Impact of the foreign exchange rates fluctuations on returns and volatility of the Bucharest Stock Exchange

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IMPACT OF THE FOREIGN EXCHANGE RATES FLUCTUATIONS ON RETURNS AND VOLATILITY OF THE BUCHAREST STOCK EXCHANGE

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Abstract
This paper explores the influence of the foreign exchange rates variation on the returns and volatility of the stock prices from the Romanian capital market for the period of time January 2000 - December 2012. This period was split in four sub-samples corresponding to different stages of the Romanian financial markets evolution. The GARCH models employed in this investigation provided different results. For the transition period January 2000 - December 2007 we found no evidence of the foreign exchange market on the Bucharest Stock Exchange. During a period of time between the Romania's adhesion to European Union and the announcement of Lehman Brothers' bankruptcy the results indicate a significant impact of the foreign exchange rates on the stock returns. For the period from September 2008 to February 2010 we find that foreign exchange rates influenced not only the stock returns but also their volatility. However, between March 2010 and December 2012 the impact of the foreign exchange market on the Romanian capital market was limited to the returns. We conclude that influence of the foreign exchange rates variation on the returns and volatility of the stock prices depended on the factors such as the foreign capitals inflows, the global crisis effects and the perceptions of the national economy.

Key words: *Romanian financial markets, Volatility, GARCH, Global crisis*

JEL Classification*: F31, G01, G19*

1. Introduction

In the last decades, the globalization of the financial markets encouraged the study of the influence of foreign exchange rates on the stock prices. The knowledge about this relationship could be useful not only in building successful strategies on investment in stock markets but also in public authorities' decisions on the monetary policy.

There are two main theoretical approaches on the linkages between foreign exchange markets and stock markets. Dornbusch and Fisher (1980) model considered that foreign exchange rates led stock prices through the influence of firms' competitiveness. The devaluation of the national currency increases the competitiveness of domestic producers causing the rise of the stock prices. By contrary, their competitiveness is eroded by a too strong national currency and that caused the decline of the stock prices. In opposition with such approach, the portfolio balance model, assigned the leading role to stock prices variation which would affect foreign exchange rates evolution through demand for the domestic financial assets (Branson, 1983; Frankel, 1983). The increase of stock prices attracts foreign capitals causing the appreciation

of the national currency. Instead, a descendant trend of stock prices could discourage the foreign investment, leading to the depreciation of the national currency.

The 1997 Asian financial crisis and the most recent global crisis attracted the attention on the financial assets behavior in the context of turbulences. It was proved that in such circumstances the relationship between foreign exchange rates and stock prices could suffer radical changes (Granger et al., 1998).

Many empirical researches highlighted the particularities of the relationship between foreign exchange rates and stock prices in the emerging markets (Abdalla, 1997). In general, the volatility in such markets is more substantial than those from advanced markets. Moreover, in the developing countries the monetary authorities usually keep a tight control over the foreign exchange rates.

In this paper we approach the influence of the foreign exchange market on stock market in the case of Romania. Two major aspects have to be taken into consideration in the analysis of this relationship. First, the Bucharest Stock Exchange (BSE) is an emerging market which experienced a significant development since Romania finalized the transition to a market oriented economy. Second, the evolution of Romanian foreign exchange market was marked by the active role played by the National Bank of Romania (NBR). Our investigation covers the period of time from January 2000 to December 2012. In order to capture the effects of some processes with substantial consequences on Romanian financial markets we split this period of time into four shorter periods:

- first period, from January 2000 to December 2006, corresponding to the last stage of Romania's transition to a capitalist system;
- second period, from January 2007 to September 2008, when, after the adhesion to European Union, Romania received massive flows of foreign capitals which, combined with the first symptoms of the global crisis, generated turbulences on capital market;
- third period, from September 2008 to February 2010, in which, following the announcement of Lehman Brothers bankruptcy, domestic financial markets were contaminated by the decline of the international capital markets;
- fourth period, from March 2010 to December 2012, when the Romanian financial markets were affected not only by the international factors but also by the problems of the national economy.

In our investigation we use daily values of BET, one of the main indices of BSE, and nominal exchange rates of euro against the Romanian national currency. We employ GARCH models in order to identify the influence of exchange rates on the stock prices.

The remainder of this paper is organized as it follows. In the second part we approach the specialized literature on the relationship between the foreign exchange market and the stock market, in the third part we describe the data and the methodology used in our investigation, in the fourth part we present the empirical results and in the fifth part we conclude.

