A VAR Analysis on the Monetary Policy Transmission Mechanism in Romania

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Abstract

The goal of this paper is to provide a characterisation of the monetary policy transmission mechanism in Romania over the period 2000 - 2011. The main contribution of this paper is the layering of empirical evidence regarding the transmission mechanism split such as to compare the results before and after the implementation of the inflation targeting regime by National Bank of Romania. The methodology used in the article is that of vector autoregressions, a widely used empirical methodology in order to analyse the monetary policy.

The results of the analysis show that the National Bank of Romania was more successful in controlling the transmission mechanism after implementing the direct inflation targeting and this monetary regime was properly chosen so as to allow the central bank to deal with the complexity and uncertainty issues raised by the current structural problems of the Romanian economy. Moreover, this strategy provides the National Bank of Romania a similar policy framework to that of the European Central Bank, this fact being an advantage given the desired adoption of the euro.

Keywords: monetary policy transmission mechanism, direct inflation targeting, VAR

JEL Classification: E42, E50, E52, E58

1. Monetary Policy Transmission Mechanism: Theory and Evidence

The Theory

The revival of the monetary policy theory started with the work of Milton Friedman and Anna Jacobson Schwartz - A *Monetary History of the United States 1867-1960* in which they adopted the view that *money does matter to aggregate demand*, contrary to the early Keynesians of the 1950s and 1960s that held the view that monetary policy does not matter at all to movements in aggregate output and hence to the business cycle. The beliefs of Keynesians in the ineffectiveness of the monetary policy was based on the fact that the low nominal interest rates during the Great Depression did not stimulate investment spending and early empirical studies found no linkage between the nominal interest rates and the investment spending. Moreover, surveys showed that the decisions of business people on how much to invest in new physical capital were not influenced by market interest rates. Friedman and Schwartz documented instead that the massive bank failures, the resulting decline in the money supply and the high real interest rates indicated that - contrary to the view of early Keynesians - monetary policy was extremely tight during the Great Depression. In the United States the revival of the belief in the potency of the monetary policy was strengthened also by the increasing disillusionment about the role of the fiscal policy, especially given the practical and political low feasibility of using it and with its low "*fine tuning*" properties (Friedman, 1968, p.1).

Friedman (1968) stated about what monetary policy can do: the monetary policy "*... can prevent money itself from being a major source of economic disturbance.…..provide a stable background for the economy in which producers and consumers, employers and employees can proceed with full confidence that the average level of prices will behave in a known way in the future.…..finally, monetary policy can contribute to offsetting major disturbances in the economic system arising from other sources*".

At the end, the Keynesian-Monetarist debate led to a convergence of their views on the importance of money to the economic activity. Current views about the monetary policy are much the same as the early monetarists' beliefs. Thus, there is a widespread agreement that counter-cyclical discretionary fiscal policy is neither desirable nor politically feasible and practical debates about stabilization policy revolve almost exclusively around monetary policy and are grounded in a number of widely accepted propositions as presented by Eichenbaum (1997). Firstly, excluding anticipated-inflation effects, monetary policy is neutral in the long run. Secondly, persistent inflation is always a monetary phenomenon. Thus, the primarily objective of the monetary policy should be long run price stability. Thirdly, the monetary policy is not neutral on the short run. Fourthly, most of the aggregate economic fluctuations are not due to the monetary policy shocks. A resultant of the last two propositions is a second objective given by a welfare-improving role for monetary policy in helping the economy to adjust to non-policy shocks. An important question in the conduct of monetary policy is how one can achieve the second objective without compromising the first (Eichenbaum, 1997).

Considering the above mentioned principles, there is an on-going debate about the monetary policy transmission mechanism, *i.e. the channel through which the monetary policy affects the economy*: does monetary policy work through a money channel, a credit channel, an asset channel, or through a channel of financial prices such as interest rates and exchange rates (Taylor, 1997)? Without being the goal of this paper to perform a detailed analysis of monetary policy transmission mechanism theory, I will present in the next part of this paper a brief layering of empirical evidence on the transmission mechanism.

The Evidence

Starting from the work of Friedman and Schwartz (1963), modern empirical research in economics emphasizes the ability of the monetary policy to stabilize the macroeconomy (Cecchetti, 1995). Much of the evidence of the monetary policy effects on the economic activity is based on the reduced form evidence that can be divided into three categories: *timing evidence*, *statistical evidence* and *historical evidence*. Keynesians typically examine the effect of money on economic activity by building a structural model, *i.e.* a description of how economy operates using a collection of equations that describes the behaviour of firms and consumers in many sectors of economy. These equations then show the channels through which monetary and fiscal policy affect the aggregate output and spending. The structural model approach has the advantage of giving an understanding of how economy works; it can obtain more pieces of evidence on whether money has an important effect on the economic activity. Also, it helps to predict how institutional changes in the economy affect the link between money and output. The main condition underlying the structural approach is that the researcher has to know the correct structure of the model and a possible omission of relevant variables in the transmission mechanism might result in an underestimate of the impact of money.

On the other hand, monetarists do not describe the specific ways in which the money supply affects the aggregate spending and, instead, examine the effect of money on the economic activity by looking if movements in output are closely related with movements in money. Thus, they treat the monetary policy transmission mechanism as a "*black box*" (Mishkin, 2001). The main advantage of the reduced form evidence is that no restrictions are imposed on the way the monetary policy affects the economy. Monetarist economists prefer the reduced form evidence because they believe that the particular channels through which monetary policy affect aggregate activity are diverse and continually changing. Acknowledging that correlation does not necessarily imply causation and the related problems regarding reverse causation, the reduced form evidence has its perils as well[1]. While no clear cut can be made in the favour of one of them and both forms of evidence (structural models and reduced form models) can be used, it is acknowledged that these types of models are rather complementary.

