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CHANGES IN THE DYNAMIC RELATION BETWEEN THE PRICES AND THE TRADING VOLUME FROM THE BUCHAREST STOCK EXCHANGE

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Abstract: *This paper explores the relation between the prices and the trading volume from the Bucharest Stock Exchange. The data employed consist in the daily values from January 2002 to March 2011. We identify some significant changes caused by events such as Romania's adhesion to the European Union or the effects of the global crisis.*

Key words: Romanian Stock Exchange, Stock Index Volume, Trading Volume Causality

JEL classification: G 10, G 15

1. Introduction

The relation between the stock prices and the trading volume is one of the main topics of the financial economics. The study of interactions between these variables could reveal some mechanisms of the stock markets (Karpoff, 1987). In the last decades several scientific papers approached this subject. Many of them found a positive correlation between the stock returns and the trading volume (Rogalski, 1978; Karpoff, 1987; Gallant et al, 1992; Lee and Rui, 2002). The Granger causality method was largely used to analyze the nature of the relation between the prices and the trading volume, with different results. Hiemstra and Jones (1993) identified bidirectional causality between the stock returns and the trading volume, while Saatcioglu and Starks (1998) obtained various results in their study about six Latin American stock markets.

Some studies found an asymmetrical nature of the relation between the prices and the trading volume (Epps and Epps, 1976; Karpoff, 1987). Other articles revealed some particularities of these interactions in the context of emerging markets (Saatcioglu and Starks, 1998; Kamath and Wang, 2006; Kamath, 2007). It was also revealed the relation between the prices and the trading volume could suffer changes in time due to economic and political events (Sidra et al, 2009; Khan and Ahmed, 2009).

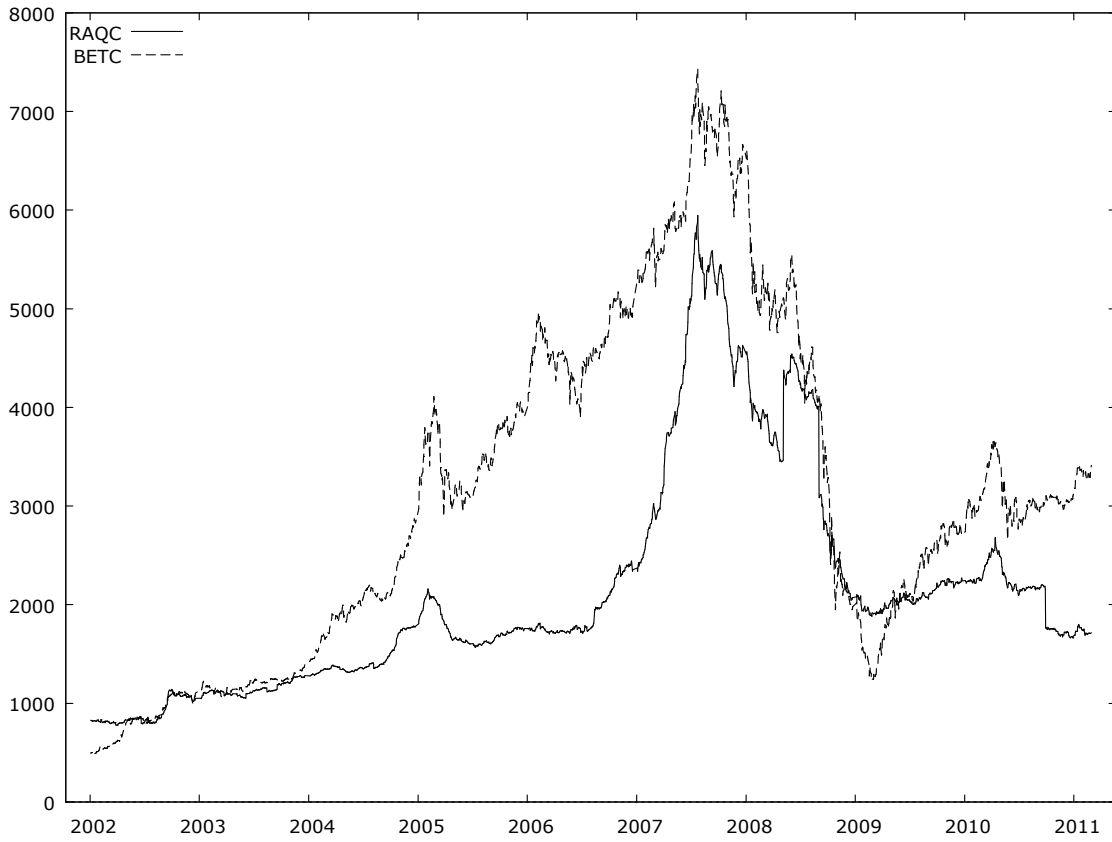
In this paper we analyze the changes that occurred in the relation between the prices and the trading volume from the Bucharest Stock Exchange (BSE). Founded in 1882, BSE was closed during the communist regime. In 1995 BSE was reopened. However, between 1997 and 2001 the difficulties of transition and the impact of the East Asian Financial Crisis caused a significant decline of the stock prices. After the consolidation of the national economy BSE experienced a recovery in 2001. Romania's adhesion to the European Union in 2007 contributed to significant inflows of foreign capitals on the domestic stock market. In 2008 the impact of the global crisis caused another drastic decline. Since 2009 the stock prices increased again but the Romanian financial markets were still under threat of the new shocks from the national economy or from abroad.