2. Literature Review

The relationship between foreign exchange markets and stock markets, in terms of returns and volatility is highly approached in the financial literature. Empirical researches found different

forms of causality between foreign exchange rates and stock prices. Bahmani – Oskooee and Sohrabian (1992) investigated the relationship between the S & P index and the effective foreign exchange rates identifying bidirectional causality among the two variables. Hatemi and Irandoust (2002) found in Sweden a unidirectional causality from stocks market to foreign exchange market. Sekmen (2011) explained the negative impact of the foreign exchange rate volatility on United States stock prices by the increase of costs associated to covering the foreign exchange rate risk.

The development of the General AutoRegressive Conditional Heteroskedasticity (GARCH) models proposed by Engle (1982) and Bollersev (1986) stimulated the research on the impact of some external factors on the financial markets volatility. Some studies revealed the volatility spillover between foreign exchange markets and stock markets (Kanas, 2000; Yang and Doong, 2004).

In the last years, the increasing interest on emerging markets investment as a tool of diversifying assets portfolios stimulated the researches on the linkages between financial markets in these countries. Mishra (2007) found a bidirectional volatility spillover between the foreign exchange markets and most of the main sectors of the Indian stock market. Morales (2007) investigated the relationship between the two variables in four Eastern European markets, Czech Republic, Hungary, Poland and Slovakia finding unidirectional causality from the exchange rates to the stock prices for the first three countries. Chkili Walid (2012) analyzed the dynamic relationship between foreign exchange rate changes and stock returns for eight emerging markets (Hong Kong, Singapore, Malaysia, South Korea, Taiwan, Argentina, Brazil and Mexico) from January 1995 to March 2009. The results indicate a significant impact of stock prices returns to foreign exchange rates returns but a less consistent influence of foreign exchange market on stock market. Instead, it was found a bidirectional volatility spillover between the two markets. Olugbenga (2012) found a significant influence of foreign exchange rates on the Nigerian stock market. The paper concluded that volatility of foreign exchange market could be used as a predictor for the stock market.

Several papers approached the impact of the turbulences on the linkages between financial markets. Fang and Miller (2002) analyzed the effects of the substantial depreciation of the Korean national currency on the capital market during the 1997 Asian financial crisis. They found that national currency depreciation negatively affected the stock market returns while the depreciation volatility positively affected these returns and raised the stock market return volatility. Choi et al. (2009) found that in New Zealand the volatility spillover between stock markets and foreign exchange markets passed, during the crisis, from a bidirectional form to a unidirectional relation from stock prices to foreign exchange rates. Parsva and Hooi (2011) studied the relation between stock markets and foreign exchange markets for six Middle Eastern countries (Egypt, Iran, Jordan, Kuwait, Oman, and Saudi Arabia) from January 2004 to September 2010. For a pre-crisis period they identified bidirectional causalities for Egypt, Iran, and Oman, a unidirectional causality from foreign exchange rates to stock prices for Kuwait and no relation for Jordan and Saudi Arabia. For the crisis period their results indicated a strengthening of the interactions reflected in the presence of bidirectional causalities for all the countries excepting Iran. Yoon and Kang (2012) examined the price returns and volatility linkages between the foreign exchange and stock markets in Korea from January 1990 to December 2009. They found a strong causality from stock prices returns to

foreign exchange rates returns. Their results suggest also that the Asian currency crisis from 1997 stimulated a bidirectional volatility spillover between the two markets.

3. Data and Methodology

In our investigation we employ daily closing values of BET, provided by BSE, and of the nominal exchange rates of euro against the Romanian national currency, provided by NBR. For both of the two variables the impact of the global crisis was substantial (Figure 1 and Figure 2).

We express the change in the exchange rates and the index returns in logarithmic forms:

$$r_{i,t} = [\ln(P_{i,t}) - \ln(P_{i,t-1})] * 100 \qquad (1)$$

where $P_{i,t}$ and $P_{i,t-1}$ are the closing values of index BET or of the exchange rates on the days t and t-1, respectively.

The sample of data which cover the period January 2000-December 2012 is split into four sub-samples:

- first sub-sample, from January 5, 2000 to December 19, 2006;
- second sub-sample, from January 3, 2007 to September 15, 2008;
- third sub-sample, from September 16, 2008 to February 26, 2010;
- fourth sub-sample, from March 1, 2010 to December 28, 2012.