A widely used reduced form empirical methodology to analyze the transmission mechanism is that of *vector autoregression models*. The methodology was popularized by Christopher Sims from Princeton University who criticized the restrictions required in large structural macroeconomic models, thus proposing a method that treats all variables as being endogenous as opposed to the endogenous / exogenous dichotomy. "*A vector autoregression, or VAR, is a system of ordinary least-squares regressions in which a set of variables is regressed on lagged values of both themselves and the other variables in the set. VARs have proved to be a convenient method of summarizing the dynamic relationships among variables, since, once estimated, they can be used to simulate the response over time of any variable in the set to either an "own" disturbance (i.e., a disturbance to the equation for which the variables is the dependent variable) or a disturbance to any other variable in the system*" (Bernanke and Gertler, 1995). Some of the papers that use this empirical tool to study the monetary policy transmission mechanism are Sims (1972, 1992), Bernanke and Blinder (1992), Bernanke and Gertler (1995), Cushman and Zha (1995), Leeper *et al* (1996), Christiano *et al* (1998), Monticelli and Tristani (1999), Mojon and Peersman (2001), Peersman and Smets (2001).

2. Identification and Estimation of the Model for Romania

In order to evaluate the inflation targeting regime adopted by NBR, I have analysed, using the econometric method of unrestricted vector autoregressions (unrestricted VAR), the transmission mechanisms of the monetary policy *before and after* the moment the new strategy was adopted, *i.e. August 2005*. In order to do so, I have used two models which include the following variables: *the Consumer Price Index,* the *industrial output, the nominal exchange rate RON / EUR, the NBR reference interest rate and a monetary aggregate (hereinafter noted as* IPC, PROD, CURS, DOB, M1 and M2).

For the identification of the relationships existing between the variables, I have used the Cholesky impulse-response function, the variance decomposition of the residuals and the Granger causality tests. The Cholesky impulse response function shows the evolution of one variable over a period of time that is due to a shock in another variable. The variance

[1] Proponents of the theory of aggregate fluctuations called *real business cycle theory*, critics the monetarist reduced-form evidence that money is important to business cycle fluctuations because they believe there is reverse causation from the business cycle to money.

decomposition of the residuals indicate the amount of information that each variable contributes with to the explanation of the evolution of other variables, while the Granger causality test shows the causality relationships between the variables that are studied. A strict causal relationship between variables is imposed due to the Choleski type identification, such that the order of the variables within the system is critical. The Choleski type identification imposes the restriction that a variable is not contemporaneously impacted by a shock in the variables that follows it in the system. This is equivalent to making a distinction between different behaviours in the actual economy; the variables observed being the results of the interaction between supply and demand in the particular markets (Cushman and Zha, 1997).

Given these considerations, I chose the ordering [IPC, PROD, CURS, DOB, M1] and [IPC, PROD, CURS, DOB, M2], respectively. The underlying assumption is that prices are considered predetermined in the short run (consistent with price stickiness theory) and policy shocks have no contemporaneous impact on output and prices, being known the time lags required for monetary policy to pass through its effects into economy (Sims *et al*, 1996). The ordering of exchange rates before the interest rate and the monetary aggregate is equivalent to assuming that the money supply and the interest rate is elastic to the exchange rate, *i.e.* the central bank responds to changes in the exchange rate. Cushman and Zha (1995) show in their paper that this assumption helps to solve for the *price puzzle* when studying a small, open economy such as Canada, and I consider that this assumption is applicable also for Romania. Moreover, being a forward looking variable, the exchange rate is presumed that incorporates contemporaneous information about the real sector and price developments and thus, the monetary authority may use this variable to resolve a signal-extraction problem. I must note that the empirical literature has not yet converged on a particular set of assumptions for identifying monetary policy, different orderings being used in the empirical studies. Nevertheless, there is considerable agreement about the qualitative effects of a monetary policy shock, in the sense that inference is robust across a large subset of the identification schemes that have been considered in the literature (Christiano *et al*, 1998).

For the two models I used monthly data and, in order to better observe the effects of the transition from the monetary regime characterised by the focus on monetary aggregates to the direct inflation targeting regime, I split the time period 2000:M01-2011:M08 within two intervals, *pre* and *post* implementation of the new monetary policy strategy. The first interval was 2000:M01-2005:M08 (62 observations) and the second interval was 2005:M09-2011:M08 (72 observations). As part of the empirical identification and determination of the statistical reliability of each estimated model I followed the next steps[2]:

❖ *Testing the series for order of integration.* I used Augmented Dickey-Fuller test and Phillips Perron tests. I used these tests as pre-tests for second-stage inference. In ADF tests the lag length was determined by the information criteria (AIC and SC). The inclusion of deterministic terms was done in the following manner: for trending variables such as monetary aggregates, industrial production and price level there was introduced a trend and a constant. In case of the interest rate and the exchange rates it was included only a constant, even if visual inspection could indicate a trend. For the estimated systems the rule was to use the variables in levels if these are stationary -I(0)- or if they are nonstationary – I(1) – but cointegrated. The majority of the variables seem to be I(1) or

[2] The data used and the results of the econometric tests may be obtained from the author upon request as they cannot be displayed at length in an Appendix to this article due to the limited space of the journal.

I(2). The finding of a cointegrating relationship (or more) in each model allowed me to estimate each model in levels. By doing the analysis in levels we allow for implicit cointegrating relationships in the data (Enders,1993). Also, Sims (1992) recommends against differencing or detrending the data *even if* the variables contain a unit root, arguing that the goal of VAR analysis is to determine the inter-relationships among the variables, not the parameters estimates. The main argument against any transformation is that it „*throws away*" information concerning the co-movements in the data (such as the possibility of cointegrating relationships) and can generate complex error structures that complicates and can invalidate estimation and inference. Hence, the form of the variables used in the VAR should mimic the true data generating process (Enders, 1993).