In order to identify the differences between the corporations and the small companies we study the two main segments of BSE: BET and RASDAQ. While on BET there are listed the biggest Romanian companies, RASDAQ contained rather smaller companies. We analyze the price – volume trading relation during four periods:

- a first period, from January 2002 to December 2006, when BSE was stimulated by the consolidation of the national economy;
- a second period, from January to December 2007, when significant inflows of the foreign capitals occurred;
- a third period, from January 2008 to February 2009, when the global crisis caused a sharp decline in the stock prices;

- a fourth period, from March 2010 to March 2011 when, despite a recovery, the threats of the new shocks persisted.

Figure 1: Evolution of the indices from the BET market (BETC) and from RASDAQ (RAQC) between January 2002 and March 2011



Source of data: BSE

In the next section there are described the data and the methodology employed in this paper. The third section presents the empirical results and the fourth section concludes.

2. Data and Methodology

In our investigation we use daily data of the trading volume and the closing index prices of the two main components of BSE: BET and RASDAQ. These values cover a period of time from January 2002 to March 2011. We split this sample of data into four sub-samples corresponding to the four phases mentioned before. We use two indices: BET-C for BET market and RAQ-C for RASDAQ market.

The returns of the two indices are computed using the equation:

$$R_t = \ln(P_t) - \ln(P_{t-1}) \quad (1)$$

where:

- R_t is the return on the day t ;
- P_t is the closing market index price on the day t .

We also use detrended values of trading volume obtained as residuals of the regression equations.

We analyze the stationarity of the returns and of the detrended trading volume using the Augmented Dickey Fuller (ADF) test.

We employ two types of regressions to analyse the relation between the prices and the volume.

In the first equation the detrended values of the trading volume (V_t) represent the dependent variable, while the returns compose the independent one:

$$V_t = \alpha + \beta R_t + \varepsilon_t \quad (2)$$

The second equation describes the dependence of the detrended values of the trading volume by the absolute values of the returns:

$$V_t = \gamma + \delta \text{abs}(R_t) + v_t \quad (3)$$

We also investigate the interactions and causalities between the two variables using Vector Autoregression (VAR) models (the number of lags is chosen based on the Akaike Information Criterion) and the Granger causality method.

3. Empirical Results

The descriptive statistics of BET and RASDAQ returns are presented in the Table 1. The means of BET returns are negative for the third sub sample, while the means of RASDAQ returns are negative for the third and fourth sub samples. The highest volatility, measured by the standard deviation, occurred in the third sub sample. For all the sub samples the skewness is negative, while the kurtosis exceeds the normal value. The Jarque-Bera tests indicate that all the time series are not normally distributed.