The descriptive statistics of returns, presented in the Table 1, indicate significant differences, in terms of means, standard deviations, skewness and kurtosis between the four sub-samples. For all four sub-samples, the Jarque - Bera test rejected the null hypothesis of the non normality of returns.

We analyze the stationarity of the two variables returns by the Augmented Dickey – Fuller (ADF) unit root tests (Dickey and Fuller, 1979). Based on the graphical representations of the returns time series we decide to use intercept terms in the ADF regressions for both exchange rates and the index returns (Figure 3). The numbers of lags are chosen by Akaike (1973) Information Criteria.

We employ ARMA (p, q) models on the returns of two variables using a Box-Jenkins methodology to determine the values of p and q. For the residuals of these regressions we employ Ljung-Box test Q and the Engle (1982) Lagrange Multiplier (LM) test for ARCH effects to investigate the presence of the autocorrelation and the heteroscedasticity.

The impact of the exchange rates on BET return and volatility are to be captured by the two equations of a GARCH model: the conditional mean equation and the conditional variance equation.

The conditional mean equation of the returns has the form:

$$retBET_t = \mu_0 + \mu_1 * retNEER_t + \sum_{k=1}^{n} (\xi_k * r_{t-k}) + \varepsilon_t \qquad (2)$$

where:

- retBET is the return of BET index;
- μ_0 is a constant term;

- μ_1 is a coefficient which reflects the returns of exchange rate changes effects on BET returns;
- retNEER is the return of the nominal exchange rates of euro against the Romanian national currency;
- ξ_k (k=1,..n) are coefficients associated to lagged returns of BET;
- n is the number of lagged returns, calculated by the Akaike (1969) Final Prediction Error Criterion;
- ε_t is the error term.

The conditional variance has the form:

$$\sigma_t^2 = \omega + \nu * retNEER_t + \sum_{k=1}^{q} \alpha_k * \varepsilon_{t-k}^2 + \sum_{l=1}^{p} (\beta_l * \sigma_{t-l}^2) \qquad (3)$$

where:

- σ_t^2 is the conditional variance of the returns of BET index;

- ω is a constant term;

- ν is a coefficient which reflects the effects of exchange rates returns on the volatility of the BET index;

- α_k (k=1, 2, …q) are coefficients associated to the squared values of the lagged values of error term from the conditional mean equation;

- q is the number of lagged values of the error term, calculated by the Akaike (1973) Information Criteria;

- β_l (j=1, 2, …p) are coefficients associated to the lagged values of the conditional variance;

- p is the number of lagged values of conditional variance, calculated by the Akaike (1973) Information Criteria.

After performing the two regressions we analyze their adequacy by employing Lagrange Multiplier (LM) test for ARCH effects on the residuals.

4. Empirical Results

The results of ADF tests, presented in the Table 2, suggested the stationarity of returns for all four sub-samples. The Table 3 reports the results of Ljung-Box Q and ARCH LM tests which suggest, for all four sub-samples, the presence of autocorrelation and the heteroscedasticity of the residuals of ARMA regressions.

For the four sub-samples we used GARCH (1, 1) models. Their results are presented in the Table 4. For the first sub-sample we find no significant coefficient of retNEER for the conditional mean equation or for the conditional variance equation. On the second and fourth sub-sample the results indicate a significant negative coefficient of retNEER for the conditional mean equation but no significance of retNEER coefficient on the conditional variance equation. For the third sub-sample we find a significant negative coefficient of retNEER for the conditional mean equation and a significant positive coefficient of retNEER

for the conditional variance equation. For all sub-samples the ARCH LM tests performed on the GARCH models residuals revealed no ARCH remaining effects.

5. Conclusions and implications

In this paper we investigated the influence of the foreign exchange rates on the BSE stock prices. The GARCH models for the four sub-samples suggest significant changes on that relation. Between 2000 and 2006 we found no evidence of a significant impact of foreign exchange rates on the stock prices. In this period of time the presence of the foreign capitals on BSE did not play a determinant role for the stock prices evolution.

From Romania's adhesion to European Union, in January 2007, until the announcement of Lehman Brothers bankruptcy, on September 15, 2008, BSE experienced a volatile stage, generated mainly by massive inflows of the foreign capitals and by the first symptoms of the crisis on international financial markets. In these circumstances, the Romanian stock returns became sensitive to the foreign exchange rates. The negative coefficient associated to the changes in exchange rates on the conditional mean equation indicate that, as in Dornbusch and Fisher (1980) model, a depreciation of the Romanian national currency caused the increase of stock prices.

