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MONETARY AND FISCAL POLICIES INTERACTIONS IN AN ESTIMATED NEW KEYNESIAN MODEL FOR ROMANIA

Abstract. *A New Keynesian model with fiscal and monetary policies interactions is tested for Romanian economy. The estimation is done on quarterly data using the Bayesian approach. There is clear evidence of interactions between monetary and fiscal policy both in the estimated reaction functions as well as in the historical decompositions of policy variables.*

Keywords: *New Keynesian models, fiscal policy, monetary policy, simulation techniques.*

JEL Classification: E52, E61, E63.

1. Introduction

The modeling with the help of New Keynesian models (NK, hereafter) of macroeconomic dynamics focused in the first place on the role of monetary policy. Not too much attention was paid to the modeling of fiscal policy within NK models, although after 2000 several models accounted for this deficiency, see Gali, Lopez and Salido (2007) for one of the recent approaches.

However, the initial wave of studies on fiscal policy within the NK paradigm treated fiscal and monetary policies as essentially separated, although such autonomy is hard to be considered as realistic, especially in the context of the aftermath effects of the current crisis that underlined the need of macroeconomic policy coordination. Addressing this deficiency, several recent models approached the modeling of monetary and fiscal policy by considering the hypothesis of strategic coordination between them. Early evidence in the favor of the existence of interactions between monetary and fiscal policies were found by Leith and Wren-Lewis (2000), Muscatelli et al. (2004), Beetsma and Jensen (2005), Favero and Monacelli (2005), or Kirsanova, Stehn and Vines (2005).

Fragetta and Kirsanova (2010) readdressed the same issue for a sample of developed economies. They considered a New Keynesian model with monetary and fiscal policies interactions for several economies, Sweden, UK, and US. The model was estimated by considering different specifications for the monetary and fiscal policy rules that took into account different hypothesis about how the macroeconomic policies interact and are coordinated.

In this paper we approach the monetary and fiscal policy in Romanian economy within a NK model. The NK model is of a small open economy type and, despite its simplicity, can serve as a tool to discuss policy interactions and their effect on economic activity.

2. A New Keynesian model with Monetary and Fiscal Policies Interactions

The approach in this paper is based on the model due to Fragetta and Kirsanova (2010), which builds on the well known small open economy model due to Lubik and Schorfheide (2007). The model is presented in the log-linear form, but the reader may find the detailed derivation of equations in the above references.

$$y_t = E_t y_{t+1} - \frac{1}{\sigma_a}(r_t - E_t\pi_{t+1}) - E_t g_{t+1} + g_t - \frac{(1+\varphi)(1+\rho_a)}{\sigma_a} a_t - \frac{\alpha\varphi(\omega-1)}{\sigma_a+\varphi}(1-\rho_{y^*})y_t^* \quad (1)$$

$$\pi_t = \beta E_t\pi_{t+1} + \lambda\left((\sigma_a+\varphi)(y_t - y_t^n) - \sigma_a g_t\right) + \varepsilon_t^{\pi} \quad (2)$$

$$y_t^n = \frac{(1+\varphi)}{\sigma_a+\varphi} a_t - \frac{(\sigma-\sigma_a)}{\sigma_a+\varphi} y_t^* \quad (3)$$

$$b_{t+1} = r_t + \frac{1}{\beta}\left(b_t - \pi_t + \frac{C}{B} g_t + \frac{1-C-\tau}{B} y_t\right) \quad (4)$$

$$r_t = \rho_r r_{t-1} + (1-\rho_r)(\rho_\pi \pi_t + \rho_y y_{t-1}) + \rho_{rb} b_t + \rho_{rglag} g_{t-1} + \varepsilon_t^r \quad (5)$$

$$g_t = \rho_g g_{t-1} + (1-\rho_g)(\rho_{g\pi}\pi_t + \rho_{gy} y_{t-1}) + \rho_{gb} b_t + \rho_{grlag} r_{t-1} + \varepsilon_t^g \quad (6)$$

$$a_t = \rho_a a_{t-1} + \varepsilon_t^a \quad (7)$$

$$y_t^* = \rho_{y^*} y_{t-1}^* + \varepsilon_t^{y^*} \quad (8)$$

The first equation, equation (1), describes an open economy IS curve. The domestic GDP, y_t, depends on its own expected value y_{t+1}, on the real interest rate, on governmental expenditure g_t, productivity a_t, as well as external production y_t^*. For the external production and productivity, as other papers that estimate open economy models, AR(1) processes are assumed, see equations (7) and (8).

