational.

4. Results

The econometric model in this paper is the estimation of the reaction function (8) in order to see if it was applicable as a monetary policy rule model as an instrument type used by the National Bank of Romania in the analyzed period, and if so, what is the value of the key parameters in that equation. We performed some comparisons using different interest rates, different time periods along with statistical tests to confirm the hypothesis of creating an "optimal" reaction function, appropriated for the implementation mechanism of the monetary policy in Romania.

To estimate the reaction function we used the GMM method (General Method of Moments), introduced by Hensen in 1982, but used in other forms even before, on a sample of 2005q2: 2014q4. The database was created using information from INSSE, annual reports and inflation reports from NBR.

The reason of using GMM is based also on the work of Hamilton (1994). More precisely, in the estimated equation we used expected values of the exogenous variables and because there are no direct observation over those, GMM permits the estimation of the reaction function with forward-looking, provided that the parameters are calculated based on the conditions that the errors made in the economic agent's forecasts are not corelated with the current known information. So it is assumed that information held by operators are enough to make correct anticipations. This is the orthogonality condition implied by GMM in this study case.

We tried to verify if in Romania it is useful such type of instrument rule, through estimating the reaction function on analized period (even as benchmark), despite the fact that in August 2005 it was introduced the inflation targeting policy.

So we checked if inflation targeting policy applied matches with the instrument type rule, in the sense that it could lead to the same results in terms of controllable variables.

$$ROBOR = (1-\rho)\alpha + (1-\rho)\beta INFLATION_{t+p} + (1-\rho)\gamma * OUTPUT\ GAP_{t+q} + \rho ROBOR_{t-1} \quad (9)$$

We considered for the estimation *p = 1* and *q = 1*. In this case the inflation rate is annualized by multiplying the quarterly values with four.

The estimated equations will be:

$$ROBOR_t = (1-\rho)\alpha + (1-\rho)\beta INFLATION_{t+4} + (1-\rho)\gamma * OUTPUT\ GAP_{t+1} + \rho ROBOR_{t-1} \tag{11}$$

As a proxi for ROBOR we will use ROBOR robor overnight rate. The output-gap will be computet based on Hodrick-Prescott filter. The evolution of the output-gap is presented in the graph below:

Figure 1. Output-gap evolution
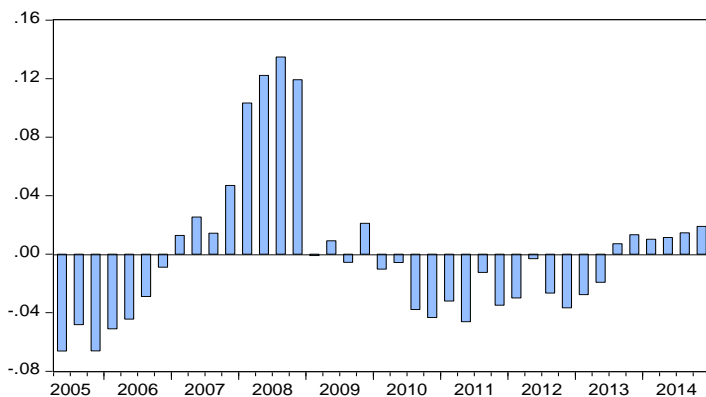
Source: Own calculation

Before estimating those two ecuatins we need to make sure that all the variables in the model are stationary. For this purpose we perfor ADF test for the existence of a unit root in all three time series. The null hypothesis of this test says that series has a unir root .We reject this hypothesis if the p-Value of the test is less than 5%. The results are presented in table 1.

Table 1. ADF test results.

Variable	Test Value	Critical Values(5%)	p-Value
OUTPUT-GAP	-2.067	-1.949	0.0386
ROBOR ON	-2.143	-1.949	0.0135
INFLATION	-2.973	-1.949	0.004

Since all the variables are stationary at 5% level we can estimate our model based on GMM. Before presenting the final resuls we performed the same estimation method using two sample, namey pre-crises sample 2005q2-2009q2, and a post crises sample 2010q4 -2014q4. The results show that the output-gap has a higher impact coefficent in post crises sample.