According to the Augmented Dickey-Fuller test, the variables used have the following integration orders for the entire period 2000 – 2011:

Series	IPC	PROD	CURS	DOB	M1	M2
Integration order	I(0), c, t	I(0), c, t	I(1),c	I(1), c	I(2), c,t	I(2), c, t

❖ *Tests for the lag length.* The tests used were determined based on informational criteria - *Akaike information criterion* and *Schwarz information criterion*, taking into consideration that if the number of lags is too small then the model does not capture all the information while if there are too many lags then the degrees of freedom are wasted (Enders,1993).

❖ *Stability of VAR.* In an autoregressive process AR(1): $\mathbf{y_t = a_0 + a_1 y_{t-1} + \varepsilon_t}$, the condition for stability is $|\mathbf{a_1}| < 1$. By analogy, in a VAR system $\mathbf{x_t = A_0 + A_1 x_{t-1} + e_t}$, the condition for stability is that the roots of the characteristic equation of matrix $\mathbf{A_1}$ lie inside the unit circle. The stability of the system implies that the shocks in the system are transitory and vanish after a period of time. The non-stationarity of the system implies that some of the results are not valid, such as the standard errors for the impulse-response function. An important observation for the present study is that the VARs estimated for the period before the adoption of the direct inflation targeting are non-stationary, while the VARs estimated for the direct inflation targeting period are stationary. The rule that should normally be used within VAR models is that the variables should be used in levels if these are either stationary or non-stationary but cointegrated. However, in the present study I decided to use all the variables in level even in the case of the non-stationary VARs, because:

(i) For the period 2000:M01 – 2005:M08 I didn't find a cointegration relationship, therefore it seems there is no long run equilibrium between the analysed variables;

(ii) The tests showed the existence of several cointegration equations for the VARs estimated for the period 2005:M9 – 2011:M8;

(iii) The use of the first difference of the variables is not necessary recommended because it eliminates the long term information from variables and the goal of the VAR is to determine the relationships between the variables and not the estimation of the equation parameters and the true data generating process should be followed;

(iv) The results would have not been directly comparable for the two sub-periods;

(v) The interpretation of the results should in any instance be made with care, given the general limits of the ability of the econometric methods to precisely capture the complexity of the economic relationships.

❖ *Residual diagnostic tests.* To test the "*white-noise*" properties of the estimated residuals I am using multivariate Lagrange Multiplier test statistic for residual serial correlation, multivariate Jarque-Bera for residual normality test and White Heteroskedasticity test for detecting heteroskedasticity.

❖ *Discussion of the results.* In the next section of the article I present the results of the econometric analysis I performed, split for the two periods but cumulated for the two models [IPC, PROD, CURS, DOB, M1] and [IPC, PROD, CURS, DOB, M2].

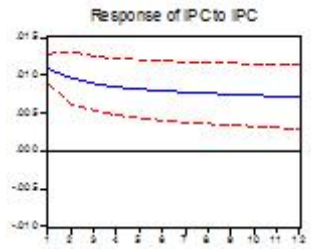
3. Results of the Analysis before the Implementation of the Inflation Targeting Regime

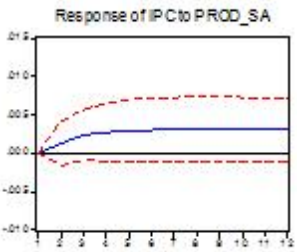
Figure 1 shows the evolution of inflation, from which we firstly note that its response to a shock in the other variables has the correct sign, in line with the predictions of the standard economic theory, although not in all case the response is very significant. Thus, IPC rises to a shock in its own value, a fact which confirms the existence of inflation persistence and the importance of inflation expectations in the inflation generating process. IPC also increases in case of an impulse from the industrial production, showing the existence of a positive output gap in the period 2000 – 2005 and the related „*heating*" of the economy.

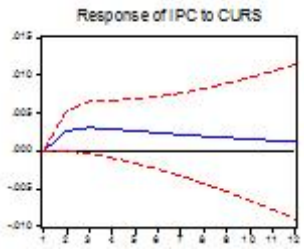
Figure 1. The impulse-response function for the change in *IPC*

Change in IPC following a shock in:

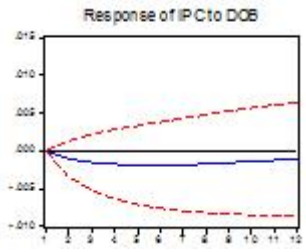
IPC ***Industrial production*** ***Exchange rate***

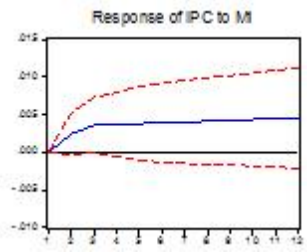


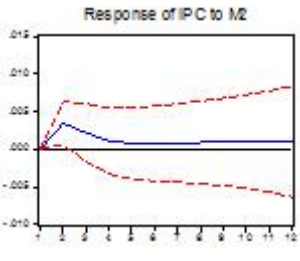




Interest rate ***M1*** ***M2***







The rise of the exchange rate, *i.e.* the depreciation of the national currency, determines the increase of the inflation rate, firstly due to the effects of the imported goods and services but also due to the balance sheet effect that determines a decrease in the value of the assets denominated in local currency. We can also observe a positive correlation between IPC and the monetary aggregates, the increase in M1 having a slower but more persistent