The NK Phillips curve is presented in equation (2), with current inflation π_t depending on expected inflation π_{t+1}, output gap (the difference between actual GDP and potential GDP y_t^n).

Potential GDP is expressed in the third equation, as depending on productivity a_t, as well as foreign production, y_t^*.

Equation (4) determines the dynamics of public debt b_t, with B the steady state ratio between public debt and GDP, C the steady state ration between private consumption and GDP and τ the income tax rate.

The monetary and fiscal policy rules are specified in equations (5) and (6), following the usual approaches in the literature, especially Fragetta and Kirsanova (2010). The specification assumes simultaneity in the design of monetary and fiscal policies.

3. Estimation

The model was estimated on quarterly data for Romanian economy. The data source was the Eurostat website. The data series consisted in quarterly time series for GDP (GDP in constant prices 2000), quarterly inflation proxied by the quarterly GDP deflator, quarterly interest rate given by the quarterly average of monthly interest rate as set by the national bank, governmental expenditures in constant prices 2000 as well as foreign output, proxied by the Euro Area GDP in constant prices 2000. In order to ensure the presence of stationarity, the series were seasonally adjusted and filtered using the Hodrick Prescott filter (a rather standard approach in the literature).

Where not possible, due to the small sample, see Saman et al. (2010) for a discussion of the issue of small samples and noisy data for Romanian case, the parameters were calibrated using results from the literature or previous studies for Romania, see Caraiani (2010) for another example of calibration Romanian economy. The parameter β, the discount factor, was calibrated at 0.99, as in the literature. In the same way, as they could not be estimated using available data, the parameters ε, σ, ψ and η were calibrated based on the data from literature, mostly from Fragetta and Kirsanova (2010) or Lubik and Schorfheide (2007). Estimating such parameters is almost impossible as the necessary microeconomic studies are not available for Romania. The long run share of capital and debt to GDP were set according to the available data for Romanian economy from national accounts. The remaining parameters were estimated. Although they represent a smaller part of the initial set of parameters, nevertheless they reflect the key aspects of the model.

Table 1

Model Estimation

PARAMETERS	PRIOR MEAN	POSTERIOR MEAN	CONFIDENCE INTERVAL	CONFIDENCE INTERVAL	PRIOR DISTRIBUTION	STANDARD DEVIATION
θ	0.70	0.92	0.88	0.97	Beta	0.15
ρ_r	0.70	0.52	0.41	0.64	Normal	0.15
ρ_π	1.50	1.36	1.11	1.60	Normal	0.15
ρ_y	0.20	0.60	0.40	0.81	Normal	0.15
ρ_{rglag}	0.00	0.004	-0.012	0.020	Normal	0.15
ρ_{rb}	0.00	0.004	-0.003	0.013	Normal	0.005
ρ_g	0.70	0.58	0.34	0.87	Normal	0.15
ρg_π	-0.20	-0.19	-0.35	-0.03	Normal	0.15
ρg_y	0.00	0.041	-0.125	0.20	Normal	0.15
ρ_{grlag}	0.01	0.009	-0.006	0.026	Normal	0.15
ρ_{gb}	-0.05	-0.049	-0.051	-0.048	Normal	0.005
ρ_{yf}	0.70	0.68	0.47	0.89	Beta	0.15
ρ_a	0.70	0.49	0.31	0.67	Beta	0.15
σr	0.10	0.044	0.036	0.052	Inverted Gamma	Infinite
σg	0.10	0.1088	0.085	0.130	Inverted Gamma	Infinite
σa	0.10	0.1433	0.107	0.177	Inverted Gamma	Infinite
σy	0.10	0.0133	0.011	0.014	Inverted Gamma	Infinite
σepi	0.10	0.0404	0.032	0.047	Inverted Gamma	Infinite