After September 15, 2008 and until February 2010 the foreign exchange rates affected not only stock returns but also their volatility. In this period of time there were strong perceptions, stimulated by the public authorities' statements, that BSE decline was caused exclusively by the contagion from the international financial markets. In this context, the Romanian capital market sensitivity to the foreign exchange rates intensified.

Since the end of February 2010 the symptoms of the Romanian national economy vulnerability to the global crisis became obvious. Such symptoms modified the perceptions about Romanian financial markets and receded the influence of the foreign exchange market on BSE volatility. However, the impact of foreign exchange rates on stock prices returns remained significant.

The investigation of the foreign exchange rates influence on the BSE stock prices could be thoroughgoing by employing the variants of GARCH models that allow taking into consideration the asymmetrical effects of foreign exchange rates variation. It could be also extended to the future stages of the global crisis.

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Appendix

Figure 1 - Evolution of BET index from January 2000 to December 2012

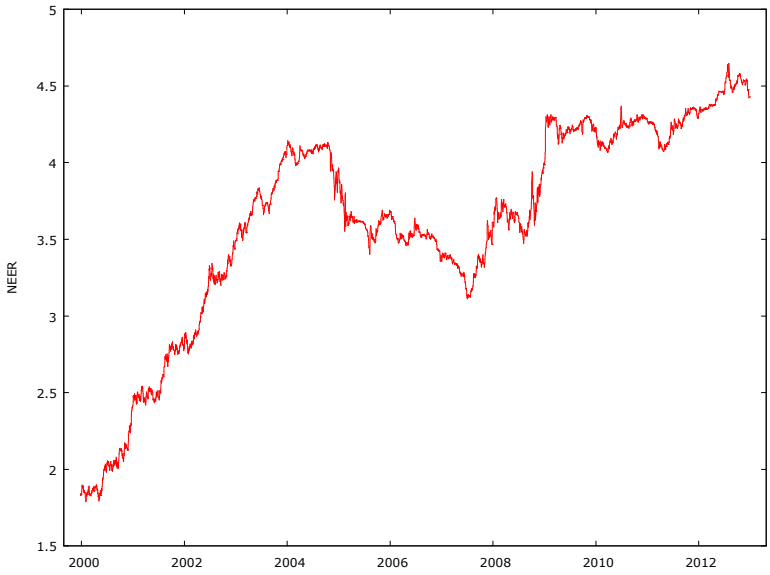

Figure 2 - Evolution of RON/EUR exchange rate from January 2000 to December 2012

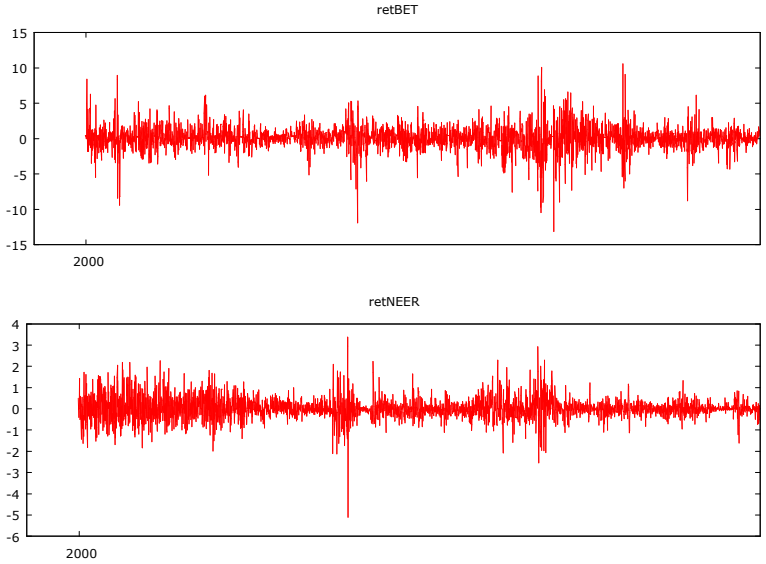

Figure 3 - Returns of BET index and RON/EUR exchange rate from January 2000 to December 2012

