Impact of the global crisis on the linkages between the interest rates and the stock prices in Romania

Razvan Stefanescu and Ramona Dumitriu

University "Dunarea de Jos" of Galati, University "Dunarea de Jos" of Galati

24. April 2010

The International Conference on Economics and Administration, Faculty of Business and Administration, University of Bucharest, Romania
ICEA – FAA Bucharest, 4-5th June 2010

IMPACT OF THE GLOBAL CRISIS ON THE LINKAGES BETWEEN THE INTEREST RATES AND THE STOCK PRICES IN ROMANIA

STEFANESCU Razvan
University "Dunarea de Jos" Galati, Faculty of Economics
rzvn_stefanescu@yahoo.com

DUMITRIU Ramona
University "Dunarea de Jos" Galati, Faculty of Economics
rdumitriu@ugal.ro

Abstract *Very often the crisis induces changes in the linkages between the financial variables. This paper explores, through a Vector Autoregression model and Granger Causality tests, the impact of the global crisis on the relation between the Romanian stock prices and the interest rates. We found this relation was very weak before the crisis, when the Romanian stock market experienced an ascendant trend. Instead, it became quite significant during the crisis when the financial markets are very sensitive to the external stimuli and the monetary policy has to take into consideration the impact of interest rates on the stock prices.*

Key words: Granger causality, Vector Autoregression, Romanian stock market, interest rates, global crisis

JEL classification: E43, E52, G10, G12

1. Introduction

In this paper we approach the changes induced by the global crisis in the relation between the interest rates and the stock prices from Romania. The study of this relation is important for the monetary policy decisions and for the attempts to predict the stock markets evolution. In this article we explore the linkages between the interest rates and the stock prices from October 2008 to March 2010, when the Romanian economy was affected significantly by the global crisis.

As a base for the comparison we use a period of time from January 2007 to September 2008. In our analysis we use the daily values of ROBOR 3M, a reference for the interest rates at which the banks could borrow three months unsecured funds from other banks in the Romanian interbank market and BET – XT, a representative index compound on the most liquid 25 shares traded on the Bucharest Stock Exchange (BSE). We identify the linkages between the two variables using a Vector Autoregressive (VAR) model and Granger Causality tests.

During the year 2007, ROBOR 3M experienced an ascendant trend reflecting a prudent monetary policy applied by the National Bank of Romania (NBR). During the first ten months of 2008, in the context of substantial threats for the monetary stability, the interest rates were raised until much higher levels. Between 15 and 20 October, facing significant speculators attacks against the national currency, NBR determined a major growing of ROBOR 3M from 15 to 49 percents. After this episode, in an attempt to stimulate the national economy affected by the global crisis, NBR slowly reduced the interest rates (Figure 1).

After Romania's adhesion to the European Union, in January 2007, BET – XT experienced months of substantial increase. During 2008 the Romanian stock market was in decline, induced by the evolution of the international financial markets. After that, the stock prices regained the ascendant trend, but their values were much lower in comparison with those from 2007 (Figure 2).

The impact of crisis on the linkages between interest rates and stock prices was revealed in several papers (for example, Blanchard;

1981, Kindleberger and Aliber; 2005, Bordo et al.; 2007). To our knowledge, until now no attempt was made to evaluate the impact of the actual global crisis on the relation between the interest rates and the stock prices from Romania. Although the end of this crisis is still far, this paper could provide a basis for further researches on this theme.

The rest of this paper is organized as follows. The second part approaches the specialized literature, the third part describes the data and the methodology employed, the fourth part presents the empirical results and the fifth part concludes.

2. Literature Review

The relation between the interest rates and the stock prices was largely approached in the specialized literature. Bernanke and Kuttner (2005) studied the mechanisms by which the stock prices were affected by the interest rates. In general, the investors compare the earnings offered by the stocks with the earnings provided by the bonds or by the bank deposits. They are also sensitive to the operations financing cost.

It is well known that an increase of the interest rates lead to a decline of the economic activity which reduces the dividends. Such potential evolutions influence the expectations regarding the stock prices which have an important role, at least on short term. The impact of the interest rates variation on the stock prices was approached in the Efficient Market Hypothesis (EHM) framework. According to this theory, in case of rational expectations of the investors, only unanticipated changes could generate shocks in the stock prices evolution (Fama; 1970).

The influence of the stock prices on the interest rates is related to the monetary policy issues. Bernanke and Gertler (2001) describe the circumstances in which central banks reacted to asset prices evolution. In general, a central bank has adequate tools to determine the interest rates evolutions. In implementing the monetary policy a central bank has to take into consideration the impact of the stock market evolution on the macroeconomic stability (Cecchetti et al.; 2000).

The asset booms and the busts could have inflationary effects, while a stock crush could bring the national economy into recession (Kent and Lowe; 1997). The extent to which the monetary policy should react to the stock prices changes is still a controversial subject (Goodfriend; 2003).

Very often, the financial crisis induced substantial transformations in the relation between the interest rates and the stock prices. In such a context the financial markets become more sensitive to the external evolutions, while the central bank is much careful not to aggravate the stock prices decline (Kindleberger and Aliber; 2005).