Source: own computations

As in usual way in the literature, the Bayesian approach was implemented through the simulation of two Metropolis Hastings chains each of 500.000 extractions. The length was set by having in mind the need to ensure convergence for each estimated parameter. The average acceptance ratio was of 26.49% for the first chain, and of 26.61% for the second one, which is within the optimal range that the literature suggests of 20% to 40%. The prior and posterior distributions are presented in Annex 1 and indicate reasonable differences of posterior distributions from the prior ones for most of the parameters. The convergence statistics following Brooks-Gelman are presented in Annexes 2 and 3 and show that convergence was reached in each case.

The results are mostly in line with previous findings for Romania, see Table 1 for the results. The parameter θ, characterizing the price rigidity, was estimated at 0.92, suggesting a high degree of price rigidity.

The estimation of monetary policy rule indicates a moderate degree of interest rate smoothing as ρ_r was estimated at 0.52. The national bank appears as moderately conservative, with the coefficient related to inflation reaction estimated at 1.36. There is also a positive but small influence of the fiscal variables.

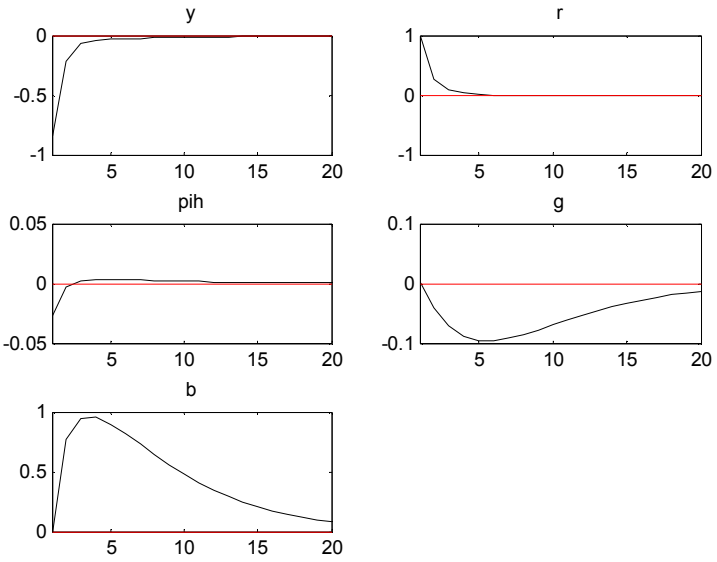
As for the fiscal rules, the smoothing coefficient is much higher, indicating a higher gradualism for fiscal policy. The signs for inflation and output coefficients are as theoretical expected, underlining the role of pro-cyclical fiscal policy. The national bank's interest rate also appears as a driver of the fiscal policy, although not in a strong manner.

4. Fiscal and Monetary Policy Interactions

In this section we discuss the impact of monetary and fiscal policy shocks. We consider both impulse response functions analysis as well as shock decompositions for the policy variables as well as output.