Table 1 - Descriptive Statistics of the returns

Indicator	**First sub-sample**	**Second sub-sample**	**Third sub-sample**	**Fourth sub-sample**
Panel A: BET returns				
Mean	0.159634	-0.122799	0.0262851	-0.00463353
Median	0.126894	-0.0450007	0.182109	0.0462141
Minimum	-11.9018	-7.56486	-13.1168	-8.76389
Maximum	8.95773	4.61086	10.0907	10.5645
Std. Dev.	1.48684	1.67371	2.74858	1.43652
C.V.	9.31406	13.6297	104.568	310.028
Skewness	-0.327517	-0.476291	-0.543127	0.0816653
Ex. kurtosis	7.82603	1.26859	2.96170	9.98171
Jarque-Bera test	4705.35	46.7691	157.152	3060.43
p-value of Jarque-Bera test	0.00001	0.00001	0.00001	0.00001
Panel B: RON/EUR exchange rates returns				
Mean	0.0335669	0.0153424	0.0332349	0.0100630
Median	0.0000001	-0.0201946	-0.0132670	-0.00242274
Minimum	-5.10636	-2.08098	-2.54008	-1.60704
Maximum	3.38565	2.29753	2.92724	1.33006
Std. Dev.	0.575190	0.495426	0.542715	0.269721
C.V.	17.1357	32.2914	16.3297	26.8032
Skewness	0.104774	0.625471	0.210792	-0.183972
Ex. kurtosis	8.32075	2.67077	6.02852	4.55565
Jarque-Bera test	2363.67	161.636	576.724	641.476
p-value of Jarque-Bera test	0.00001	0.00001	0.00001	0.00001

Table 2 - Results of ADF tests for returns

Returns	BET returns		RON/EUR exchange rates returns	
	Number of lags	**Test statistics**	**Number of lags**	**Test statistics**
First sub-sample	22	-8.59735 (0.0001***)	21	-8.25304 (0.0001***)
Second sub-sample	10	-5.01346 (0.0001***)	10	-5.3721 (0.0001***)
Third sub-sample	16	-3.26275 (0.01666**)	12	-6.41206 (0.0001***)
Fourth sub-sample	11	-7.30334 (0.0001***)	3	-15.5401 (0.0001***)

Notes: p-values are within brackets ***, **, *; mean significant at 0.01, 0.05, and 0.1 levels, respectively

Table 3 - Results of Ljung-Box Q Tests and ARCH LM Tests for BET returns

Sub-sample	**Ljung-Box Q Test**	**ARCH LM Test**
First sub-sample	9.54402 (0.08924*)	254.429 (0.0001***)
Second sub-sample	15.2181 (0.0550*)	29.2421 (0.0002***)
Third sub-sample	4.14818 (0.0417**)	55.6092 (0.0001***)
Fourth sub-sample	8.76834 (0.0672*)	116.995 (0.0001***)

Notes: p-values are within brackets ***, **, *; mean significant at 0.01, 0.05, and 0.1 levels, respectively.

Table 4 - Results of GARCH regressions

Indicator	**First sub-sample**	**Second sub-sample**	**Third sub-sample**	**Fourth sub-sample**
Panel A: GARCH conditional mean equation				
μ_0	0.147211 (0.0282225) [0.0001***]	-0.0312199 (0.0674414) [0.6434]	0.144008 (0.102556) [0.1603]	0.0379250 (0.0341619) [0.2669]
μ_1	-0.0231174 (0.0345816) [0.5038]	-0.853036 (0.188896) [0.0001***]	-0.973813 (0.317729) [0.0022***]	-0.603423 (0.132620) [0.0001***]

Panel B: GARCH conditional variance equation				
ω	0.222720 (0.0876425) [0.0110**]	0.484944 (0.257943) [0.0601*]	0.267208 (0.186092) [0.1510]	0.0586207 (0.0366657) [0.1099]
ν	-0.154081 (0.137587) [0.2628]	0.244970 (0.204757) [0.2315]	0.963026 (0.457360) [0.0352**]	-0.0004201 (0.0015385) [0.7848]
α	0.367584 (0.09019) [0.0001***]	0.226922 (0.09232) [0.0140**]	0.224986 (0.08629) [0.0091***]	0.213090 (0.0892397) [0.0169**]
β	0.613022 (0.0854466) [0.0001***]	0.599191 (0.137706) [0.0001***]	0.755476 (0.072835) [0.0001***]	0.773527 (0.084991) [0.0001***]
ARCH LM tests for residuals of GARCH model	4.82951 [0.184715]	6.15823 [0.291125]	2.47588 [0.780123]	8.21583 [0.144735]

Notes: Standard Errors are within round brackets; p-values are within squared brackets; ***, **, * mean significant at 0.01, 0.05, and 0.1 levels, respectively