ANALYSIS OF THE DYNAMIC RELATIONS BETWEEN BET AND RASDAQ-C

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This paper explores the dynamic relations between two indices of Romanian stock markets: BET and RASDAQ-C. The results of our analysis cannot strongly support the hypothesis of the cointegration between the two variables. A Vector Autoregression model revealed weak interactions between the two indices. We find evidence of an unidirectional causality from BET to RASDAQ-C.

Keywords: Romanian Stock Markets, Cointegration, Vector Autoregression, Granger Causality

JEL Classification: E44, C22, C32

Introduction

In this paper we approach the relationship between two major indices of the Romanian stock markets: BET and RASDAQ-C. The first is computed from the prices of the ten most liquid stocks (except Investment Funds) of Bucharest Stock Exchange, while the second reflects the evolution of RASDAQ, a less regulated stock market modeled on NASDAQ.

The study of the relationship between two or more financial markets indices has many applications. The revealing of linkages among markets could help investors in their efforts to manage risks by diversifying investment portfolio. It is also useful for predicting the financial markets evolution.

In the recent years, several studies approached dynamic relations between prices from various financial markets. The main tools used were the cointegration techniques, the Vector Autoregressive (VAR) framework, GARCH models and causality tests. These analyses led to mixed results. Jeon and Furstenburg (1990) proved, using VAR techniques, that after the world stock markets crash of October 1987 the linkages between international stock exchanges had strengthened. Ahlgren and Antell (2002) found that international stock prices were not cointegrated. Wong et all. (2005) proved that Indian stock market was integrated with the stock markets from the major developed countries. Cho and Ogwang (2006) analyzed the dynamic relations between two Canadian stock prices: TSX Composite Index and TSX Venture Composite Index. The results suggested that there were no cointegration between the two variables although it was proved a unidirectional causality between them.

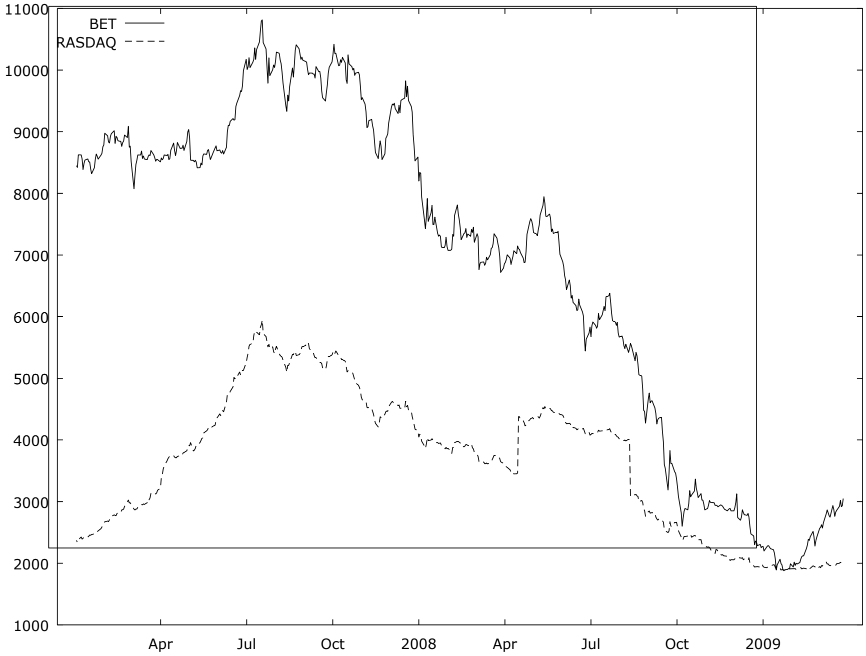

Figure 1 - The evolution of BET and RASDAQ-C between January 2007 and April 2009

In the last years both BET and RASDAQ-C experienced complex evolutions (see Figure 1). The period of significant growing from the first half of 2007, was followed by a drastic decline under the impact of the global crisis. In these circumstances, we have to apply in our analysis some techniques specialized for structural breaks.

The remaining part of this paper is set out as follows. The second part approaches the data and methodology we used. The results of the analyses are presented in the third part and the fourth part concludes.

Data and Methodology

In our analysis we employ daily close values of the two indices provided by Bucharest Stock Exchange. The sample we use covers the period from January 2007 to April 2009. We use four variables:

- l_BET for natural logarithms of BET;
- l_RASDAQ for natural logarithms of RASDAQ-C ;
- d_l_BET for first differences of l_BET;
- d_l_RASDAQ for first differences of l_RASDAQ.