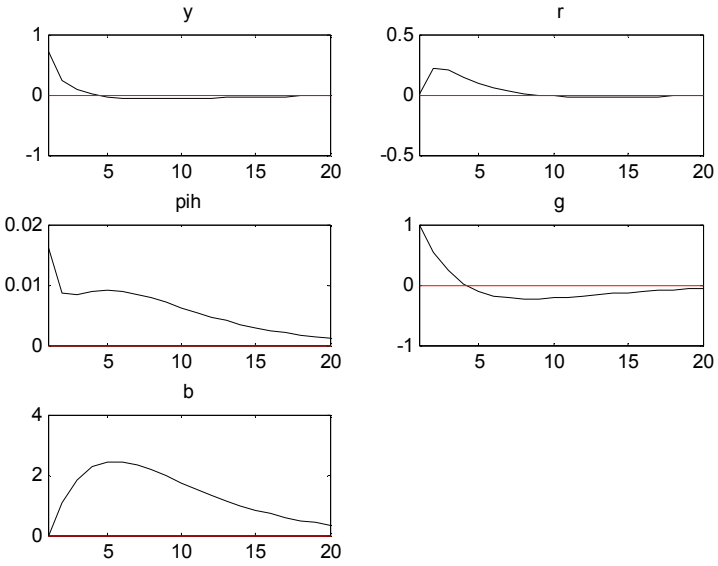
The impulse response function analysis is done by considering the impact of monetary and fiscal policies shocks assumed to be unexpected, uncorrelated and of a magnitude of 1%. The model was simulated based on the calibrated values of the parameters. For the estimated parameters, posterior means were chosen for the simulations.

Figure 1
Monetary policy shocks impact



Source: own computations

Figure 2
Fiscal Policy Shocks Impact



Source: Own computations

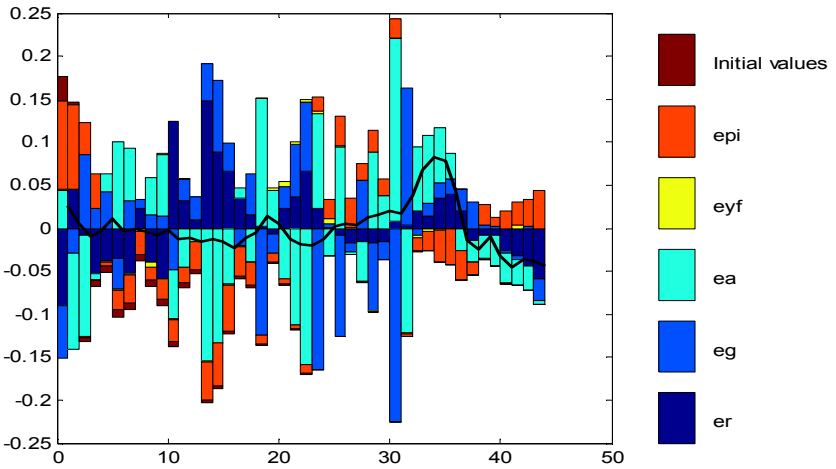
Figure 1 shows the impact of a positive shock in monetary policy, through the interest rate, on the endogenous variables. We assume that the shock produces in the initial period and that is of 1%. As expected, the production responds negatively, with a maximum negative impact of -0.7%. Fiscal policy behaves pro-cyclical, with a decrease of -0.1% at the peak. We also notice a hump-shaped reaction function for the fiscal variable.

The next shock we analyze is that of fiscal policy, see Figure 2. Again, it is assumed a 1% positive shock that is produced in the initial period. There is an immediate impact on production (this might be also a limitation of the model) with the maximum effect at 0.8%. The monetary policy is again countercyclical, the national bank responding to the accelerated economic growth by an increased in the interest rate by approximately 0.2%-0.3%, at the peak.

Overall, the results indicate a pro-cyclical fiscal policy and, at the same time, a counter-cyclical monetary policy. Moreover, policy variables respond to changes in each other and tend to react in different directions to the changing economic conditions.

We extend the analysis on the interactions and behavior of monetary and fiscal policies by using shock decomposition for output and the two policy variables, the monetary and the fiscal variable.

