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# INVESTIGATING THE EFFECTS OF ECONOMIC AND MONETARY SHOCKS IN ROMANIA USING VAR ANALYSIS

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*Abstract*

***This study aims at analyzing the impact of the economic and monetary shocks, through a follow-up of the assessment of the monetary policy transmission in our country as well as of the prices' dynamic. Vector auto regression (VAR) model has thus been chosen, as it has the advantage of simplicity and flexibility in adapting various specifications, while its disadvantage is represented by their empiric structure. The sample period is 2000 Q1 - 2019 Q3, for a quarterly frequency, but also includes two time subintervals, such as 2000 Q1 - 2008 Q3 and 2010 Q3 – 2019 Q3. The empirical findings suggested a high level of uncertainty of the response functions.***
***Keywords: monetary policy, vector auto-regression (VAR) model, economic shocks, central bank, macroeconomic variables***

## I. INTRODUCTION

The very moment of the Maastricht Treaty rendered credible the idea of a European monetary integration, the empiric analyses that called on the VAR models in view of studying its consequences multiplied. The first ones studied the nature of supply and demand disturbances within the European Union countries, along with their asymmetry level (Bayoumi and Eichengreen, 1992). Most of the studies used the criteria defined by the optimal monetary areas in order to analyses the prices' dynamic under the adoption of single currency conditions. When the forthcoming of the single currency became obvious, a second type of studies oriented towards the research on possible asymmetries within prices and monetary shocks' dynamics in Euro Area.

(Mojon and Peersman, 2003). The irrefutable success of the VAR models in the field of monetary analysis did not restrain the emergence of certain critics. The approach of such models is distant from theoretic fundaments, rendering impossible a genuine economic interpretation of the coefficients. However, even the latest structural models are still subject to statistical limitations. As emphasized by Amato and Gerlach (2001) or Elbourne and Haan (2006), small sized structural models rest on identification hypotheses that are far more exigent that the ones underlying VAR models. Therefore, in this context we chose a simpler model, without imposing certain constraints.

The lack of long enough data series as well as the chronic instability resulting from the transition towards the market economy are the main issues to be addressed when constructing robust empiric models for the Central and East-European countries in general and for Romania, in particular. Still, such issues are not insurmountable. In what concerns the first issue, for the moment we have data series that are long enough for constructing significant appraisals. The second issue may be solved by eliminating the first years of transition, when major macroeconomic mutations occurred. Our study will thus be constructed based on data since 2000. This research paper joins the continuum of studies like those conducted by Maliszewski (1999), Christoffersen et al. (2001), Boțel (2002), Ganev et al. (2002), Creel and Levansseur (2005), Elbourne and Haan (2006), Spulbar and Nițoi (2012), Spulbar, Nițoi and Stanciu (2012), Spulbar and Nițoi (2013), Spulbar and Birau (2019).

## II. RESEARCH METHODOLOGY AND DATA COLLECTION

At large, in view of analyzing the channels of the monetary policy, the dedicated literature provides for multiple models: (i) stochastic dynamic general equilibrium models; (ii) traditional econometric models; (iii) vectorial autoregressive models. The appraisal of these models enables the identification of the impact of the monetary policy inflections upon prices and production and the way the effects propagate. Generally, these models are based on three equations - an IS curve, a Phillips curve and Taylor monetary policy rule. The traditional econometric models are the modern version of old Keynesian models, improved during the 1900 by considering the anticipations and by examining their long-term properties. The vectorial auto regressive models are based on the hypothesis of limited knowledge on economy functioning. Therefore, no structure is imposed within these models.

The scope of this study justifies the selection of this methodology. The macroeconomic phenomena are acting as complex dynamic systems, with mutual causal relationship and feedback. Hence, system-type analyses (simultaneous equations) are able to grasp the interconnections among

macroeconomic variables. Moreover, we should also consider the dissimilarity within the macroeconomic entities included in the analysis. Even more, VAR models are quite common in time series analyses, mainly due to their flexibility and user-friendliness. This could be considered a prevalence of the univariate autoregressive model, since the dependent variables are lags of explanatory variables as well as of the simultaneous equations, since a system of equations is simultaneously assessed. The VAR analysis is modelling each variable endogenous to the system in accordance with the former values of all system's endogenous variables(Sims, 1980).