The stationarity of the time series is analyzed by two unit root tests: the classic Augmented Dickey Fuller (ADF) and a test proposed by Saikkonen and Lutkepohl (2002) and Lanne et al (2002) which allows taking into account the eventual structural breaks. The numbers of lagged differences are selected using four criteria: Akaike Info Criterion (AIC), Final Prediction Error (FPE), Hannan-Quinn Criterion (HQC) and Schwarz Criterion (SC).To test the cointegration between indices we use two methods: Engle-Granger (1987) and Johansen trace test (1995) which allows the including of structural breaks.

The interactions between the two indices are studied using a VAR model that allows the disentangling such relations (Lütkepohl 2007). In this framework we also analyze the Granger – Causality between the two indices investigating if the information relevant to the prediction of them is contained solely in the two time series data (Granger 1969).

Empirical Results

We test the stationarity of l_BET and l_RASDAQ using intercept and time trend as deterministic terms. We start with the ADF tests resulting that for both of the two time series we cannot reject the null hypothesis of a unit root (see Table 1).

Table 1 - Augmented Dickey Fuller Unit Root Tests for levels values of the two indices (with intercept and time trend as deterministic terms)

Variable	Lagged differences	Test statistics
l_BET	AIC, FPE, HQC: 1	-1.8586
	SC: 0	-1.7966
l_RASDAQ	AIC, FPE: 1	-2.6594
	HQC, SC: 0	-2.6055

We continue the analysis of the stationarity by performing unit root tests with structural breaks (see Table 2). We use two kind of shift function for the structural breaks: with impulse dummy and with shift dummy. Again it resulted that both of the two time series are not stationary.

Table 2 - Unit root tests with structural breaks for levels values of the two indices (with intercept and time trend as deterministic terms)

Variable	Shift Function	Break Date	Lagged differences	Test statistics
l_BET	Impulse dummy	449	AIC, FPE: 2	-1.0005
		449	HQC: 1	-1.0158
		449	SC: 0	-0.9501
	Shift dummy	503	AIC, FPE, HQC: 1	-1.0831
		503	SC: 0	-0.9854
l_RASDAQ	Impulse dummy	420	AIC, FPE: 1	-0.7713
		420	HQC, SC: 0	-0.6903
	Shift dummy	421	AIC, FPE, HQC, SC: 0	-0.7370

In order to establish the order of integration for the two variables we extended the stationarity analysis for their first differences using only intercept as deterministic term. The ADF tests results indicate that the null hypothesis of a unit root could be rejected for both time series (see Table 3).

Table 3 - Augmented Dickey Fuller Unit Root Test for the first differences values of the two indices (with intercept as deterministic term)

Variable	Lagged differences	Test statistics
d_l_BET	AIC, FPE, HQC, SC: 0	-21.7884***
d_l_RASDAQ	AIC, FPE, HQC, SC: 0	-22.0457***

*** Indicates that the results are significant at the 1% level of significance.

We perform unit root tests with structural breaks for the first differences of the two indices using impulse dummy and shift dummy. It results that in all forms the two time series are stationary (see Table 4). We can conclude that l_BET and l_RASDAQ could be considered as integrated of order one I(1).

Table 4 - Unit root tests with structural breaks for the first differences values of the two indices (with intercept as deterministic term)

Variable	Shift Function	Break Date	Lagged differences	Test statistics
d_l_BET	Impulse dummy	503	AIC, FPE, HQC, SC: 0	-21.4017***
	Shift dummy	450	AIC, FPE, HQC, SC: 0	-4.6536***
	Impulse dummy	421	AIC, FPE, HQC, SC: 0	-21.1558***
	Shift dummy	432	AIC, FPE, HQC, SC: 0	-14.8597***

*** Indicates that the results are significant at the 1% level of significance.

We start analyzing the cointegration between l_BET and l_RASDAQ using the Engle Granger technique. In the first step we perform a regression between the two variables (see Table 5).

Table 5 - Cointegration regression (Dependent variable: l_RASDAQ)

Variable	Coefficient	Std. Error	t-statistic	p-value
const	3.16728	0.125219	25.2939	<0.00001***
l_BET	0.570643	0.0143294	39.8233	<0.00001***
R^2	0.731875			
Durbin-Watson statistic	0.0117251			