The results for the first model are presented below.
Table 1. GMM results for equation

Coeffcients	Value	Std. Error	t-statistic	p-Value
ρ	0.6366	0.0812	7.8366	0.00%
α	0.0902	0.0161	5.5932	0.00%
β	1.6375	0.0098	-2.6360	1.30%
γ	0.4429	0.1736	2.5513	1.59%

Our fist approach was to estimate the model using least square method. In this case β and γ haven't been statistically significant. The errors were correlated with independent variables and with a high level of autocorrelation.

As we can in table 1 all coeffcient are significant at 5% level. The value of R-suared is 77% which is high, meaning that evolution of interest rate is explained by independent variables evolution in three cases out of four . The autocorelations among errors and heteroskedasticicity were eliminated based on Newey-West matrix. As instrumesnts we use the level and first two lags for inflation, lever and first three lags of interest rate and level and fist lag of output-gap.

The resulted equation is presented below:

$$ROBOR_t = 0.038 + 0.5952 * INFLATION_{t+4} + 0.16 * OUTPUT\ GAP_{t+1} + 0.6366 * ROBOR_{t-1}$$ (12)

As we ca see in equation 12 for an increase with 1% in espectation of next year inflation, the Central Bank should increase the interest rate with 0.5952 %. This is a logical results, and the impact coeffcient is big enough in order for Central Bank to make an action in this way . This is the same situation with an increase with 1% in espectation of output-gap in the next quarter. The sign of the coeffcient is in line with economic and Central Bank of Romania should increase the interest rate with 0.16%.

Figure 2. Performance Analysis
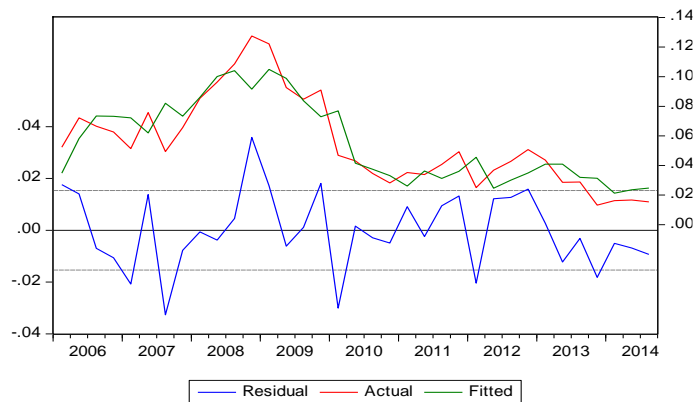
In figure 2 we can see the actual value and the fitted value for the model. Between 2006 and 2010 the model is not so closed to the reality, given the fact that in 2006-2008 there was an unsustainable economic growth in Romania due to the massive foreign investments, and after that the economic crises effects became more and more visible.

Starting with 2012 the model is closed to the reality. One explination would be that, in our opinion, Central Bank of Romania adopted a monetary policy that involves both inflation targeting and a sustainable economic growth and not only inflation targeting which was the main concern before the crises.

Conclusions

It is difficult to say even nowadays when a lot of empirical studies have been done, how is the optimal monetary policy. Targeting rules or simple instrument rules, discretion or commitment, forward-looking ruler or backward-looking rules, are freuent questions which don't have a certain right answer.

In this paper we tried to answer to the questions regarding reaction function of Central Bank of Romania. In this way we considered that interest rate is influenced by expectations for annualized inflation and output-gap.

We found that the evolution of interest rate has an auto-regressive behaviour but even with that in mind the impact of variables like output-gap or inflation is still at very high level.

The main finding of this paper is that the evolution of interest rate is influenced by expectation regarding next year inflation and on a lower scale by the expectation in next quarter level of output-gap.

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