One of the VAR model's characteristics is that it observes the dynamic structure of several variables at once, and the impulse response functions observe the propagation of a dependent variable shock within the system. The VAR models focus on the analysis of shocks upon the studied variables. The shocks represent that part of the variable's level that cannot be explained by historical dynamics or by other variables within the system. The main purpose of the VAR analysis is to assess the impact of various shocks on the variables within the system.In VAR models, the shock response function describes the impact of a shock conducted on a variable upon the future values of each variable within the system, by following the course of such impact over time, at various time-horizons.

On the other hand, the autoregressive vector methodology pays the price of rigid constraints that are implicitly imposed to variables. This leads, for certain specifications, to the emergence of responses to impulses that are inconsistent with the economic theory (inflation increase over a short time period upon a monetary policy shock, i.e. interest rate rises). These inconsistencies between assessments and the economic theory were called „puzzles". The empiric literature that studies the effects of the monetary policy has identified more than one puzzle: liquidity puzzle, i.e. a positive shock of the monetary aggregates is assigned to an interest rate augmentation instead of reduction, price puzzle, i.e. a positive shock of the interest rate is assigned to a price augmentation instead of reduction, exchange rate puzzle, i.e. a positive shock of the interest rate is assigned to a depreciation of the exchange rate instead of its appreciation and output puzzle, i.e. an augmentation of the production as result of a positive shock on the exchange rate.

The framework of our empiric analysis has been constructed following the example of our country and consequently we shall assess the following VAR model:

$$Y_t = \sum_{i=1}^{n} A_i Y_{t-i} + \mu_t$$

Where $Y_t$ is the vector of endogenous variables and $\mu_t$is the vector of normally distributed errors. $Y_t$has been constructed based on the quarterly data on real GDP growth ($y_t$), the inflation rate ($p_t$), the interest rate ($r_t$), the exchange rate ($ex_t$) and the interbank exchange rate ($r_t$).

One prerequisite for using the mentioned methodology is the stationarity of the series used. The tests suggest the stationarity, except for the interest rate, in some cases and at certain significance levels. Moreover, the VARs that have been run for both the entire period and the two sub-periods were stable. A VAR model is stable (stationary) if the effects of the shocks on the variable within the system diminish towards consumption after a certain period. If VAR is not stable (i.e. it is explosive), then the confidence intervals for shock response cannot be constructed, as the standard errors are not accountable by conventional methods. Moreover, the economists prefer to work with stable VARs, arguing that, actually, the explosive economic phenomena are extremely rare. VAR stability checks out when the eigenvalues are less than 1 in modulus and lie within the unit circle.

The next step is the selection of the number of lags to be considered, where the Akaike information criterion has been used, starting from a maximum of four, given that the sample is quite reduced. The same procedure has also been used for the mentioned time-subintervals. TableA1shows the results of the said test, the optimal lag being identified with *.In order to determine the shocks' impact we shall use the recursive Cholesky decomposition, the sequence of endogenous variables being as follows: GDP, inflation, actual exchange rare, interest rate.

$$Y_t = (y_t, p_t, ex_t, r_t)$$

Such sequence reflects the traditional hypotheses that refer to the short-term impact of the monetary shocks upon the real sphere. Hence, the shocks of the interest rate, the exchange rate and currency demand are not instantly affecting the real sphere, due to the slow adjustment of production and prices. The analysis used the following series: quarterly annualized growth rate of the real GDP, quarterly inflation rate (HICP, annualized), quarterly annualized variation of the real exchange rate on interbank interest rate3M. The source of these data is the Eurostat, the author carrying out seasonal adjustments for the real GDP series and the Harmonized Index of Consumer Prices (HIPC).