Table 1: Descriptive Statistics for Returns

Indicator	Mean	Std. Dev.	Skewness	Ex. kurtosis	Jarque-Bera test	p-value for Jarque-Bera test
BET Returns						
First Sub-sample	0.00188088	0.0126980	-0.416985	6.68844	2337.79	0.0000
Second Sub-sample	0.00113000	0.0129814	-0.295533	1.62679	31.2063	0.0000
Third Sub-sample	-0.0054978	0.0269849	-0.413382	3.62795	155.762	0.0000
Fourth Sub-sample	0.00154913	0.0185706	-0.366924	4.47750	451.189	0.0000
RASDAQ Returns						
First Sub-sample	0.0008478	0.00796909	-0.348741	20.2458	21117.5	0.0000
Second Sub-sample	0.00270147	0.0116866	0.174541	1.97247	41.7968	0.0000
Third Sub-sample	-0.0031882	0.0241675	-0.967427	79.6733	71455.2	0.0000
Fourth Sub-sample	-0.0002492	0.0118135	-8.86945	149.389	496013	0.0000

Source of data: BSE

In the Table 2 there are presented the descriptive statistics of the trading volume. The means were highest for the second sub-samples. For all the sub samples the skewness is positive and the kurtosis exceeds the normal value. According to the Jarque-Bera tests all the time series are not normally distributed.

Table 2: Descriptive Statistics for Trading Volume

Indicator	Mean	Std. Dev.	Skewness	Ex. kurtosis	Jarque-Bera test	p-value for Jarque-Bera test
BET Trading Volume						
First Sub-sample	41.9187	79.6776	17.5724	443.505	1.01935e+007	0.0000
Second Sub-sample	56.9398	51.4133	3.91750	18.4965	4203.2	0.0000
Third Sub-sample	51.3295	49.9390	5.32106	39.3897	18729	0.0000
Fourth Sub-sample	55.7533	160.255	17.4009	343.899	2.61855e+006	0.0000
RASDAQ Trading Volume						
First Sub-sample	5.76907	32.2491	32.0899	1086.67	6.10264e+007	0.0000

Second Sub-sample	17.2461	64.6072	12.0839	163.932	286020	0.0000
Third Sub-sample	7.64525	15.9682	7.73734	67.8584	54497.5	0.0000
Fourth Sub-sample	5.67661	9.97088	12.2527	206.979	952078	0.0000

Source of data: BSE

We analyzed the stationarity of the variable using the Augmented Dickey-Fuller Tests. For all the sub samples we used constants as deterministic terms, while the number of lags was chosen by the Akaike Information Criterion. The results of the unit root tests, reported in the Table 3, indicate that all the time series are stationary.

Table 3: Results of Augmented Dickey-Fuller Tests

Indicator	First Sub-sample	Second Sub-sample	Third Sub-sample	Fourth Sub-sample
BET Returns				
Number of lags	32	20	18	21
Test statistic	-6.91655	-3.5014	-15.9087	-5.46401
Asymptotic p-value	5.549e-010	0.00798	2.053e-029	2.086e-006
RASDAQ Returns				
Number of lags	35	10	12	17
Test statistic	-5.46368	-3.04971	-15.8842	-21.9267
Asymptotic p-value	2.09e-006	0.03053	4.296e-028	4.73e-038
BET Detrended Volume				
Number of lags	29	8	21	14
Test statistic	-4.35426	-13.8382	-2.88843	-4.95802
Asymptotic p-value	1.443e-005	1.212e-024	0.04669	2.486e-005
RASDAQ Detrended Volume				
Number of lags	31	10	2	16
Test statistic	-35.1186	-3.86483	-6.13944	-21.7158
Asymptotic p-value	7.849e-022	0.002321	5.493e-008	4.56e-038

Source of data: BSE

The regression results for the detrended trading volume on the stock returns are shown in the Table 4. We didn't find any significant coefficient.