3. Data and Methodology

In our analysis we employ daily values of ROBOR 3M, provided by the National Bank of Romania (NBR) and daily closing values of BET-XT, provided by the Bucharest Stock Exchange (BSE). Our data cover the period of time between 3 January 2007 and 31 March 2010. We divide this sample in two sub – samples:

- The first sub-sample, from 3 January 2007 to 30 September 2008, corresponding to a relative tranquil period of time;
- The second sub-sample, from 1 October 2008 to 31 March 2010, when the global crisis affected substantially the financial markets from Romania.

We use the returns of the two variables:

$$RROB=(\ln ROBOR\ 3M_t - \ln ROBOR\ 3M_{t-1})*100 \quad (1)$$

and:

$$RBETXT = (\ln BET\text{-}XT_t - \ln BET\text{-}XT_{t-1}) * 100 \quad (2)$$

where:

- ROBOR $3M_t$ and ROBOR $3M_{t-1}$ are the values of three months ROBOR in the day t, respectively t-1;
- BET-XT_t and BET-XT_{t-1} are the values of BET-XT index in the day t, respectively t-1.

The descriptive statistics of the two variables for the two sub – samples are presented in the Tables 1, 2, 3 and 4. They indicate significant differences between the

evolutions in the two periods of time. For all four time series the null hypothesis of normality was rejected.

In order to avoid the spurious regression we test the stationarity of the four time series. We begin with the classical Augmented Dickey-Fuller Test. The numbers of lags were chosen based on the Akaike Information Criterion. Based on the graphical representation we use two forms of test: one with no constant and no trend, other with constant and no trend (Figures 3, 4, 5 and 6). The results, presented in the Tables 5 and 6, indicate the stationarity of all four time series.

Because of the two variables complex evolutions we double the Augmented Dickey-Fuller Test with the test proposed by Saikkonen and Lutkepohl (2002) and Lanne et al (2002) which allows taking into account the eventual structural breaks. The shift functions were chosen based on the graphical representation. For RROB we used an impulse dummy for both sub – samples, while for RBEXT we use, also for both sub – samples, a shift dummy. In the Tables 7 and 8 there are presented the results of the tests indicating the stationarity of all four time series.

The interactions between RROB and RBEXT for the two samples will be studied using the Vector Autoregressive (VAR) models. The number of lags for the VAR model is chosen based on the Schwartz Bayesian Criterion. In the VAR framework we test the Granger causality between the two variables.

4. Empirical Results

Based on the graphical representation we used intercept and trend as deterministic variables for the VAR equations of the first sub-sample. The coefficients of the two equations are presented in the Table 9. The values of R-squared coefficients suggested, for both equations, weak linkages between the variables.

The impulses – responses between RROB and RBETXT are shown in the Figure 7. A shock in RROB leads initially to a decline in RBETXT. However, after some fluctuations, RBETXT is back to the initial level. A shock in RBETXT provokes the decline of RROB followed by a recovery. In the Table 11 there are presented the results of the Granger causality tests for the first sub-sample. They indicate no causality between the two variables.

For the second sub – sample the graphical representation suggests using only intercept as deterministic variable for the VAR equations. In the Table 10 there are presented the coefficients of the two equations. The values of R-squared coefficients indicate a significant influence for the first equation (with RROB as dependent variable). The Figure 8 shows the impulses – responses between RROB and RBETXT. A shock in one of the two variables provokes a fluctuant evolution of the other variable which finally is back to the initial level. The Granger causality tests for the second sub-sample are presented in the Table 12, proving a bi-directional causality between the two variables.

5. Conclusions and implications

In this paper we studied the relation between the Romanian stock prices and the interest rates before and during the global crisis. We use a VAR model employing daily values of BET – XT and ROBOR 3M.

The results indicate quite weak linkages between the interest rates and the stock prices before the global crisis. This situation could be explained by the economic trend from this period of time. The stock market experienced an ascendant trend which was quite insensitive to the interest rates. The monetary policy was applied with less regard to the stock market.

During the global crisis we found significant linkages between the two variables. A bi-directional Granger causality was revealed by the tests, suggesting that in the global crisis context the stock prices became much more sensitive to the interest rates evolution. In these circumstances the management of the monetary policy has to take into consideration the interest rates impact on the stock market.

This investigation could be continued in the future, in the next phases of the global crisis, when the relation between the interest rates and the stock prices could suffer changes.