In what concerns the time-period used, the data availability has been taken into account when selecting the length of the intervals, namely 2000 Q1 - 2019 Q3, for a quarterly frequency. Subsequently, the specifications have also been assessed for two time subintervals, namely 2000 Q1 - 2008 Q3 and 2010 Q3 – 2019 Q3.

## III. EMPIRICAL RESULTS AND CONSIDERATIONS

This section presents the results. Whereas the analyzed interval shows a major shock determined by the global financial crisis, we split the assessments in three, i.e. 2000Q1-2019Q3 – full sample and two sub-samples – 2000 Q1 – 2008 Q3 and 2010 Q3 - 2019 Q3.

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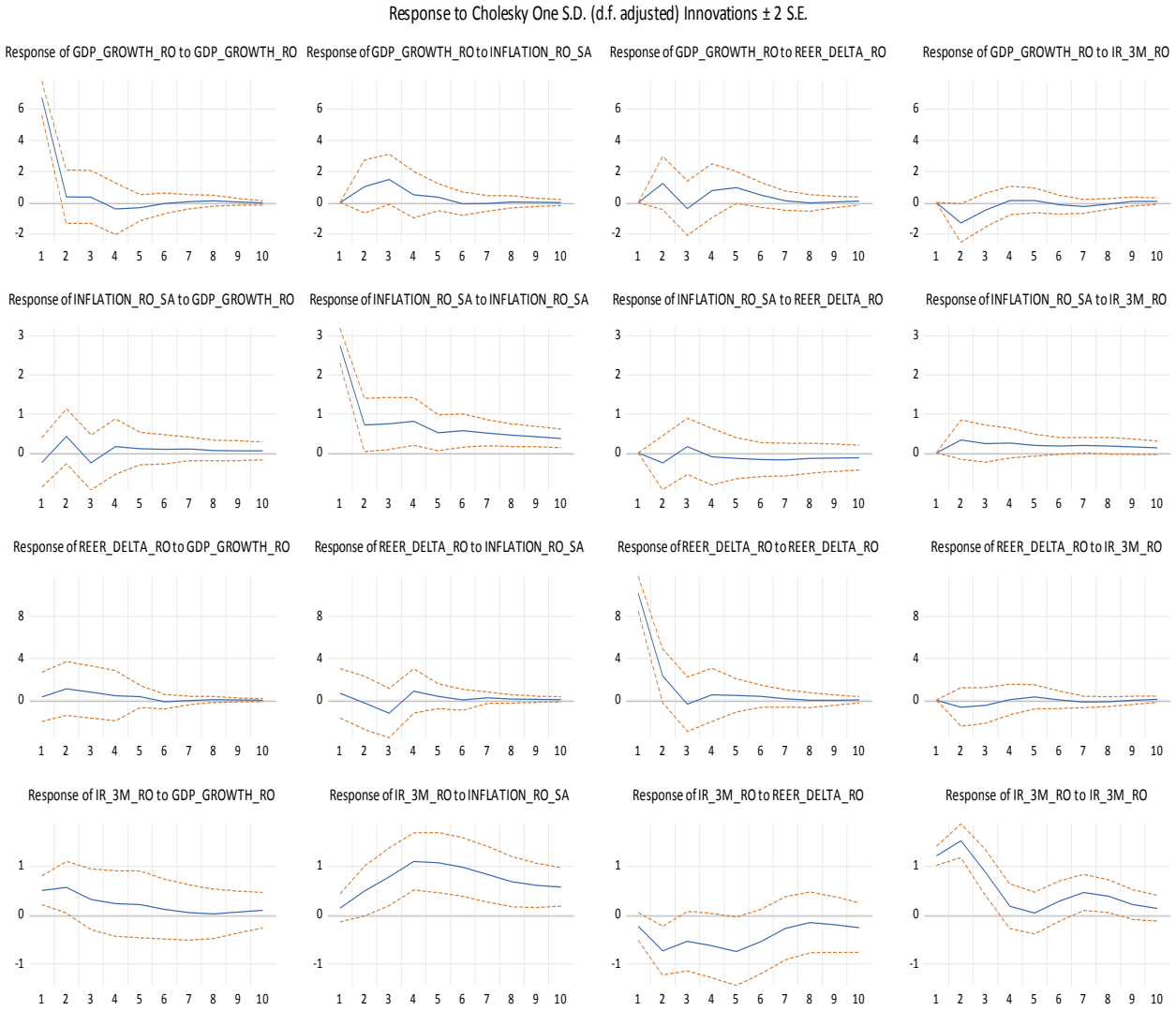
**Figure1: The results of the VAR model for Romania for the period 2000Q1-2019Q3**