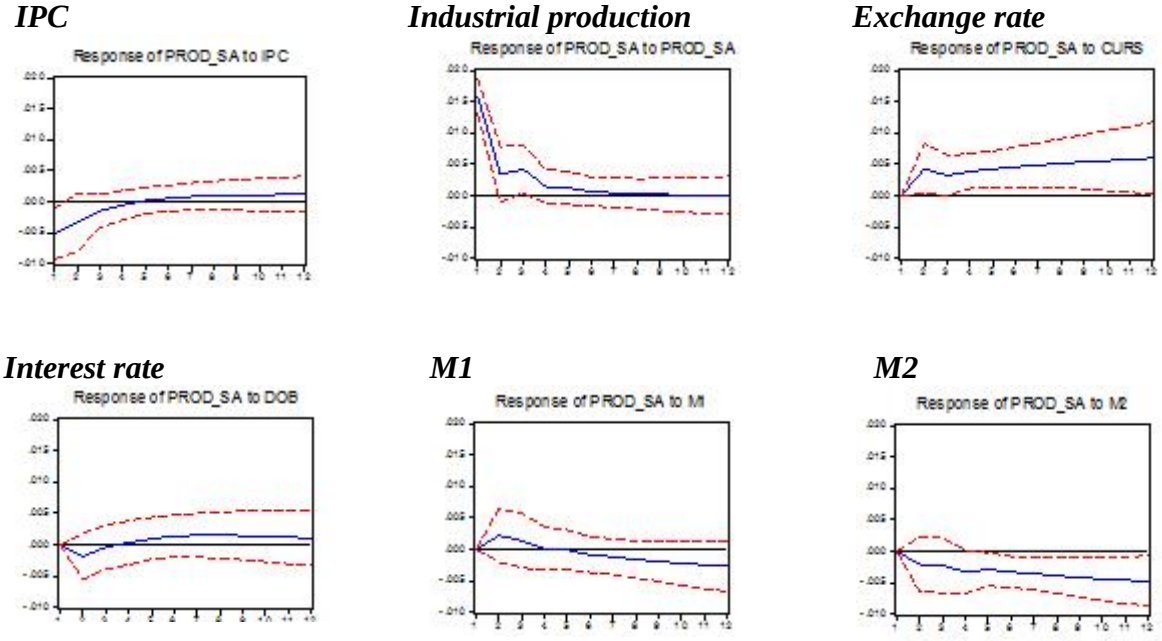
impact, while M2 has a sudden impact which however vanishes after two or three months. The persistence of the M1 effect can be explained by the fact that this aggregate represents cash and overnight deposits which directly enters into the process of exchange of goods and services and shows the fact that *„too much money follows too few goods"* and that the National Bank of Romania (NBR) had hard times to absorb the liquidity surplus. The increase of IPC following a shock in M2 indicates a normal behaviour of individuals and economic agents when they faced with a big amount of money (*e.g.* wage compensation payments, money transfers from abroad), whereby they spent a part of the money while the other part saved it in deposits with a maturity up to two years. Thus, the impact in IPC was sudden and, practically, concomitant with the increase in M2.

On the other hand, an increase of the reference interest rate determined a slight decrease of IPC, but the results must be interpreted with care because the confidence interval is close to zero, which is in line with the information drawn from the NBR Reports indicating that the interest rate channel has a weak influence on the price level, at least on short term.

The impact of the variables on the industrial production can be observed in **Figure 2**, which shows that the industrial production increases due to shocks from the exchange rate (*i.e.* depreciation of the national currency) and is stabilising after approximate three months. The explanation is that, on one hand, the exports are cheaper and the related increase in the demand for local goods triggers an increase in the industrial production. On the other hand, the imports become more expensive and redirect the internal demand towards the national output.

Figure 2. The impulse-response function for the change in *Industrial production*

Change in Industrial production following a shock in:



The industrial production significantly decreases following a shock in IPC and reference interest rate but quickly returns to the previous level. This finding indicates a possible increase of the productivity which alleviated the negative supply side effects as, for

example, the increase in productivity was accelerating by the forecasted moment of Romania entering the European Union.

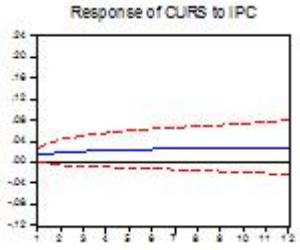
The results however showed that the industrial production increases in the second month from a shock in M1 after which it has a descending trend while a shock in M2 directly determines a decrease of the industrial production. This behaviour can be explained in the case that both the monetary aggregates and the industrial production reacts, with a different sign, to the same supply side adverse shock, such as the increase in the taxes or the increase in the oil prices. Thus, the money demand increases concomitantly with the decrease of the production but, at the end, the adverse supply shock impacts the industrial production in long run.

From the exchange rate perspective (**Figure 3**), we can observe that the national currency depreciates as a result of a shock in IPC and it exhibits a very strong persistence to the shocks in its lagged values. This fact confirms, on one hand, the strong relationship between the exchange rate and the inflation and, on other hand, the fact that the exchange rate represents a *forward looking* variable which incorporates relevant economic information. We can observe that neither the industrial production nor the interest rate do influence the exchange rate. Interestingly, the increase in M1 and M2 determined the exchange rate appreciation after a period of four or five months, although the exchange rate exhibits a depreciation trend in long run. This appreciation of the exchange rate following an increase in the monetary aggregates (especially for M2) shows in fact the existence of a very strong internal and external demand for local goods and services, possibly concomitantly with capital inflows – a premise that is feasible for the analysed period. However, we should not forget that, in fact, the exchange rate depreciated in the period 2000 – 2004 and only starting 2004 it started a sustained appreciation trend. In this depreciation context, we cannot rule out the existence of interventions of NBR in order to temper the depreciation of the national currency generated by the monetary expansion at a higher pace that that of the output.