References

1. Bernanke, B. S. and Gertler, Mark. (2001) *Should Central Banks Respond to Movements in Asset Prices?*, American Economic Review 91(3), pp. 253-57.
2. Bernanke, B. S. and Gertler, M. (1999) *Monetary Policy and Asset Volatility*, Federal Reserve Bank of Kansas City Economic Review 84(4), pp. 17-52.
3. Bernanke, B. S. and Kuttner, K.N. (2005) *What Explains the Stock Market's Reaction to Federal Reserve Policy?,* Journal of Finance 60(3), pp. 1221-57.
4. Bordo, M.D., Dueker, M. J. and Wheelock, D. C. (2007) *Monetary Policy and Stock Market Booms and Busts in the 20th Century*, Federal Reserve Bank of St. Louis, Research Division.
5. Blanchard, O. J. (1981) *Output, the stock market, and interest rates*, *American Economic Review*, 71, pp. 132–43.
6. Cecchetti, S.G.; Genberg, H.; Lipsky, J. and Wadhwani, S. (2000) *Asset Prices and Central Bank Policy*, Geneva Reports on the World Economy 2, International Center for Monetary and Banking Studies and Centre for Economic Policy Research.
7. Fama, E.F. (1970) *Efficient capital markets: a review of theory and empirical work*, Journal of Finance, 25, 383-417.
8. Flannery, M.J. and James, C.M. (1984) *The Effect of Interest Rate Changes in The Common Stock Returns of Financial Institutions,* Journal of Finance, Vol. 39, 1141-1153.
9. Goodfriend, M. (2003) *Interest Rates Policy Should Not React Directly to Asset Prices*, in William C. Hunter, George G. Kaufman, and Michael Pomerleano, eds., *Asset Price Bubbles: The Implications for Monetary, Regulatory, and International Policies*. Cambridge, MA: The MIT Press, pp. 445-57.
10. Granger, C.W.J. (1969) *Investigating Causal Relations by Econometric Models and Cross-Spectral Methods*, *Econometrica*.
11. Hayford, M. D. and Malliaris, A.G. (2004) *Monetary Policy and the U.S. Stock Market*. Economic Inquiry, 42(3), pp. 387-401.
12. Kent, C., Lowe, P. (1997) *Asset price bubbles and monetary policy*, Research Discussion Paper 9707. Reserve Bank of Australia.
13. Kindleberger, C. P., and Robert Z. A. (2005) *Manias, Panics and Crashes: A History of Financial Crises*, Fifth Edition, Palgrave-MacMillan.
14. Lanne, M., Lütkepohl, H. and Saikkonen, P. (2001) *Test procedures for unit roots in time series with level shifts at unknown time*, Discussion paper, Humboldt-Universität Berlin.
15. Lütkepohl, H. (2007) *Econometric Analysis with Vector Autoregressive Models*, European University Institute, Working Papers, ECO 2007/11.
16. Rigobon, R. and Sack, B. (2003*) Measuring the Reaction of Monetary Policy to the Stock Market*, Quarterly Journal of Economics, 118(2), pp. 639-69.
17. Saikkonen, P. and Lütkepohl, H. (2002) *Testing for a unit root in a time series with a level shift at unknown time,* Econometric Theory 18:313-348.
18. Shiller, R. J. (2005) *Irrational Exuberance*, 2nd Edition, Princeton: Princeton University Press.
19. Schwartz, A. J. (1995) *Why Financial Stability Depends on Price Stability*, Economic Affairs 15(4), Autumn, pp. 21-25.
20. Titman, S. and Warga, A. (1989), *Stock Returns As Predictors of Interest Rates and Inflation,* Journal of Financial and Quantitative Analysis, Vol. 24.
21. Wicker, E. (2006) *Stock Market Speculation and the Federal Reserve*, Indiana University working paper.

APPENDIX

Table 1 - Descriptive Statistics of variable RBETXT for the first sub – sample

Mean	Median	Minimum	Maximum
-0.151964	-0.0298130	-6.67267	5.08820
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.75067	11.5203	-0.452883	1.19925

Doornik-Hansen test = 19.9756, with p-value 0.000001
Jarque-Bera test = 39.3374, with p-value 0.000001

Table 2 - Descriptive Statistics of variable RROB for the first sub – sample

Mean	Median	Minimum	Maximum
0.102417	0.000000	-6.43700	8.54417
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.28606	12.5571	0.433076	10.0646

Doornik-Hansen test = 431.098, with p-value 0.000001
Jarque-Bera test = 1777.31, with p-value 0.000001

Table 3 - Descriptive Statistics of variable RBETXT for the second sub – sample

Mean	Median	Minimum	Maximum
0.00749916	0.142541	-11.7104	10.6842
Std. Dev.	C.V.	Skewness	Ex. kurtosis
3.01230	401.685	-0.413574	2.07939

Doornik-Hansen test = 40.7167, with p-value 0.000001
Jarque-Bera test = 82.0064, with p-value 0.000001

Table 4 - Descriptive Statistics of variable RROB for the second sub – sample

Mean	Median	Minimum	Maximum
-0.212636	-0.0949217	-42.7784	50.6237
Std. Dev.	C.V.	Skewness	Ex. kurtosis
4.79044	22.5288	2.66813	75.2595

Doornik-Hansen test = 2371.49, with p-value 0.000001
Jarque-Bera test = 93214.2, with p-value 0.000001

Table 5 - Augmented Dickey-Fuller Test for the observations from the first sub-sample

Variable	Deterministic terms	Lagged differences	Test statistics
RROB	No constant and no trend	1	-10.5592***
	Constant and no trend	1	-10.6393***
RBETXT	No constant and no trend	8	-5.5584***
	Constant and no trend	8	-5.7076***

Note: *** denotes significance at 1% level.