*Source: authors own calculations*

We excluded from the sample two years approximately. This strategy will enable us to identify whether any changes occurred in the monetary policy transmission before and after the global financial crisis.

The results of VAR models for Romania show a high level of uncertainty (the following figures). Specifically, most of the shock response functions are statistically zero. A positive shock on the real GDP growth will entail a significant growth of production in the first quarter only.The shock

rapidly vanishes in the second quarter, so the effect is marginal. The effect of the GDP growth rate positive shock upon inflation is minor, while it entails a short-term appreciation of the exchange rate. In response to GDP growth rate, the interest rate will also grow.

A positive shock on the inflation rate will lead, surprisingly, to the real GDP growth. As well, one may notice that the persistency of inflation is high, the effect being very high in the first two quarters. The effect then stabilizes, the downward trend being minor. In our opinion, such response roots in the historical background of high inflation rate in Romania. A significant and unexpected growth determines a minor effect on the exchange rate. On the other hand, the interest rate grows. Such response is consistent with the response of the central banks to a positive shock on the inflation rate.

A positive shock on the exchange rate variation, i.e. the appreciation of the exchange rate, will have marginal effects on the real GDP growth rate and the inflation rate. Actually, their impact is zero. Instead, the interest rate decreases in order to counterbalance the appreciation of the exchange rate.

A positive shock on the interest rate will lead to a decrease of the real GDP growth rate in the first three quarters. The impact is minor and vanishes rapidly. Surprisingly, there is a slight growth in the inflation rate due to the growth of the interest rate, thus generating a price puzzle. Such effect can be explained by the working capital channel. As well, this function of response indicates the inflation inertia to the growth of the interest rate. This inertia has been determined by the endogenous character of the inflation in Romania or by the authorities' gradual approach with respect to price liberalization. As well, a positive shock on the exchange rate will determine a minor and short depreciation of the exchange rate.