Figure 3
Shock decomposition for output



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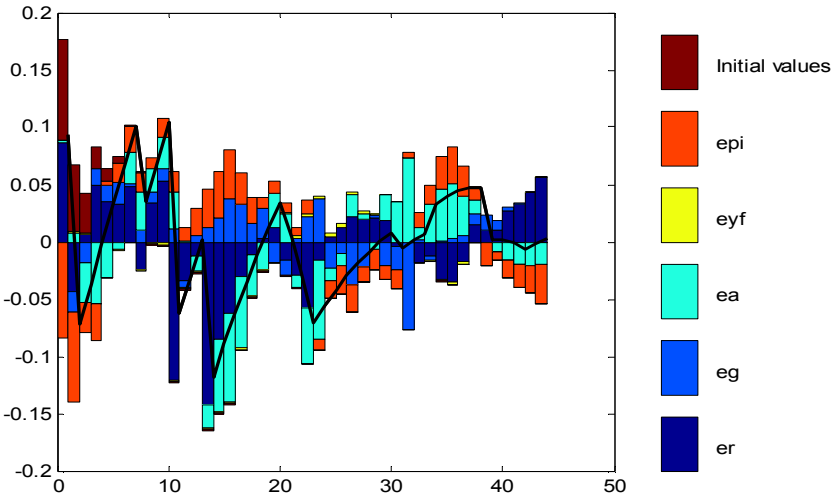
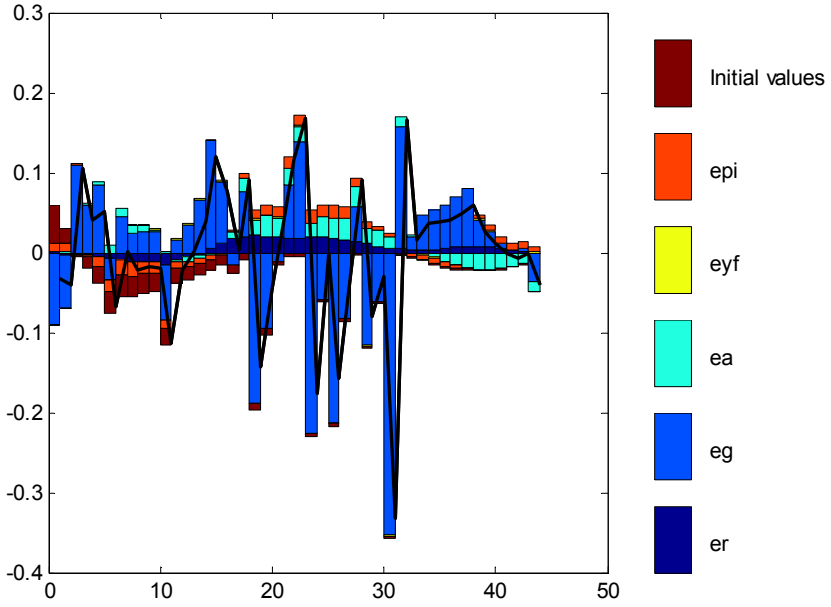


Figure 4
Shock decomposition for interest rate
Source: own computations

Figure 5
Shock decomposition for government expenditures



Source: own computations

The decomposition of shocks, as evidenced from Figure 4 to 6, shows in which measure the shocks in fiscal policy and monetary policy contributed to the dynamics of each other as well as how they influence the overall dynamics of one of the key macroeconomic variables, the output. We find further evidence that the monetary and fiscal policies influence each other as underlined in the graphs of each policy variables. Although a policy variable's own shocks have more influence, they also drive the dynamics of the other policy variable.

The shock decomposition for output, Figure 4, further outlines how output was driven by both fiscal and monetary policies shocks. Fiscal policy appears again as pro-cyclical during the last cycle, as it accelerated the economic growth during the last years of growth toward 2008, and then it contributed to the rapid economic decline. However the behaviors of both monetary and fiscal policies appear to have mixed contributions if we take into consideration the whole sample.

5. Conclusion

In this paper we found clear evidence on the existence of interactions between monetary and fiscal policy. This was outlined through the estimated reaction function which showed significant coefficients for the influence of one policy variable on the other, through the fiscal and monetary impulse response functions as well as through shock decompositions. This paper is a first step into the direction of a better understanding of how monetary and fiscal policies interact in Romania and can help in the understanding, design and coordination of them.

Further understanding of monetary and fiscal policies interaction could be done by considering more specific elements that characterize the new member states and by integrating into the NK models elements fiscal constraints specific to these economies, see Altar et al. (2010) or Talpos et al. (2011) for some recent studies on fiscal issues in Romanian economy.