Table 4: Regression for Detrended Trading Volume on Stock Returns

Indicator	First Sub-sample	Second Sub-sample	Third Sub-sample	Fourth Sub-sample
BET				
α	-0.0766994 (-0.0343)	-0.178551 (-0.0547)	0.960188 (0.3136)	-0.279871 (-0.0400)
β	45.1566 (0.2591)	158.01 (0.6296)	174.65 (1.5680)	180.663 (0.4808)
R^2	0.000054	0.001596	0.009091	0.000441
RASDAQ				
α	0.00464832 (0.0050)	-0.00716297 (-0.0017)	0.00643996 (0.0066)	0.00187664 (0.0044)
β	0.524203 (0.0045)	2.65151 (0.0076)	2.01991 (0.0502)	7.53172 (0.2077)
R^2	0.00000001	0.00000001	0.000009	0.000082

Source of data: BSE

In the Table 5 there are presented the regression results for the detrended trading volume on the absolute stock returns. The regression coefficients are significant only for the BET market on the first and the third sub-samples.

Table 5: Regression for Detrended Trading Volume on Absolute Stock Returns

Indicator	First Sub-sample	Second Sub-sample	Third Sub-sample	Fourth Sub-sample
BET				
γ	-8.49568*** (-2.7768)	-5.26057 (-1.0746)	-8.70274** (-2.0938)	-0.801775 (-0.0826)
δ	952.849*** (3.9962)	539.665 (1.4336)	451.706*** (2.9875)	61.9167 (0.1188)
R^2	0.012786	0.008219	0.032229	0.000027
RASDAQ				
γ	0.457783 (0.3939)	4.62744 (0.7410)	-0.0162523 (-0.0153)	-0.229709 (-0.4652)
δ	-92.1837 (-0.6354)	-510.318 (-0.9783)	1.64966 (0.0378)	38.9099 (0.9301)
R^2	0.000327	0.003844	0.000005	0.001648

Note: *** and ** indicate statistical significance at 0.01 and 0.05 per cent level respectively.

Source of data: BSE

The results of the Vector Autoregression analysis for the BET market are shown in the Table 6. The interactions between the two variables are significant for the first and for the third sub-samples.

Table 6: Vector Autoregression analysis for the interactions between the Stock Returns and the Detrended Trading Volume from BET market

First sub - sample

Equation 1: V_t	Coefficient	Std. Error	t-ratio	p-value
const	-0.749941	2.30794	-0.3249	0.74528
V_{t-1}	0.0588195	0.0286511	2.0530	0.04029**
V_{t-2}	0.0483181	0.0287207	1.6823	0.09276*
V_{t-3}	0.0461002	0.0287617	1.6028	0.10923
V_{t-4}	0.0926318	0.0286757	3.2303	0.00127***
V_{t-5}	0.115451	0.0286624	4.0279	0.00006***
V_{t-6}	0.00589222	0.0288306	0.2044	0.83810
V_{t-7}	0.0117568	0.0287635	0.4087	0.68280
V_{t-8}	0.0838992	0.0287312	2.9201	0.00356***
R_{t-1}	83.7992	177.985	0.4708	0.63785
R_{t-2}	331.02	181.116	1.8277	0.06785*
R_{t-3}	-77.9989	181.298	-0.4302	0.66711
R_{t-4}	-1.54574	181.208	-0.0085	0.99320
R_{t-5}	155.32	180.877	0.8587	0.39067
R_{t-6}	-23.6137	180.843	-0.1306	0.89613
R_{t-7}	-16.1624	180.656	-0.0895	0.92873
R_{t-8}	-11.0776	177.309	-0.0625	0.95019