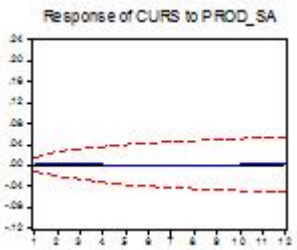
Figure 3. The impulse-response function for the change in the *Exchange rate*

Change in Exchange rate following a shock in:

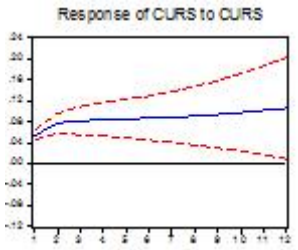
IPC



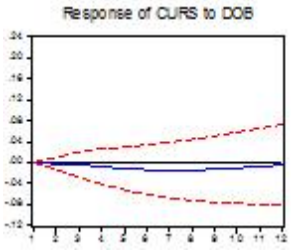
Industrial production



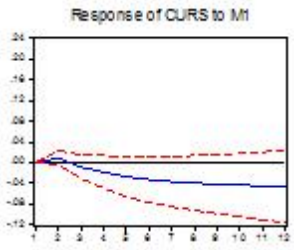
Exchange rate



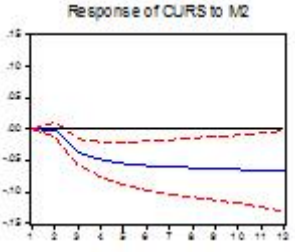
Interest rate



M1



M2

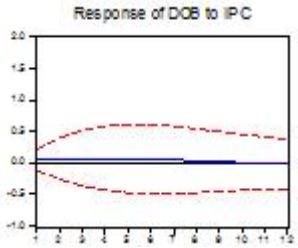


Regarding the reference interest rate, it is interesting to observe if it had a role of a monetary policy tool, at least a role of setting market expectations, because during the major part of the period 2000 – 2005 NBR found itself in a net debtor position against the Romanian banking system. As we expected, however, we can observe from **Figure 4** that the response of the reference interest rate is not significant in most of the cases, thus, not being a real monetary policy instrument. Basically, an inflationary shock or a shock in the industrial production does not determine any changes of the interest rate. The latter variable is increasing only further to a depreciation of the exchange rate and is decreasing further to the monetary expansion (*the liquidity effect*).

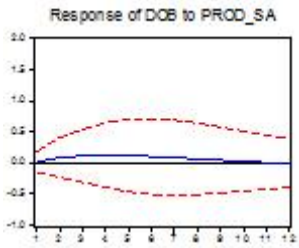
Figure 4. The impulse-response function for the change in the *Interest rate*

Change in the Interest rate following a shock in:

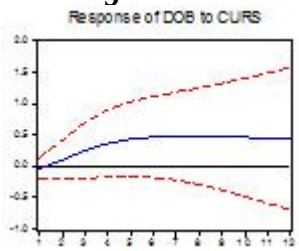
IPC



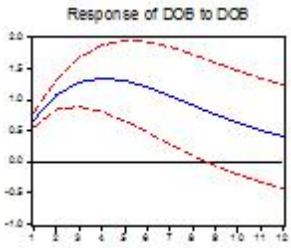
Industrial production



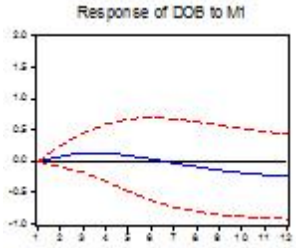
Exchange rate



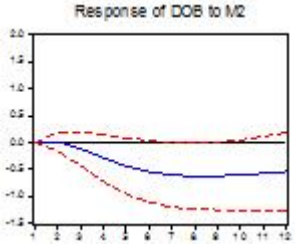
Interest rate



M1

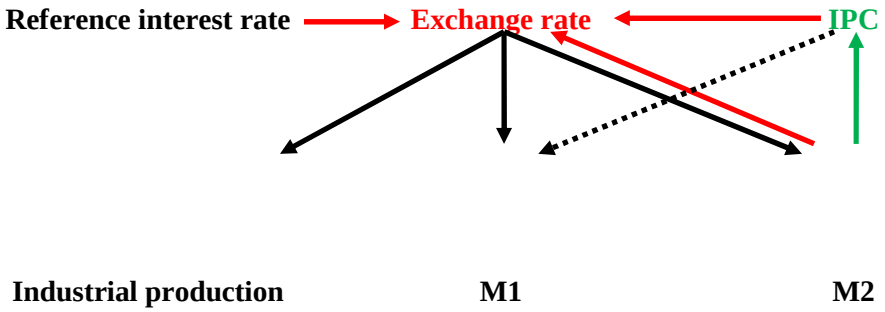


M2



As regards the intensity of the relationships between the variables used in the models, the *forecast error variance decomposition tests* indicate that the variance of IPC explains 10% of the variance of the industrial production and in proportion of 8% that of the exchange rate. The variance of the monetary aggregate M1 explains 10% - 15% of the variance of IPC (we observe again a weak relation between inflation and monetary aggregates), while M2 explains approximate 30%- 40% of the variance of the exchange rate, after a period of six months.

Figure 5. Granger causality between the variables in the models 2000 - 2005



The examination of the Granger causality (**Figure 5**) for the estimated models reveals o causality between the exchange rate and the industrial production (Prob.=0.0026), the exchange rate and M1 (Prob.=0.0845), the exchange rate and M2 (Prob.=0.0029). On the other hand, the exchange rate is Granger caused by IPC (Prob.=0.0000), M2 (Prob.=0.0000) and the reference interest rate (Prod.=0.0101). IPC is Granger caused by M2 (Prob.=0.0414), and the monetary aggregate M1 is determined by IPC (Prob.=0.0265).

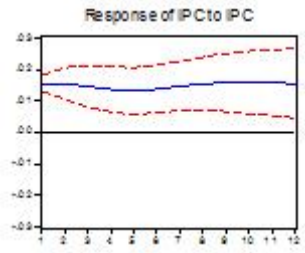
4. Results of the Analysis after the Implementation of the Inflation Targeting Regime

We can observe from **Figure 6** that after the adoption of the direct inflation targeting regime, the inflation persistence was very strong, a fact which shows that the inflation expectations have been difficult to anchor even after the implementation of the new monetary policy strategy – which is by excellence a strategy focused on transparent communication and credibility. Given the way the inflation expectations are formed in Romania, most probably adaptive and not rationale, it was very important for the NBR, in the first years of the new strategy, to anchor or to consolidate these expectations such that no supplementary inflationary pressures are created. Thus, it was not necessarily important to immediately reduce the inflation or the expectations of the economic agents and individuals about its development but rather it was important to anchor them and to gain credibility. The econometric results shows that IPC has a very weak negative response (almost insignificant) to a shock in the industrial production, which confirms that the disinflation process was consolidated and that the increase in production has not triggered inflationary pressures (*i.e.* there is no speed limit effect).