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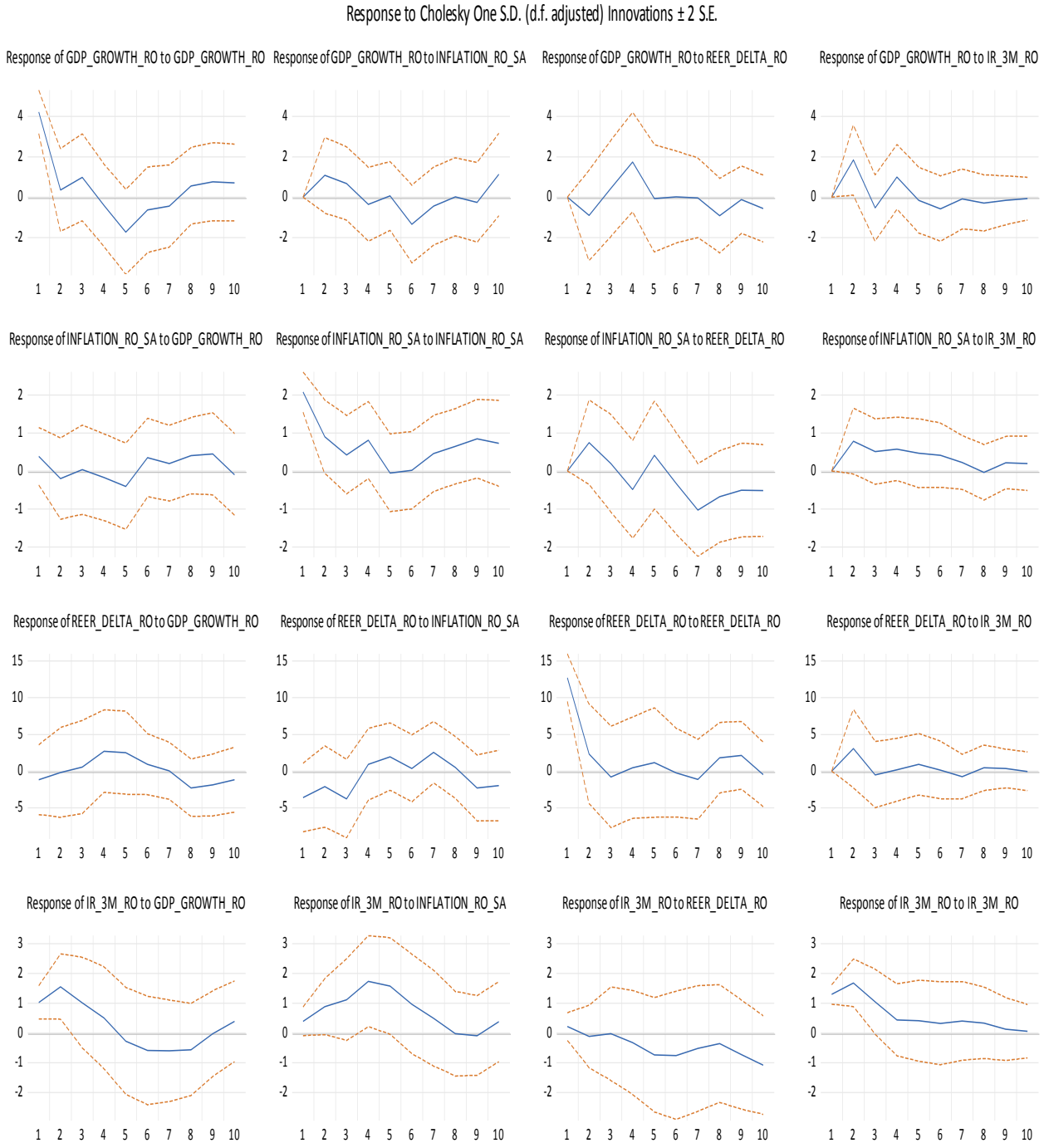
**Figure 2: The results of the VAR model for Romania for the period 2000 Q1-2008 Q3**