Adjusted R-squared = 0.047676; F(16, 1210) = 4.836092; P-value(F) = 1.09e-09

Equation 2: R_t	Coefficient	Std. Error	t-ratio	p-value
const	0.00143625	0.00037234	3.8574	0.00012***
V_{t-1}	6.19733e-06	4.62229e-06	1.3407	0.18025
V_{t-2}	-4.42833e-06	4.63352e-06	-0.9557	0.33941
V_{t-3}	1.18263e-05	4.64012e-06	2.5487	0.01094**
V_{t-4}	1.488e-06	4.62625e-06	0.3216	0.74778
V_{t-5}	-4.51917e-06	4.6241e-06	-0.9773	0.32861
V_{t-6}	3.45933e-06	4.65124e-06	0.7437	0.45718

V _{t_7}	-7.84401e-06	4.64041e-06	-1.6904	0.09121*
V _{t_8}	1.34764e-06	4.6352e-06	0.2907	0.77130
R _{t_1}	0.223359	0.0287143	7.7787	0.00001***
R _{t_2}	-0.0341774	0.0292195	-1.1697	0.24236
R _{t_3}	0.0118758	0.0292488	0.4060	0.68480
R _{t_4}	-0.0743448	0.0292342	-2.5431	0.01111**
R _{t_5}	0.0237303	0.0291809	0.8132	0.41626
R _{t_6}	0.0207309	0.0291754	0.7106	0.47749
R _{t_7}	0.108838	0.0291452	3.7343	0.00020***
R _{t_8}	-0.0300223	0.0286053	-1.0495	0.29414

Adjusted R-squared = 0.063210; F(16, 1210) = 6.170282; P-value(F) = 2.45e-13

Source of data: BSE

Second sub – sample

Equation 1: V _t	Coefficient	Std. Error	t-ratio	p-value
const	-0.231	3.21773	-0.0718	0.94283
V _{t_1}	0.123177	0.0636161	1.9363	0.05400*
V _{t_2}	0.0951049	0.0634751	1.4983	0.13535
R _{t_1}	-476.948	256.345	-1.8606	0.06401*
R _{t_2}	659.457	249.694	2.6411	0.00880***

Adjusted R-squared = 0.043427; F(16, 1210) = 3.803375; P-value(F) = 0.005097

Equation 2: R _t	Coefficient	Std. Error	t-ratio	p-value
const	0.00084265	0.000809163	1.0414	0.29873
V _{t_1}	1.70183e-05	1.59976e-05	1.0638	0.28847
V _{t_2}	3.52607e-06	1.59621e-05	0.2209	0.82535
R _{t_1}	0.0892814	0.0644633	1.3850	0.16732
R _{t_2}	0.0316713	0.0627906	0.5044	0.61444

Adjusted R-squared = -0.001592; F(16, 1210) = 0.901874; P-value(F) = 0.463482

Source of data: BSE

Third sub – sample

Equation 1: V _t	Coefficient	Std. Error	t-ratio	p-value
const	0.691672	3.04356	0.2273	0.82040
V _{t_1}	0.138305	0.0609176	2.2704	0.02400**
V _{t_2}	0.136881	0.0608042	2.2512	0.02521**
V _{t_3}	0.20266	0.0607578	3.3355	0.00098***
R _{t_1}	62.8801	107.904	0.5827	0.56057
R _{t_2}	120.32	108.396	1.1100	0.26803
R _{t_3}	-70.2858	108.265	-0.6492	0.51678

Adjusted R-squared = 0.100016; F(16, 1210) = 5.926800; P-value(F) = 8.10e-06

Equation 2: R _t	Coefficient	Std. Error	t-ratio	p-value
const	-0.00537514	0.00174927	-3.0728	0.00235***
V _{t_1}	-3.21423e-06	3.5012e-05	-0.0918	0.92692
V _{t_2}	2.96084e-05	3.49469e-05	0.8472	0.39764
V _{t_3}	3.34914e-05	3.49202e-05	0.9591	0.33841
R _{t_1}	0.0963588	0.062017	1.5537	0.12146

R_{t_2}	-0.0246311	0.0623001	-0.3954	0.69290
R_{t_3}	-0.0596896	0.0622245	-0.9593	0.33832