Table 6 - Augmented Dickey-Fuller Test for the observations from the second sub-sample

Variable	Deterministic terms	Lagged differences	Test statistics
RROB	No constant and no trend	10	-5.8861***
	Constant and no trend	10	-5.9570***
RBETXT	No constant and no trend	4	-7.8536***
	Constant and no trend	4	-7.8433***

Note: *** denotes significance at 1% level.

Table 7 - Unit root tests with structural breaks for the observations from the first sub-sample

Variable	Shift Function	Break Date	Lagged differences	Test statistics
RROB	Impulse dummy	406	1	-10.4370***
RBETXT	Shift dummy	266	6	-2.6492*

Note: * and *** denote significance at 10% and 1% levels, respectively.

Table 8 - Unit root tests with structural breaks for the observations from the second sub-sample

Variable	Shift Function	Break Date	Lagged differences	Test statistics
RROB	Impulse dummy	34	10	-6.4166***
RBETXT	Shift dummy	31	4	-5.1239***

Note: *** denotes significance at 1% level.

Table 9 - VAR system for the first sub - sample

Equation 1 (with RROB as dependent variable)

Variable	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
const	-0.0781013	0.149184	-0.5235	0.60089
RROB1_1	0.156001	0.0895539	1.7420	0.08226*
RROB1_2	0.179452	0.0684053	2.6234	0.00903***
RBETXT1_1	-0.00235969	0.0295597	-0.0798	0.93641
RBETXT1_2	-0.00387094	0.0307654	-0.1258	0.89994
time	0.000729586	0.000631028	1.1562	0.24828

Mean dependent var	0.110875	S.D. dependent var	1.272631
Sum squared resid	620.1673	S.E. of regression	1.229879
R-squared	0.077309	Adjusted R-squared	0.066057
F(5, 410)	2.573525	P-value(F)	0.026191
rho	-0.001465	Durbin-Watson	1.997403

Equation 2 (with RBETXT as dependent variable)

Variable	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
const	0.163944	0.147939	1.1082	0.26843
RROB1_1	-0.0164433	0.0674078	-0.2439	0.80740
RROB1_2	-0.0703323	0.0622556	-1.1297	0.25925
RBETXT1_1	0.0553248	0.063359	0.8732	0.38307
RBETXT1_2	0.0138408	0.0564917	0.2450	0.80657
time	-0.00141276	0.000690961	-2.0446	0.04153**

Mean dependent var	-0.153410	S.D. dependent var	1.751596
Sum squared resid	1249.162	S.E. of regression	1.745491
R-squared	0.018924	Adjusted R-squared	0.006959
F(5, 410)	1.861435	P-value(F)	0.099988
rho	0.002886	Durbin-Watson	1.990960

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

Table 10 - VAR system for the second sub - sample

Equation 1 (with RROB as dependent variable)

Variable	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
const	-0.199001	0.187959	-1.0587	0.29048
RROB2_1	0.891966	0.110021	8.1072	<0.00001***
RROB2_2	-0.493022	0.119904	-4.1118	0.00005***
RROB2_3	0.164703	0.110045	1.4967	0.13541
RROB2_4	-0.165267	0.110349	-1.4977	0.13516
RROB2_5	-0.336594	0.159555	-2.1096	0.03564**
RROB2_6	0.405434	0.145889	2.7791	0.00576***
RROB2_7	-0.160549	0.11532	-1.3922	0.16478
RROB2_8	-0.122198	0.120609	-1.0132	0.31171
RROB2_9	0.0980794	0.0986244	0.9945	0.32071
RROB2_10	-0.333667	0.126966	-2.6280	0.00898***
RROB2_11	0.353089	0.137063	2.5761	0.01042**
RROB2_12	-0.220304	0.112072	-1.9657	0.05015*
RROB2_13	0.0150518	0.0954356	0.1577	0.87477
RROB2_14	-0.0637042	0.0683786	-0.9316	0.35219
RROB2_15	-0.0133139	0.0781298	-0.1704	0.86479
RROB2_16	0.0533691	0.0962554	0.5545	0.57964
RROB2_17	-0.0993711	0.0889865	-1.1167	0.26492
RROB2_18	0.0274701	0.0713853	0.3848	0.70062
RROB2_19	-0.0642147	0.0465293	-1.3801	0.16848
RBETXT2_1	-0.120703	0.108299	-1.1145	0.26585
RBETXT2_2	0.130747	0.144299	0.9061	0.36554
RBETXT2_3	0.148244	0.102285	1.4493	0.14818
RBETXT2_4	-0.12642	0.169663	-0.7451	0.45672
RBETXT2_5	-0.215602	0.0638579	-3.3763	0.00082***
RBETXT2_6	-0.0286544	0.10946	-0.2618	0.79365
RBETXT2_7	-0.105657	0.0836101	-1.2637	0.20722
RBETXT2_8	-0.222082	0.104935	-2.1164	0.03505**
RBETXT2_9	0.209669	0.0861815	2.4329	0.01550**
RBETXT2_10	-0.087443	0.04778	-1.8301	0.06812*
RBETXT2_11	0.00777719	0.0502644	0.1547	0.87713
RBETXT2_12	0.00599198	0.0513044	0.1168	0.90709
RBETXT2_13	-0.0482937	0.0491687	-0.9822	0.32671
RBETXT2_14	0.0200357	0.063662	0.3147	0.75317
RBETXT2_15	-0.0662256	0.0424732	-1.5592	0.11989
RBETXT2_16	0.0682025	0.0737276	0.9251	0.35560
RBETXT2_17	0.011889	0.0687835	0.1728	0.86288
RBETXT2_18	-0.0936829	0.0499684	-1.8748	0.06168*
RBETXT2_19	0.229245	0.139756	1.6403	0.10188