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REFERENCES

[1] **Altar, M., C. Necula, and G. Bobeica (2010),** ***Estimating the Cyclically Adjusted Budget Balance for the Romanian Economy. A Robust Approach***. *Romanian Journal of Economic Forecasting 13 (2)*, 79-99;

[2] **Beetsma, R. and H. Jensen (2005),** ***Monetary and Fiscal Policy Interactions in a Micro-founded Model of a Monetary Union***. *Journal of International Economic 67(2)*, 320-352;

[3] **Caraiani, P. (2010), The Role of Financial Frictions in the Dynamics of Romanian Economy.** *Economic Computation and Economic Cybernetics Studies and Research 44 (3),*147-158;

[4] **Dixit, A. and L. Lambertini (2003) ,** ***Interactions of Commitment and Discretion in Monetary and Fiscal Policies***. *American Economic Review 93*, 1522-1542;

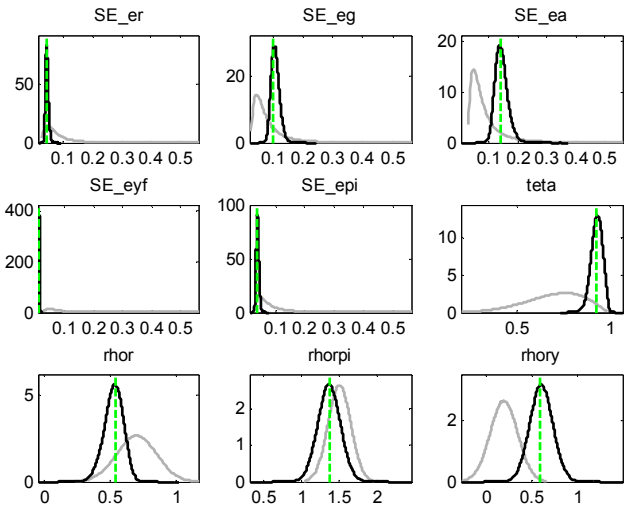
[5] **Dobrescu, E. (2010) ,** ***Macromodel Simulations for the Romanian Economy***. *Romanian Journal of Economic Forecasting* 13 (2), 7-28;

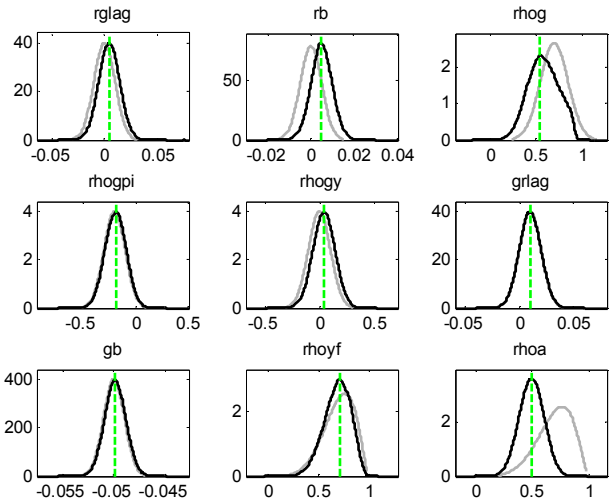
[6] **Favero, C. and T. Monacelli. (2005),** ***Fiscal Policy Rules and Regime (In)Stability: Evidence from the U.S.*** Mimeo, University of Bocconi;

[7] **Fragetta, M., T. Kirsanova. (2010),** ***Strategic Monetary and Fiscal Policy Interactions: An Empirical Investigation***. *European Economic Review 54(7)*, 855-879;