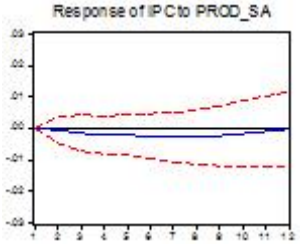
Figure 6. The impulse-response function for *IPC* 2005 - 2011

Change in IPC following a shock in:

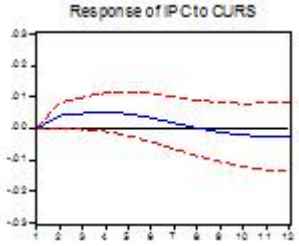
IPC



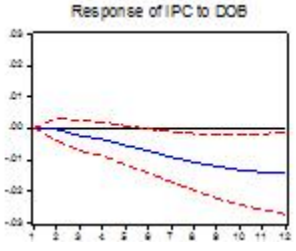
Industrial production



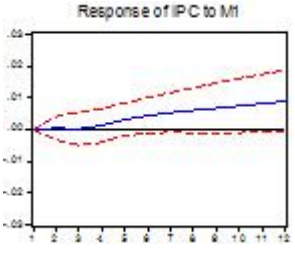
Exchange rate



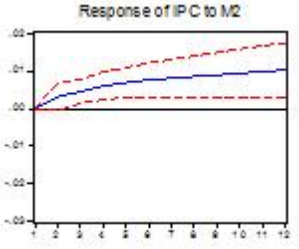
Interest rate



M1



M2



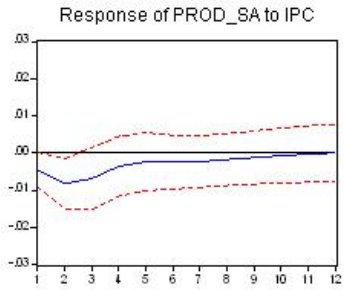
The other results are in line with the standard economic theory predictions, as a depreciation of the national currency triggers an increase of IPC, the effects disappearing after a period of eight months. Moreover, the increase in the reference interest rate determines a decrease of IPC, with significant effects after approximate one year, which indicates some effect of the interest rate channel. The increase of the monetary aggregates determines an increase in IPC, the response being more firm and significant for M2.

Figure 7 shows that the industrial production decreases on short run given a shock in IPC, but this shock is quickly absorbed and becomes insignificant after few months. Thus, we may say that the IPC shock is a supply shock (e.g. oil price increases) which is absorbed by the increase in the productivity or by a strong demand. The industrial production increases in the short run following a depreciation of the national currency and it begins to decrease after a period of four months, which means that the depreciation of the national currency firstly determines an increase of the external demand for the national products (which are now cheaper), but the effect of the exchange rate pass towards inflation in time, fact that is confirmed by the response of IPC to the depreciation of the national currency. The increase of the interest rate determines the decrease of the industrial production on medium and long term, most probably through the credit channel. We also observe that the industrial production is stimulated in the short run by shocks in M1 but not by the shocks in M2.

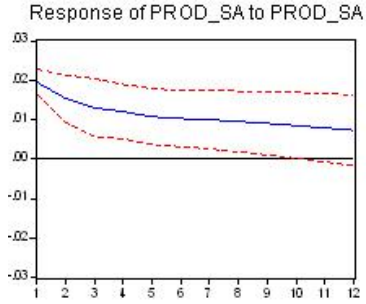
Figure 7. The impulse-response function for *Industrial production* 2005 - 2011

Change in Industrial production following a shock in:

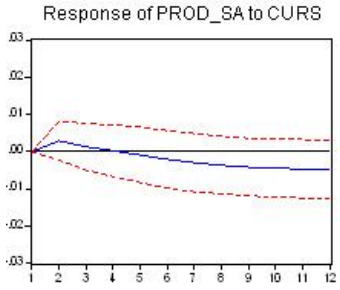
IPC



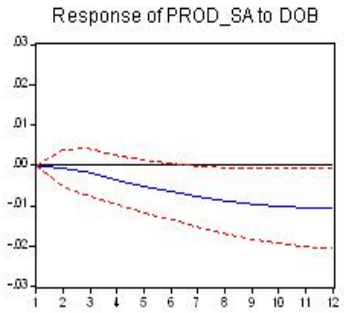
Industrial production



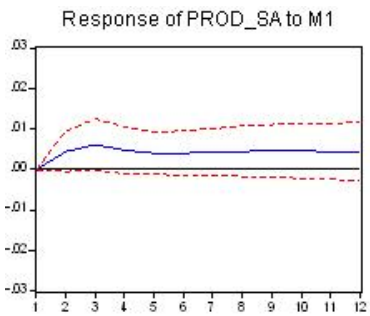
Exchange rate



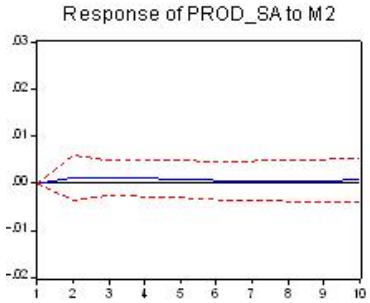
Interest rate



M1



M2



Figures 8 and 9 show the impulse response functions for the exchange rate and the interest rate. The national currency is appreciating further to a shock to the industrial production due to the increase in the demand for local products and the related increased demand for national currency. The currency is depreciating after 4 – 6 months from a shock in IPC, in this case the inflationary shock seeming to be a supply shock which is not absorbed by the real economy through an increased productivity and, thus, is compensated by a depreciation of the national currency.