Mean dependent var	-0.222211	S.D. dependent var	4.897979
Sum squared resid	2887.912	S.E. of regression	2.936092
R-squared	0.677269	Adjusted R-squared	0.640660

F(38, 335)	24.93559	P-value(F)	4.43e-76
rho	0.017683	Durbin-Watson	1.961729

Equation 2 (with RBETXT as dependent variable)

Variable	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
const	0.0282105	0.150269	0.1877	0.85120
RROB2_1	0.0206103	0.0513611	0.4013	0.68847
RROB2_2	0.000917498	0.060439	0.0152	0.98790
RROB2_3	-0.114261	0.0645741	-1.7695	0.07773*
RROB2_4	0.0757979	0.0669618	1.1320	0.25846
RROB2_5	-0.208128	0.0742494	-2.8031	0.00536***
RROB2_6	0.00149619	0.0803933	0.0186	0.98516
RROB2_7	-0.125922	0.0872155	-1.4438	0.14973
RROB2_8	0.107818	0.0849681	1.2689	0.20535
RROB2_9	-0.0264117	0.0842908	-0.3133	0.75422
RROB2_10	-0.0494278	0.0791032	-0.6249	0.53249
RROB2_11	-0.00684864	0.0672442	-0.1018	0.91894
RROB2_12	0.0534905	0.057183	0.9354	0.35024
RROB2_13	0.018557	0.0648056	0.2863	0.77479
RROB2_14	-0.065045	0.0625035	-1.0407	0.29878
RROB2_15	0.112218	0.0559006	2.0075	0.04550**
RROB2_16	-0.0293258	0.0592641	-0.4948	0.62104
RROB2_17	0.0978468	0.0598187	1.6357	0.10284
RROB2_18	-0.154919	0.0569951	-2.7181	0.00691***
RROB2_19	0.130532	0.0400809	3.2567	0.00124***
RBETXT2_1	0.0751265	0.0784733	0.9574	0.33908
RBETXT2_2	-0.0443009	0.0790436	-0.5605	0.57554
RBETXT2_3	-0.0606551	0.0699589	-0.8670	0.38656
RBETXT2_4	-0.0439212	0.0608598	-0.7217	0.47100
RBETXT2_5	0.137539	0.0630806	2.1804	0.02993**
RBETXT2_6	-0.0411248	0.0554856	-0.7412	0.45910
RBETXT2_7	-0.0814389	0.0561202	-1.4512	0.14767
RBETXT2_8	0.138557	0.0569236	2.4341	0.01545**
RBETXT2_9	0.0747237	0.0511981	1.4595	0.14536
RBETXT2_10	0.000996279	0.055267	0.0180	0.98563
RBETXT2_11	-0.0625423	0.0591501	-1.0573	0.29111
RBETXT2_12	0.0438554	0.0656953	0.6676	0.50488
RBETXT2_13	-0.0826586	0.0672691	-1.2288	0.22002
RBETXT2_14	0.0397776	0.0557052	0.7141	0.47568
RBETXT2_15	0.0971288	0.072878	1.3328	0.18352
RBETXT2_16	0.138811	0.0752119	1.8456	0.06583*
RBETXT2_17	0.095425	0.069736	1.3684	0.17211
RBETXT2_18	0.00680669	0.0719774	0.0946	0.92472
RBETXT2_19	0.0498156	0.0529737	0.9404	0.34770

Mean dependent var	0.060230	S.D. dependent var	2.959718
Sum squared resid	2505.439	S.E. of regression	2.734762
R-squared	0.233214	Adjusted R-squared	0.146235
F(38, 335)	6.342439	P-value(F)	3.05e-22
rho	0.001208	Durbin-Watson	1.997305

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

Table 11 - Granger causality between RROB and RBETXT for the first sub – sample

Null hypothesis	F-statistic	P-value	Causal inference
RROB do not Granger-cause RBETXT	0.6227	0.5368	RROB do not Granger-cause RBETXT
RBETXT do not Granger-cause RROB	0.0090	0.9911	RBETXT do not Granger-cause RROB