*Source: own calculations*

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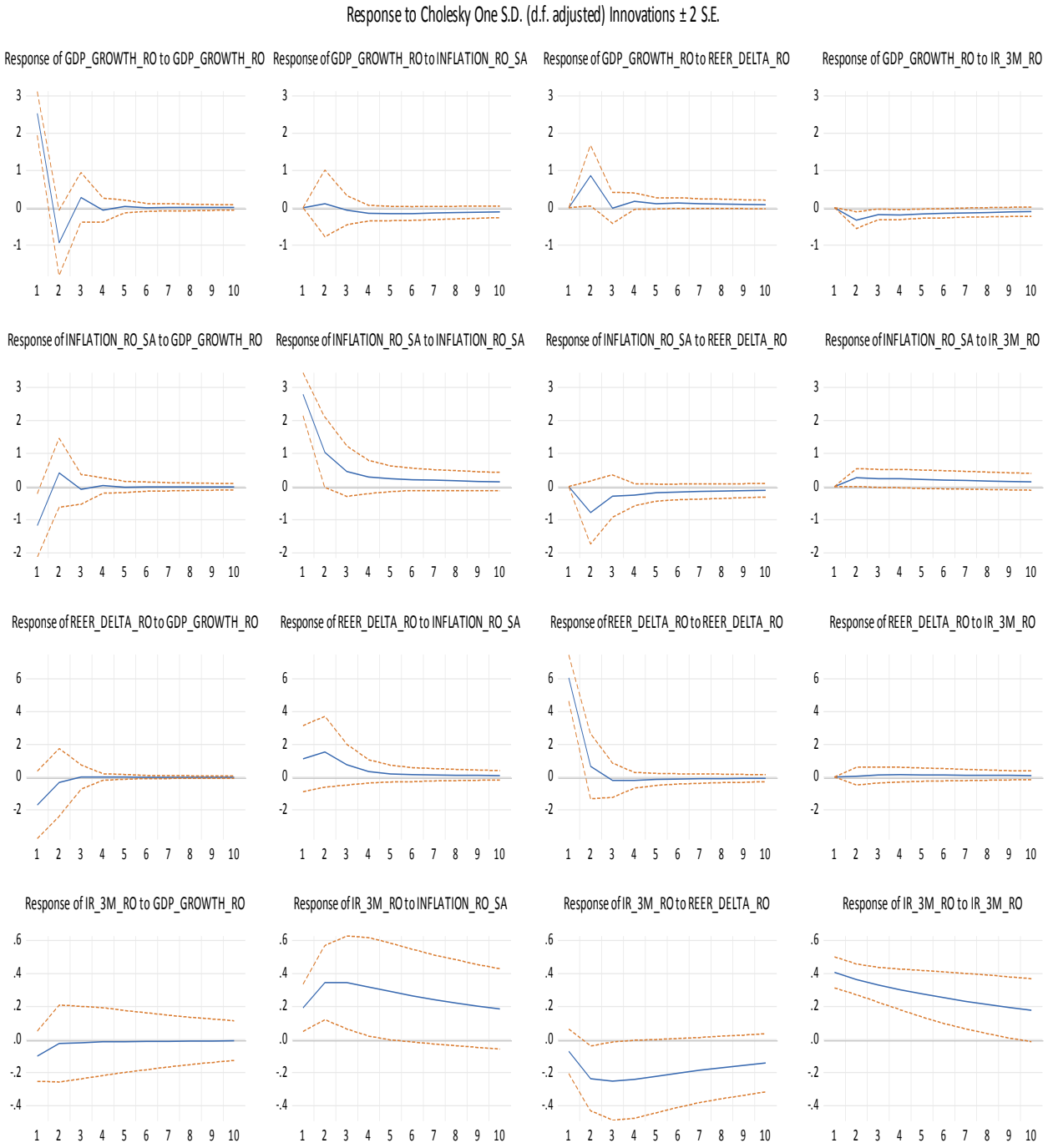
**Figure 3: The results of the VAR model for Romania for the period2010Q3-2019Q3**




*Source: own calculations*

During 2000Q1-2008Q3, the response functions have many inflexion points, the statistical significance diminishing even in case of robust responses. For instance, the interest rate response is not so consistent anymore. Specifically, after five quarters, the impact becomes negative. To be noted that the price puzzle phenomenon stands also in this time span. During 2010Q3-2019Q3, the results are different from those noted during 2000Q1-2008Q3. The inflexion points are missing and the impact of the shocks is minor or zero. Therefore, we may state that in Romania the effects of the shocks depend on the cycle's dynamics.

A positive shock on the interest rate generates an inflation growth, which is contrary to the economic theory. This emphasizes the ineffectiveness of the interest rate channel, as an instrument used by the central banks to control inflation. It is also notable the fact that a positive shock on the exchange rate generates important and persistent effects. The result underlines the importance of the exchange rate channel, which reflects, besides the effect of the exchange rate variation on the net exports, also the presence of significant return effects, due to the higher level of indebtedness in foreign currency in Romania. The analysis revealed a high level of uncertainty of the response functions. In this context, where the shocks' effects are asunder, the accession to a single monetary area may lead to reactions that are opposed to the assumed objectives. For instance, in certain states, the inflation rate may decrease, while in others it may increase as result of interest rate modification. Such responses encumber the mission of the central bank and require the correlation of the economic cycles.