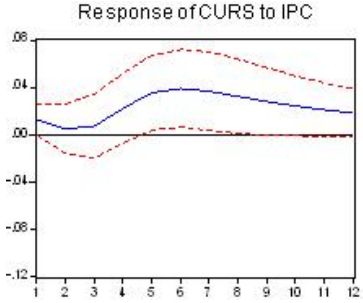
The interest rate and M1 do not have an impact on the exchange rate and only a shock to M2 determines a depreciation of the currency. Overall, the econometric model has not exhibited „abnormal" responses of the exchange rate in the period after the implementation of the direct inflation targeting regime, this variable showing its effects through the net exports channel, the balance sheet effect and the wealth effect. The interest rate does not exhibit a strong response to a shock to the other variables, except the rise in the interest rate following a depreciation of the national currency (as a normal reaction of the monetary authority to make the national currency attractive and to increase the demand for the national currency in order to limit the depreciation) and the decrease of the interest rate following an increase in M1 (*liquidity effect*).

The monetary aggregates M1 and M2 do not generally have significant responses to the shocks in the other variables, the most significant one being the increase of M1 as a response to a shock in industrial production, this leading to the conclusion that it was a demand driven shock that determined both the increase in the industrial production and in the demand for money.

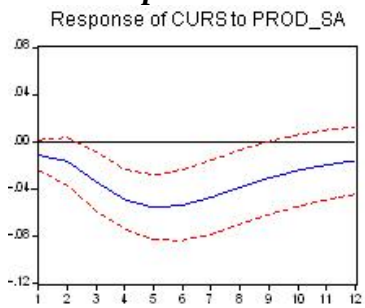
Figure 8. The impulse - response function for the *Exchange rate* 2005 - 2011

Change in the Exchange rate following a shock in:

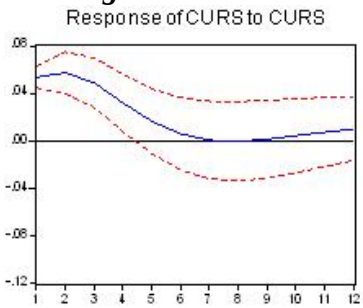
IPC



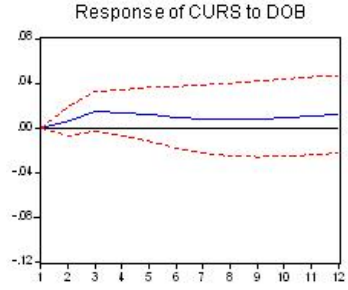
Industrial production



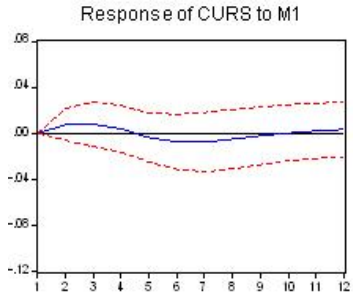
Exchange rate



Interest rate



M1



M2

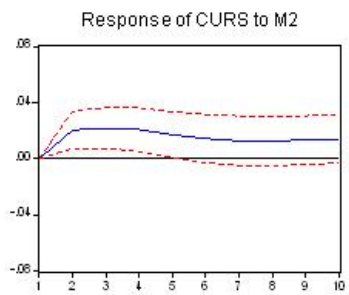
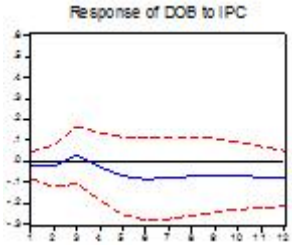


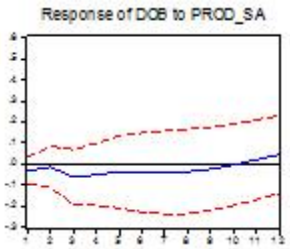
Figure 9. The impulse - response function for the *Interest rate,* 2005 - 2011

Change in the Reference interest rate following a shock in:

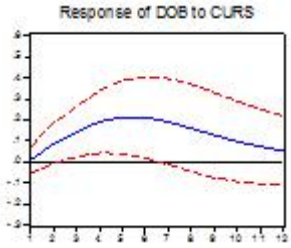
IPC



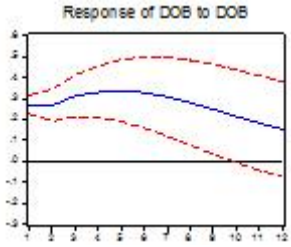
Industrial production



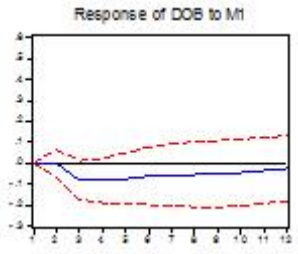
Exchange rate



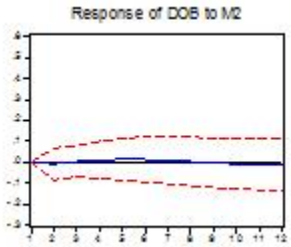
Interest rate



M1



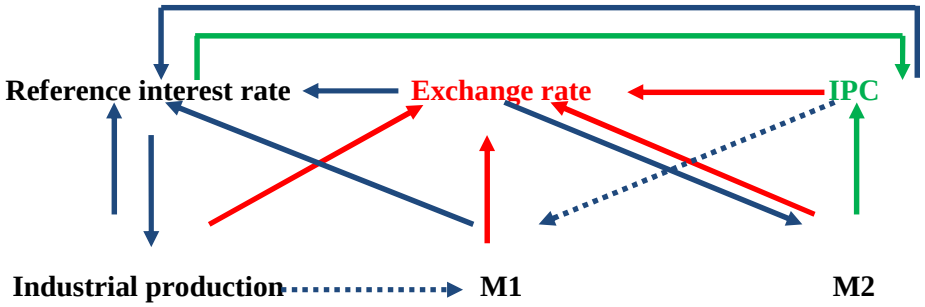
M2



As regards the intensity of the relationships between the variables used in the models, the variance decomposition indicated for the period after 2005:M08 significant relationships only for the variance of the industrial production. This variance explains, after six months, approximately 40 – 50% from the variance of M1 and 40% of the variance of the exchange rate. It is a positive sign that the variance of the interest rate explains 20% of the variance of IPC, after a lag of nine months, confirming the increase in the effectiveness of the interest rate channel after the implementation of the inflation targeting regime.