Table 12 - Granger causality between RROB and RBETXT for the second sub – sample

Null hypothesis	F-statistic	P-value	Causal inference
RROB do not Granger-cause RBETXT	3.5885	0.00001	RROB Granger-cause RBETXT
RBETXT do not Granger-cause RROB	4.8550	0.00001	RBETXT Granger-cause RROB

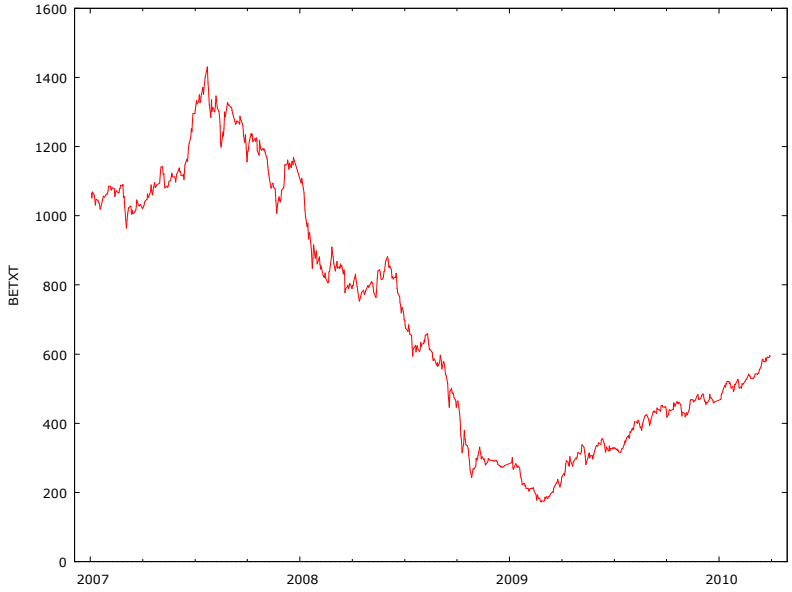

Figure 1 - Evolution of BET-XT from 3 January 2007 to 31 March 2010