Adjusted R-squared = -0.001763; F(16, 1210) = 0.921982; P-value(F) = 0.479550
Source of data: BSE

Fourth sub-sample

Equation 1: V_t	Coefficient	Std. Error	t-ratio	p-value
const	-0.165876	7.01384	-0.0236	0.98114
V_{t_1}	0.00796986	0.0437718	0.1821	0.85559
R_{t_1}	154.266	376.961	0.4092	0.68253

Adjusted R-squared = -0.003440; F(2, 522) = 0.101871; P-value(F) = 0.903164

Equation 2: R_t	Coefficient	Std. Error	t-ratio	p-value
const	0.00151928	0.000815357	1.8633	0.06298*
V_{t_1}	1.11952e-07	5.08847e-06	0.0220	0.98246
R_{t_1}	0.0186978	0.0438216	0.4267	0.66979

Adjusted R-squared = -0.003480; F(2, 522) = 0.091498; P-value(F) = 0.912578

Note: ***, ** and * indicate statistical significance at 0.01 and 0.05 and 0.1 per cent level respectively.

Source of data: BSE

In the Table 7 there are presented the results of Vector Autoregression analysis for the RASDAQ market. The interactions between the two variables are lowest for the fourth sub-sample.

Table 7: Vector Autoregression analysis for the interactions between the Stock Returns and the Detrended Trading Volume from RASDAQ market

First sub – sample

Equation 1: V_t	Coefficient	Std. Error	t-ratio	p-value
const	-0.141736	0.934585	-0.1517	0.87948
V_{t_1}	0.00075181	0.0285706	0.0263	0.97901
V_{t_2}	-0.00352538	0.028521	-0.1236	0.90165
V_{t_3}	-0.000265825	0.0285227	-0.0093	0.99257
R_{t_1}	-21.6163	116.311	-0.1859	0.85259
R_{t_2}	251.292	118.246	2.1252	0.03377**
R_{t_3}	-49.5817	118.043	-0.4200	0.67454

Adjusted R-squared = -0.001160; F(16, 1210) = 0.762217; P-value(F) = 0.599724

Equation 2: R_t	Coefficient	Std. Error	t-ratio	p-value
const	0.000663922	0.000228817	2.9015	0.00378***
V_{t_1}	1.2622e-06	6.99502e-06	0.1804	0.85683
V_{t_2}	-2.65723e-06	6.98288e-06	-0.3805	0.70361
V_{t_3}	1.7441e-06	6.98329e-06	0.2498	0.80282
R_{t_1}	0.0907762	0.0284767	3.1877	0.00147***
R_{t_2}	0.0474058	0.0289504	1.6375	0.10179
R_{t_3}	0.0846101	0.0289008	2.9276	0.00348***

Adjusted R-squared = 0.015586; F(16, 1210) = 4.248394; P-value(F) = 0.000304

Source of data: BSE

Second sub – sample

Equation 1: V_t	Coefficient	Std. Error	t-ratio	p-value
const	1.31598	4.24631	0.3099	0.75689
V_{t-1}	-0.000917082	0.0639417	-0.0143	0.98857
V_{t-2}	-0.0381102	0.06368	-0.5985	0.55009
R_{t-1}	-918.158	369.739	-2.4833	0.01369**
R_{t-2}	467.845	371.089	1.2607	0.20861

Adjusted R-squared = 0.010524; F(16, 1210) = 1.656747; P-value(F) = 0.160739

Equation 2: R_t	Coefficient	Std. Error	t-ratio	p-value
const	0.00177636	0.000723589	2.4549	0.01479
V_{t-1}	-1.6383e-05	1.08959e-05	-1.5036	0.13399
V_{t-2}	-2.7163e-05	1.08513e-05	-2.5032	0.01297**
R_{t-1}	0.224725	0.063005	3.5668	0.00044***
R_{t-2}	0.150585	0.0632351	2.3813	0.01802**