*** Indicates that results are significant at 1% level of significance.

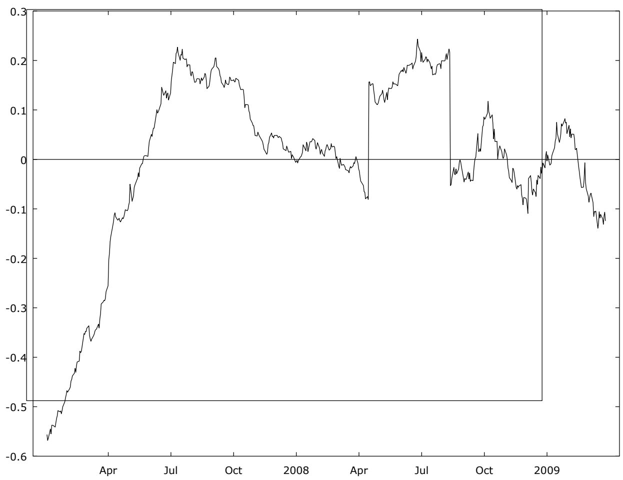

Figure 2 -The residuals of the cointegration regression

Table 6 - Augmented Dickey Fuller Unit Root Test for the cointegration regression residuals

Deterministic terms	Lagged differences	Test statistics
Intercept	AIC, FPE, HQC, SC: 0	-3.1337**
Intercept and time trend	AIC, FPE, HQC, SC: 0	-2.36303

** Indicates that results are significant at 5% level.

In the second step we analyze the stationarity of the regression residuals by performing two forms of ADF tests: first with only intercept as deterministic term and second with intercept and time trend as deterministic terms (see Figure 2). Only in the first case we can reject the null hypothesis of a unit root (see Table 6).

We continue the analysis of cointegration using Johansen technique including two structural breaks and two lags. The likelihood ratio (LR) tests indicate a cointegration rank $r = 0$ (see Table 7). Since Johansen technique is considered more powerful than Engle Granger technique we conclude that we cannot establish a cointegration relation between l_BET and l_RASDAQ.

Table 7 - Johansen test for cointegration between l_BET and l_RASDAQ

r	LR	p-value	90%	95%	99%
0	47.72	0.0001	27.96	30.45	35.50
1	16.22	0.0415	13.64	15.69	20.05

We analyzed the interactions between d_l_BET and d_l_RASDAQ using a VAR framework with one lag. The first equation, with d_l_BET as dependent variable, indicates a low impact of d_l_BET_1 and d_l_RASDAQ_1 (see Table 8).

Table 8 - VAR Equation 1: d_l_BET

Variable	Coefficient	Std. Error	t-statistic	p-value
const	-0.00158221	0.000989768	-1.5986	0.11046
d_l_BET_1	0.0846596	0.0438859	1.9291	0.05421*
d_l_RASDAQ_1	0.0459197	0.0561125	0.8184	0.41349
R^2	0.0103875			
F-statistic	3.03348**			
Durbin-Watson statistic	1.98602			

* Indicates that results are significant at 10% level;
** Indicates that results are significant at 5% level.

The second equation, with d_l_RASDAQ as dependent variable, indicates again a low impact of d_l_BET and d_l_RASDAQ_1 (see Table 9).

Table 9 - VAR Equation 2: d_l_RASDAQ

Variable	Coefficient	Std. Error	t-statistic	p-value
const	-5.29206e-05	0.000767997	-0.0689	0.94509
d_l_BET_1	0.0922525	0.0340526	2.7091	0.00695***

d_l_RASDAQ_1	0.0492214	0.0435397	1.1305	0.25874
R^2	0.0201403			
F-statistic	5.94017***			
Durbin-Watson statistic	2.0041			

*** Indicates that results are significant at 1% level of significance.

We analyzed the causality between d_l_BET and d_l_RASDAQ. It resulted from d_l_BET to d_l_RASDAQ (see Table 10).

Table 10 - Granger causality between d_l_BET and d_l_RASDAQ

Null hypothesis	F-statistic	P-value	Causal inference
d_l_BET do not Granger-cause d_l_RASDAQ	7.3393	0.0068	d_l_BET Granger-cause d_l_RASDAQ
d_l_RASDAQ do not Granger-cause d_l_BET	0.6697	0.4133	d_l_RASDAQ do not Granger-cause d_l_BET

Conclusions

In this paper we investigated the dynamic relations between BET and RASDAQ-C. We found that the two variables were non stationary in level values, but stationary in their first differences. We failed to prove firmly the cointegration between the two indices. Weak interactions were revealed between the two variables and a unidirectional causality from BET to RASDAQ-C.

These results could be explained by the significant differences of the firms listed in the two indices. While BET reflects the performances of only large companies, RASDAQ-C refers in general to smaller firms. The foreign investors which play a major role on the Romanian stock markets are probably interested mainly in the firms listed on BET. In these circumstances the two indices are not necessary moving together although they are frequently influenced by similar factors. However, the abrupt fluctuations of BET could be considered as a signal for the investors on RASDAQ market.

The research over the dynamic relations between the two indices could be extended by using GARCH models that allow the study of the volatilities. Another direction for future researches could consist in the study of the financial crisis impact over the main components of the Romanian Stock Market.

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