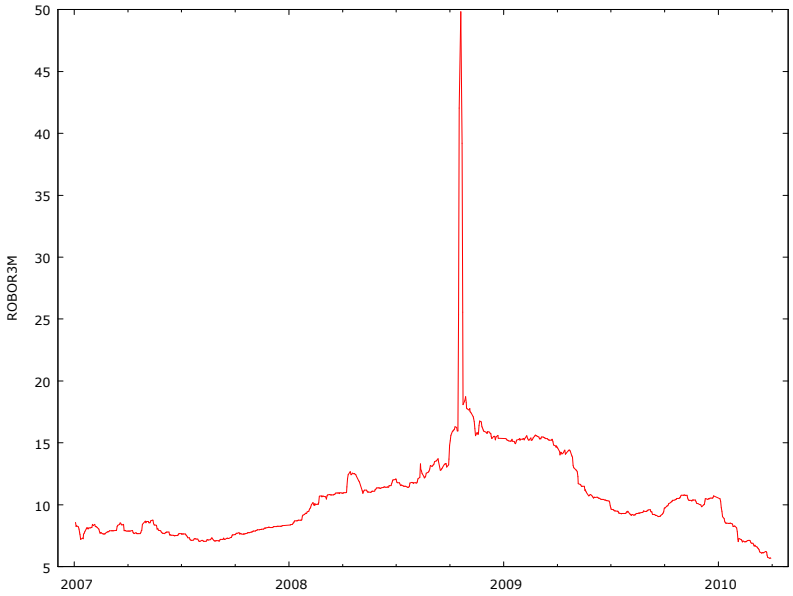

Figure 2 - Evolution of ROBOR3M from 3 January 2007 to 31 March 2010

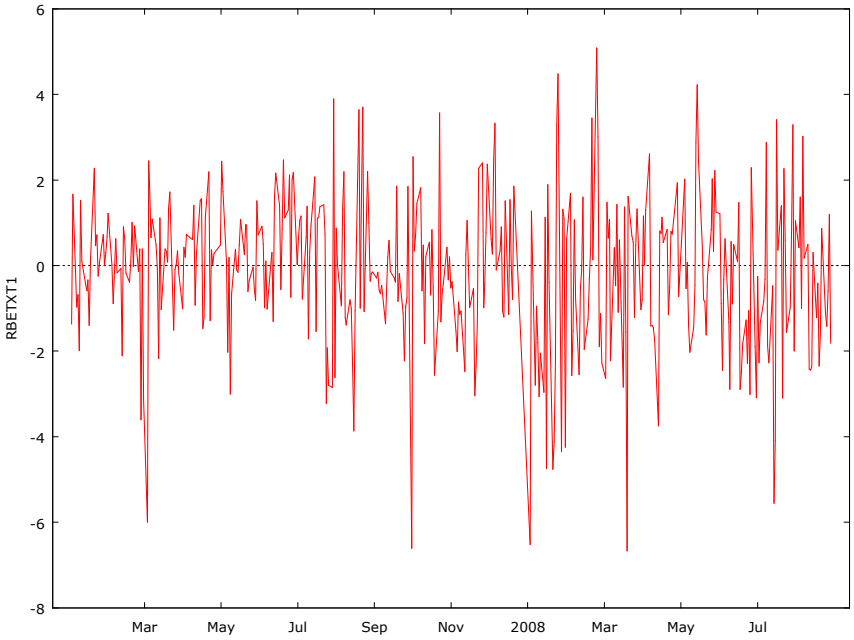

Figure 3 - Evolution of RBETXT from 3 January 2007 to 30 September 2008

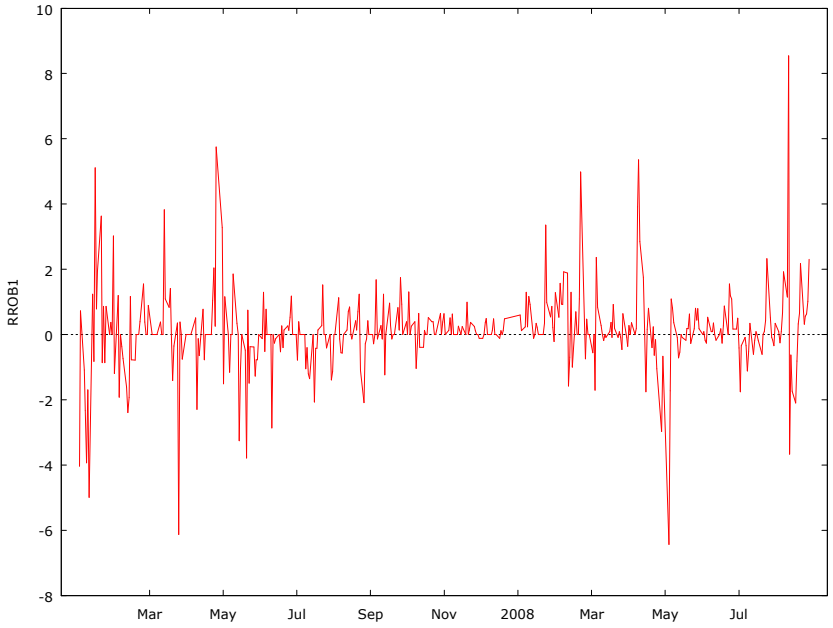

Figure 4 - Evolution of RROB from 3 January 2007 to 30 September 2008

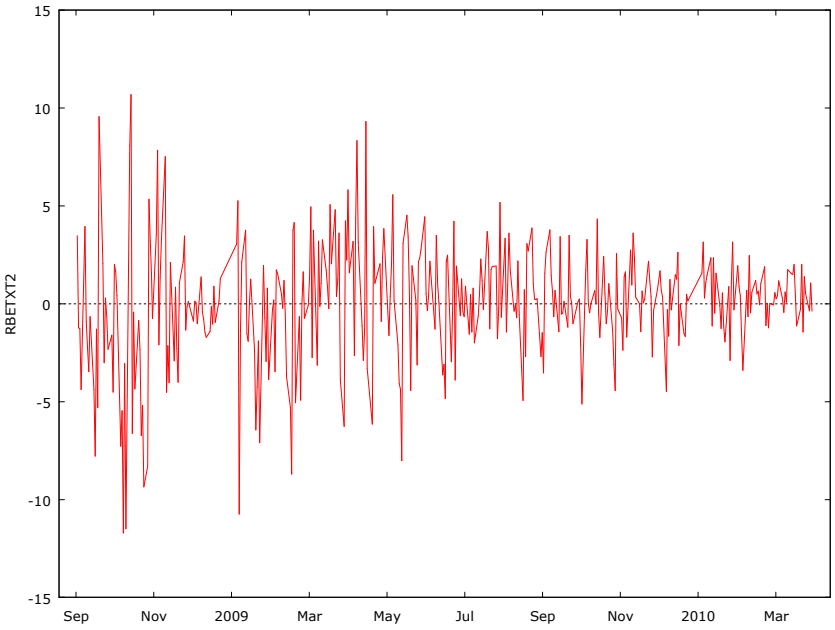