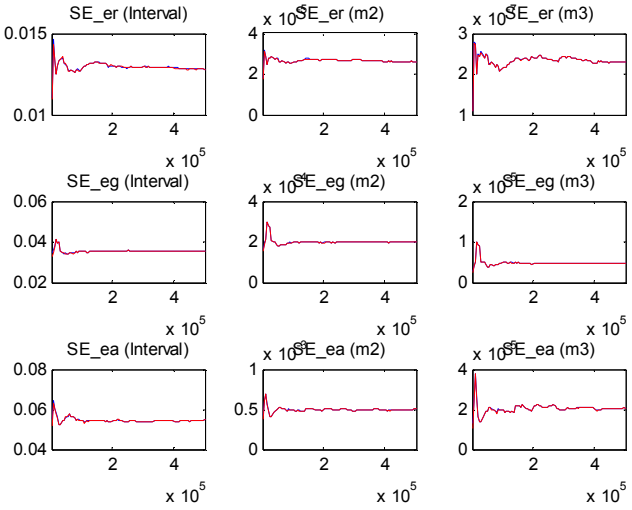
[8] **Kirsanova, T., S.J. Stehn, D. Vines (2005),** ***A Simple View of the Interactions between Fiscal Policy and Monetary Policy***. *Oxford Review of Economic Policy 21(4)*;
[9] **Leith, C. and S. Wren-Lewis (2000) ,*Interactions between Monetary and Fiscal Policy Rules***. *The Economic Journal 110*: C93-C108;
[10] **Lubik, T., F. Schorfheide (2007),** ***Do Central Banks Respond to Exchange Rate Movements? A Structural Investigation*** *; Journal of Monetary Economics 54(4)*, 1069-1087;
[11] **Muscatelli, A., P. Tirelli and C. Trecroci. (2004) ,** ***Fiscal and Monetary Policy Interactions: Empirical Evidence and Optimal Policy Using a Structural Neo-Keynesian Model*** . *Journal of Macroeconomics 26*, 257-280;
[12] **Saman, C., C. Scutaru and C. Stanica. (2010),** ***Predictability and Complexity: The Case of the Export and Import as GDP Components in the Romanian Economy.*** *Economic Computation and Economic Cybernetics Studies and Research 44 (1)*, 131-146;
[13] **Talpos, I., B. Dima, Al. Crâsneac and M. Mutascu. (2011) ,** ***Fiscal Decentralization and Tax Competition in the EU Member States***. *Economic Computation and Economic Cybernetics Studies and Research 45 (2)*, 93-104;
[14] **Woods, R. (2005),** ***Fiscal Stabilization and EMU.*** *CESifo Economic Studies 51(4)*, 601-647.