Adjusted R-squared = 0.119067; F(16, 1210) = 9.346159; P-value(F) = 4.84e-07

Source of data: BSE

Third sub – sample

Equation 1: V_t	Coefficient	Std. Error	t-ratio	p-value
const	0.0289976	0.985004	0.0294	0.97654
V_{t-1}	0.00237231	0.0613108	0.0387	0.96916
R_{t-1}	9.9068	40.4204	0.2451	0.80657

Adjusted R-squared = -0.007285; F(2, 266) = 0.030817; P-value(F) = 0.969656

Equation 2: R_t	Coefficient	Std. Error	t-ratio	p-value
const	-0.00304582	0.0013819	-2.2041	0.02838**
V_{t-1}	0.00057427	8.60152e-05	6.6764	0.00001***
R_{t-1}	0.027223	0.0567073	0.4801	0.63158

Adjusted R-squared = 0.137785; F(2, 266) = 22.41362; P-value(F) = 1.01e-09

Source of data: BSE

Fourth sub – sample

Equation 1: V_t	Coefficient	Std. Error	t-ratio	p-value
const	0.0116348	0.428485	0.0272	0.97835
V_{t-1}	0.0513635	0.043689	1.1757	0.24027
R_{t-1}	28.0362	36.2673	0.7730	0.43985

Adjusted R-squared = -0.000007; F(2, 522) = 0.998044; P-value(F) = 0.369302

Equation 2: R_t	Coefficient	Std. Error	t-ratio	p-value
const	-0.000264063	0.000515731	-0.5120	0.60885
V_{t-1}	4.12911e-05	5.25847e-05	0.7852	0.43267
R_{t-1}	0.0429428	0.0436518	0.9838	0.32569

Adjusted R-squared = 0.137785; F(2, 522) = 0.799110; P-value(F) = 0.450278

Note: ***, ** and * indicate statistical significance at 0.01 and 0.05 and 0.1 per cent level respectively.

Source of data: BSE

The results of the Granger Causality Tests are presented in the Table 8. For the second sub-sample, on the BET market returns Granger-cause volume, while for the RASDAQ market we found a bidirectional causality. For the third sub-sample, on the RASDAQ market volume Granger-cause returns.

Table 8: Results of the Granger Causality Tests

Indicator	First Sub-sample	Second Sub-sample	Third Sub-sample	Fourth Sub-sample
BET, H0: V_t do not Granger-cause R_t				
Test statistic	1.6681	0.6259	0.6891	0.0005
pval-F	0.1011	0.5352	0.5590	0.9825
BET, H0: R_t do not Granger-cause V_t				
Test statistic	0.6059	4.8192	0.6778	0.1675
pval-F	0.7736	0.0085	0.5659	0.6824
RASDAQ, H0: V_t do not Granger-cause R_t				
Test statistic	0.0798	4.2367	44.5740	0.6166
pval-F	0.9710	0.0150	0.0000	0.4325
RASDAQ, H0: R_t do not Granger-cause V_t				
Test statistic	1.5190	3.2437	0.0601	0.5976
pval-F	0.2076	0.0399	0.8065	0.4397

Source of data: BSE

3. Conclusions

This paper approached the changes occurred in the relation between the stock market returns and the trading volume from two main components of BSE: BET and RASDAQ. We found significant differences between these segments that could be considered as a reflection of the size impact on this relation. We also identify an asymmetrical behavior on the BET market for the first and the third sub-sample, when the returns experienced the highest, respectively the lowest means.

On the BET market the results showed that returns Granger caused the volume only for the second sub-sample. In this period of time the significant inflows of the foreign capital encouraged the speculative transactions. In these circumstances the information contained in evolution of the returns influenced the volume of transactions. For the same period of time on the RASDAQ market we found bidirectional causality, suggesting that in comparison with the BET market the returns were more sensitive to the trading volume.

For the third sub-sample on the RASDAQ market the trading volume Granger caused the returns. In this period of time the financial markets were affected by the global crisis and the investors from the RASDAQ market, considered riskier than the BET markets, were very sensitive to the evolution of the trading volume.

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