Figure 5 - Evolution of RBETXT from 1 October 2008 to 31 March 2010

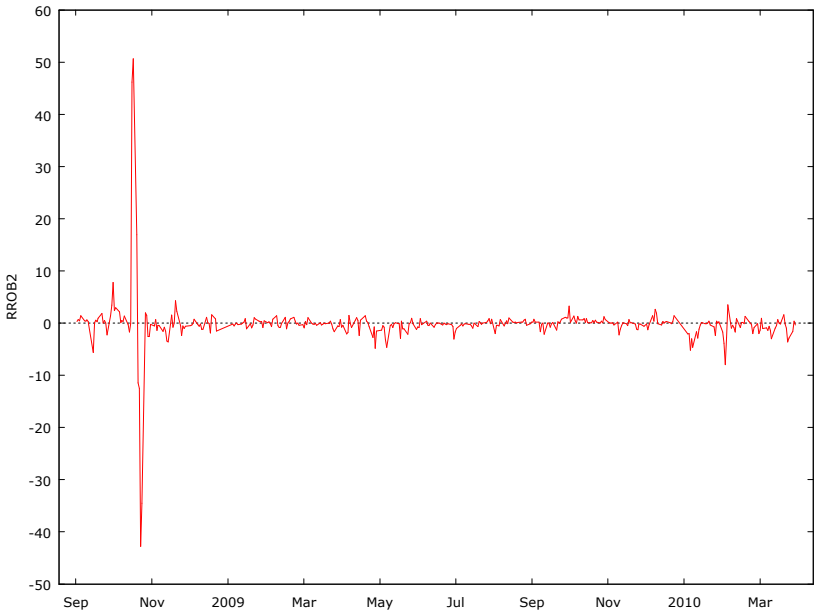

Figure 6 - Evolution of RROB from 1 October 2008 to 31 March 2010

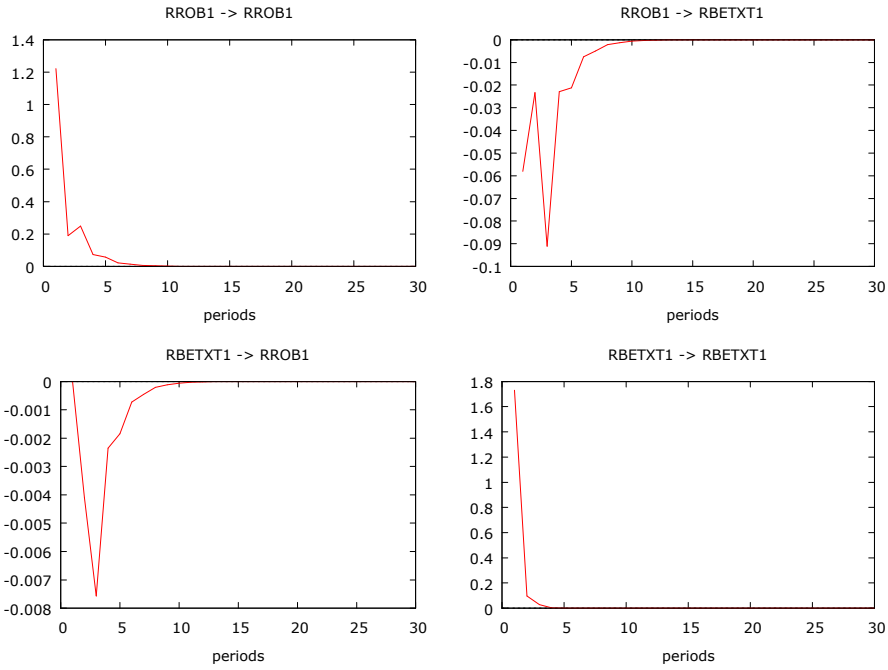

Figure 7 - Impulse – response analysis in a VAR framework for the first sub - sample

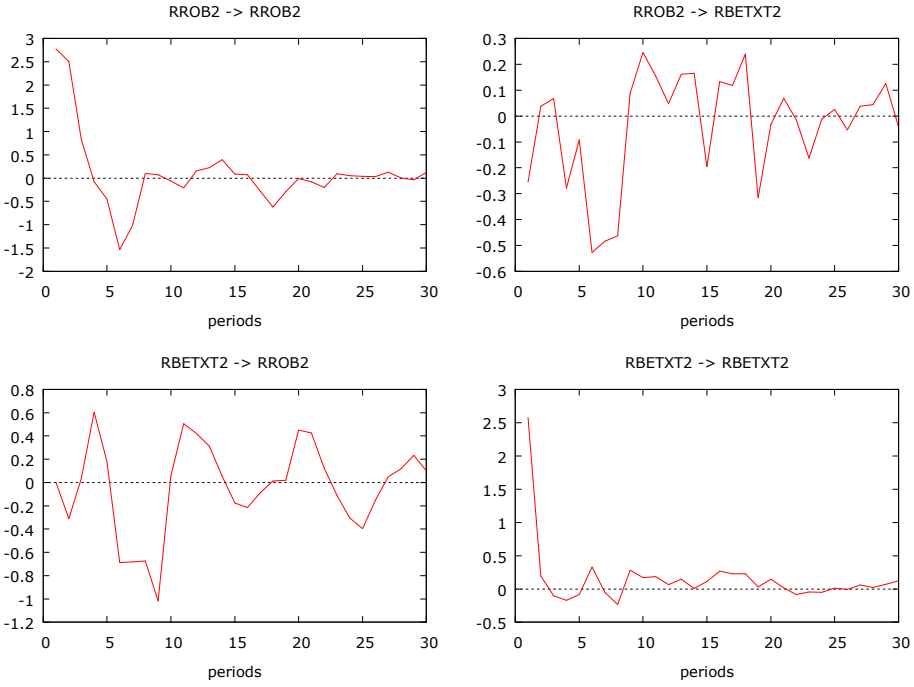

Figure 8 - Impulse – response analysis in a VAR framework for the second sub - sample