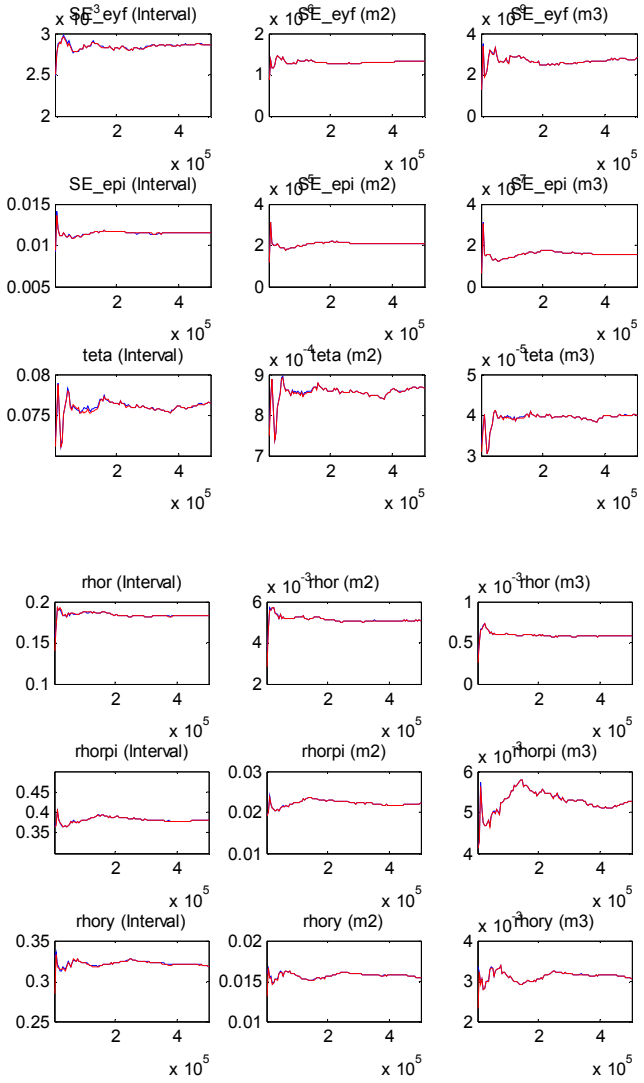
Annex 1. Posterior Distributions





Annex 2. Univariate convergence statistics

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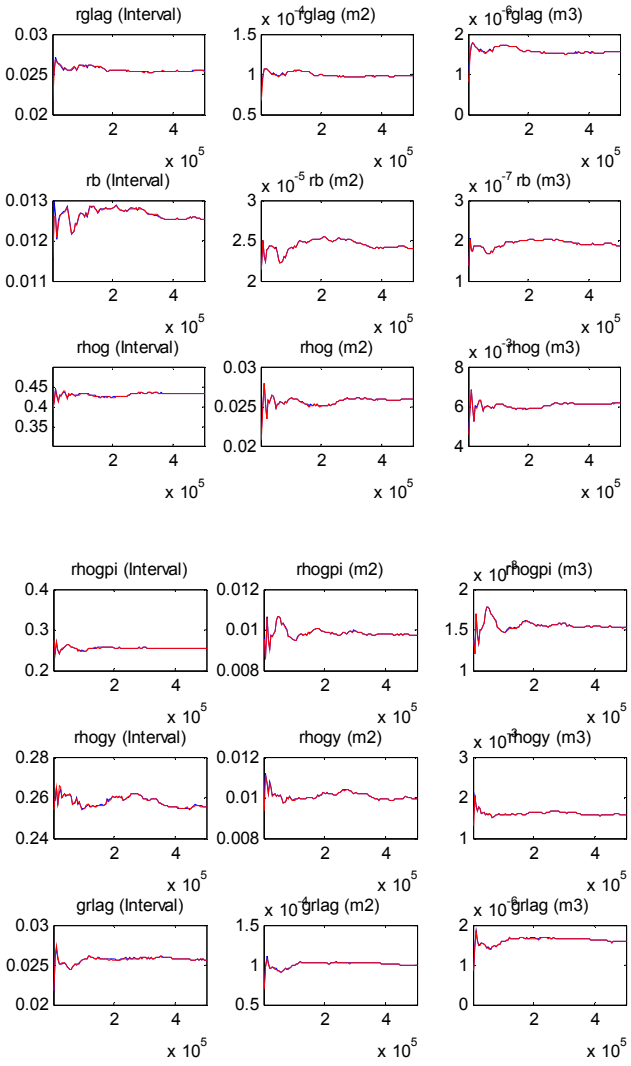
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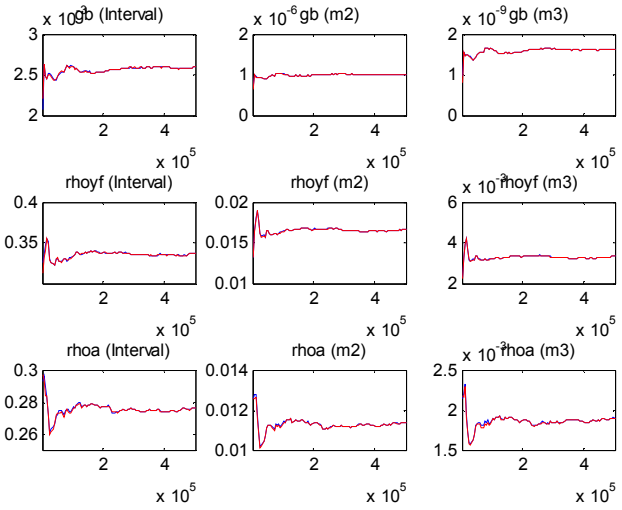

Annex 3. Multivariate convergence statistics