## IV. CONCLUSIONS

This study presented the manner in which various variables react to economic shocks and the transmission mechanisms of the monetary policy in Romania. The result is that a positive shock on the exchange rate generates an increase of inflation, fact that is contrary to the economic theory. This puts forward the ineffectiveness of the exchange rate channel as an instrument used by the central bank to control inflation. In addition, a positive shock on the exchange rate generates significant and persistent effects, thus showing the importance of the exchange rate channel and reflecting, besides the effect of the exchange rate variation on the net exports, the presence of significant return effects, due to the higher level of indebtedness in foreign currency. The analysis revealed a high level of uncertainty of the response functions. In our opinion, possible explanation for such result is the lack of sound economic structures and of economic mechanisms that are specific for the transition to the market economy. The high level of uncertainty may be a disadvantage for the central bank in reaching its monetary policy objectives.

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**APPENDIX**

| **Table A 1: Akaike information criterion** | | | |
|---|---|---|---|
| Romania | 2000Q1-2019Q3 | 2000Q1-2008Q3 | 2010Q3-2019Q3 |
| 1 | 22.92899 | 23.15251 | 17.57596* |
| 2 | 22.83743 | 23.21645 | 17.97450 |
| 3 | 22.72701* | 22.89430 | 18.33694 |
| 4 | 22.73595 | 22.50986* | 17.70228 |

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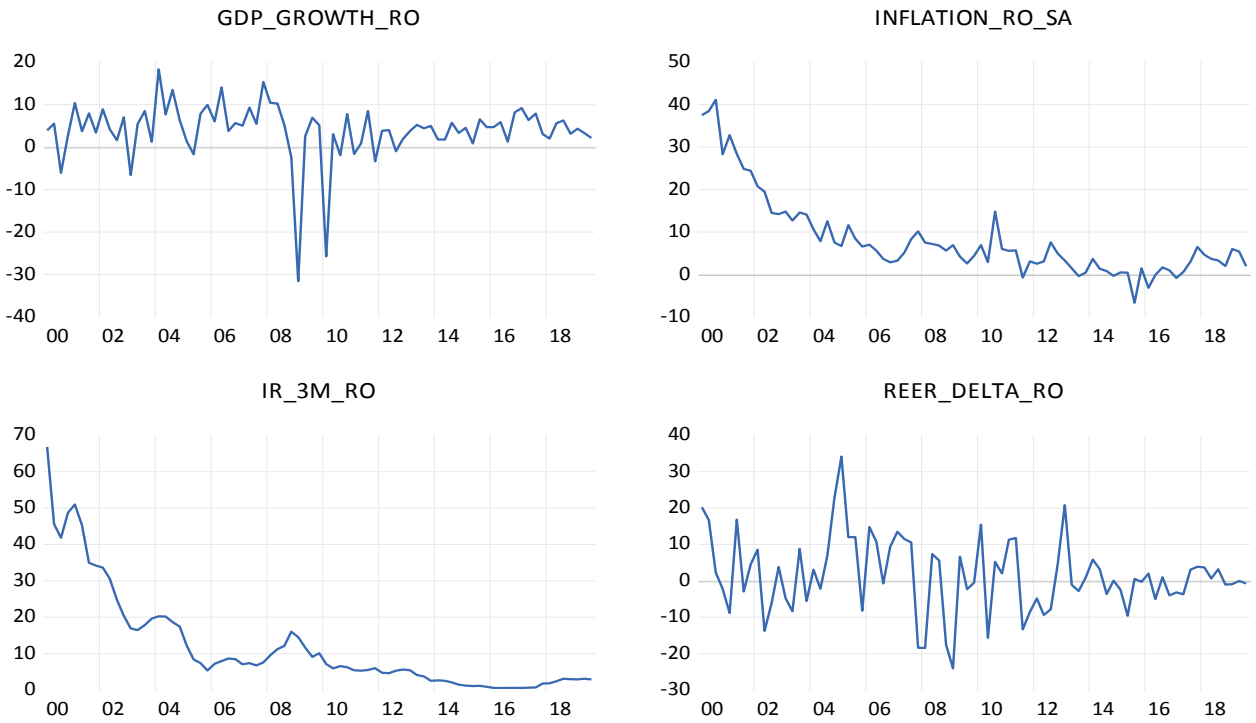
**Figure 4 The trend of certain data series in the case of Romania**




*Source: Eurostat and authors own calculation*