In respect of the causality existent between variables (**Figure 10** below), the Granger causality tests shows much more significant results for the period after the implementation of the direct inflation targeting regime than the results for the previous period. Thus, IPC is Granger caused by the reference interest rate **(Prob.=0.0383)** and by the monetary aggregate M2 **(Prob.=0.0093).** The industrial production is Granger caused by the reference interest rate **(Prob.=0.0418)**, while the latter variable is Granger caused by M1 **(Prob.=0.0192)**, IPC **(Prob.=0.0371)**, industrial production **(Prob.=0.0088)** and the exchange rate **(Prob.=0.0222)**. According to the econometric tests, the exchange rate is Granger caused by the industrial production **(Prob.=0.0001)**, IPC **(Prob.=0.0027)**, M1**(Prob.=0.0364)** and M2 **(Prob.=0.0002)**. The monetary aggregate M1 is Granger caused by the industrial production **(Prob.=0.0365)** and IPC **(Prob.=0.0741)**.

Figure 10. Granger causality between the variables in the models, 2005 – 2011



5. Conclusions

The first conclusion of this article is that ***after the implementation of the inflation targeting regime,*** NBR managed to better guide the evolution and response of IPC to a demand shock (interpreted from the increase of the industrial production) as well as due to the depreciation of the national currency. Also, the interest rate channel is more efficient while the monetary aggregates continue to have a direct proportional relationship with the evolution of IPC, however weaker in case of M1.

After the implementation of the inflation targeting, the exchange rate exhibited a greater flexibility, this being a proof that NBR allowed a managed floating of the exchange rate and, possibly, it made foreign exchange market interventions only to avoid extreme currency appreciation or depreciation situations but not to use the exchange rate as a policy instrument to control the inflation. This fact can be observed from the normal evolution of the exchange rate to the shocks in IPC, industrial production, interest rate and monetary aggregates. Thus, the currency depreciates to an inflationary shock and to the increase of the monetary aggregates and appreciates further to an increase in the industrial production. The depreciation of the currency to an increase in the interest rate proves that both variables contemporaneously respond to a supply side shock.

On the other hand, in the period prior to the inflation targeting regime, the currency showed no response to the changes in IPC, industrial production or interest rate but merely was appreciating when M1 or M2 increased, a sign that either NBR performed sterilisation operations in order to stop the depreciation of the currency or that there were strong demand shocks to which both variables were responding.

In respect of the reference interest rate, we cannot draw the clear conclusion that this channel became more efficient after the implementation of the new strategy, the response of this variable before and after the inflation targeting regime being similar but, nonetheless, not very statistically significant. The only exception is in case of the shocks to the exchange rate which triggered a firm reaction of the monetary authorities, the depreciation of the national currency being tempered by the increase in the interest rate.

As regards the role of the monetary aggregates, their impulse-response functions have not been statistically significant either before or after the implementation of the inflation targeting. We can see significant responses only to the shocks in the industrial production, therefore to shocks in the aggregate demand, in line with the predictions of the neo-

Keynesians school - according to which the general dynamic equilibrium is temporarily shifted from an efficient allocation of resources due to price rigidity and, possible, to a variety of imperfections of markets while the short term change in the money stock is one of the multiple factors which impacts the real economy.

The lack of a relationship between the money and inflation is in line with the real cycle theory which argues that the central bank has an indirect and imperfect influence on the quantity of money within the economy (*inside money*), the quantity of money being determined by the behaviour of commercial banks and by the interaction of a multitude of economic agents. Thus, contrary to the hypothesis of the monetary theory, we can observe in the case of Romania that the money multiplier proved to be unstable and unpredictable and does not show a stable relationship between the monetary base (*outside money*) and the money supply (*inside money*) and, hence, between the monetary aggregates and the real activity (*the case of missing money*)[3]. This lack of relationship was recently confirmed by the NBR representatives who presented at the seminar „*Money supply and inflation. Theory and practice*" (6 March 2012) the fact that NBR has not identified a stable relationship between the money supply and inflation. This situation is similar to the one found by the European Central Bank for the euro area.

However, we should not draw the conclusion that monetary indicators have no relevance for the conduct of monetary policy, but one should understand that the role of the monetary analysis within the process of designing and implementing the monetary policy has the aim to offer relevant information related to the economic developments on short and medium term, in line with the statement of Milton Friedman (1984): „*monetary aggregates can have an important role as an indicator, even if they don't have a structural or causal role in the inflation process or in the mechanism of transmission of the monetary policy. Even if inflation can be viewed as the sole result of the excess demand or of the cost pressures, the monetary developments may however provide information that allows a better identification of the nature of shocks that hit the economy and / or to forecast the trend of future evolution of prices".*

Based on the evidences provided in this article, we may certainly say that NBR has been efficient in the transition from an eclectic monetary approach (based on the use of monetary aggregates as intermediary objectives and on the control of the exchange rate) to the implementation of the direct inflation targeting. This strategy represented for Romania a much stricter institutional and operational framework for applying the monetary policy. Also, this strategy makes NBR to be very close to the approach of ECB, of which monetary policy is conducted based on two pillars - the economic analysis and the monetary analysis. Moreover, the direct inflation targeting regime allows NBR to act with a maximum of efficiency within a financial and economic environment characterised by complexity and uncertainty.

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[3] Even the recent liquidity injections in USA (quantitative easing operations) from the beginning of the financial crisis have not found themselves in the creation of money supply because the money multiplier drastically decreased.

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Econometric results:

Due to the extended number of pages required by the multitude of models tested and due to the limited space allocated for this article, the data and the full econometric results are available from the author upon request.