TESTING THE EFFICIENT MARKET HYPOTHESIS ON THE ROMANIAN CAPITAL MARKET

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ABSTRACT

The Efficient Market Hypothesis (EMH) is one of the leading financial concepts that dominated the economic research over the last 50 years, being one of the pillars of the modern economic science. This theory, developed by Eugene Fama in the `70s, was a landmark in the development of theoretical concepts and models trying to explain the price evolution of financial assets (considering the common assumptions of the main developed theories) and also for the development of some branches in the financial industry. For example, the main impact was on the development and the mutual fund industry, regarding the increase and the diversification of the funds, of the assets under management and the relevance to the financial industry.

As the financial crises that occurred on the financial markets had important consequences on the EMH and its usefulness in the financial field, definitions refining and new concepts were made and introduced, in order to explain the non-typical evolutions.

In the case of Romania, we use the closing values for BET index (the most representative index on Bucharest Stock Exchange) for January, 01, 2002 – May, 15, 2014, in order to test the EMH, using unit root test, Jarque-Bera test, multiple variance ratio test and GARCH model. The results obtained show that the Romanian capital market is not weak-form efficient.

KEYWORDS: *efficient market hypothesis, capital market, market index, return, financial assets.*

JEL CLASSIFICATION: *G22*

1. INTRODUCTION

The recent financial crisis, that began in 2007, was the starting point of a period characterized by significant turbulences in the financial markets, in which the extreme volatility of the prices had reminded the economists and researchers about past phenomenon that were considered impossible to reoccur on a large scale (like bank runs, nationalisation of the banks in serious financial difficulties etc.).

The occurence of these non-typical evolutions questioned the validity of the financial theories developed under the free market ideology, that dominated the economic research starting the 1960, one of them being Efficient Market Hypothesis (EMH), developed by Eugene Fama. In 1965, Fama defined the characteristics of an efficient market, as a market in which, taking into consideration all the available information, the current prices in every moment are a good approximation of the intrinsec values of the financial assets. More, Fama defined three forms of the informational efficiency of the capital market: *weak-form* (future prices of the financial assets cannot be estimated using the past values), *semi-strong form* (current prices reflect all the public

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information available about the assets) and *strong form* (current prices reflect all public and non-public information about the assets).

In this article, we present a brief analysis of the evolution of the Romanian capital market, including tests of the EMH theory, using the closing values for BET index between 01.01.2002 and 15.05.2014.

2. EMH CONCEPTS

In order to test the informational efficiency, several statistical and econometrical tests have been applied (such as the unit root test, Jarque-Bera test, multiple variance test ratio, GARCH model) to data series consisting of relevant stock exchnge indexes, as well as of the individual price values of the companies based on which those indexes were structured.

Worldwide, the informational efficiency of capital markets was subject to multiple tests, with different results depending on the data used, on the time frames and the methods applied. E. Fama (1970) was one of the pioneers of this field, focusing on the autocorrelation of the daily return for DJIA stocks, during 1957 to 1962, the results indicating the weak-form efficiency of the American stock market. Malkiel (2012) reached a similar conclusion by testing the quarterly aggregated return on the US market, during 1926 to 2009. The informational efficiency of the capital market was subject to and confirmed by tests performed by Khan, Ikram and Mehtab (2012), Sapate and Ansari (2011) for the Indian capital market, Nisar and hanif (2012) for Japan, South Korea, Australia and Hong Kong.

Lo and MacKinlay (1988, 1990) applied the multiple variance ratio test on US market data from 1962-1985, concluding that the market does not present the features of a weak form informational efficiency model. Moreover, Borges and Gairifo (2013) confirmed the existence of abnormal return on mergers and acquisitions of listed companies in Belgium and Portugal, which leads to the idea that those are not informational efficient markets either. Mishra (2011) rejected the efficient market hypothesis, based on a database made up of relevant indexes of the capital markets in India, China, Brasil, South Korea, Rusia, Germany, USA and Great Britain for the period January 2007 – December 2010. Thomas and Kumar (2010), as well as Patel, Radadia and Dhawan (2012) came to the same conclusion for the case of India.

In Romania, Dragotă and Mitrică (2004), Stănculescu and Mitrică (2012) proved that the local market does not present the features of a weak-form efficient market. Pele (2007) and Dragotă, Stoian şi Pele (2009) applied the multiple variance ratio test concluding that the weak-form efficient hypothesis cannot be entirely rejected.

3.INFORMATIONAL EFFICIENCY TESTS OF THE ROMANIAN CAPITAL MARKET

Since the Romanian economy turned from a state controled economy to a market economy, in 1995 the Bucharest Stock Exchange (BVB) was set up, its development paralleling the reform process of the Romanian economy and adjustment to the global market. The development of the capital market was sustained by passing Law 297/ 2004 which set up the framework for the adjustment of the internal legislation to the EU legal provisions on capital markets, regulating market abuse risks, stating the pre-conditions for a informational efficient capital maket.

The presence of capital market open to foreign investment is shown by the evolution of the BET index during 1995 – 2014, that shows the improved macroeconomic conditions (beginning of 2004), mainly following the accession to the European Union (resulting in an important development of the Bucharest Stock Exchange). The dependence on foreign investments was noticed during the accelarated crash in 2008 (in the context of the global financial crisis).

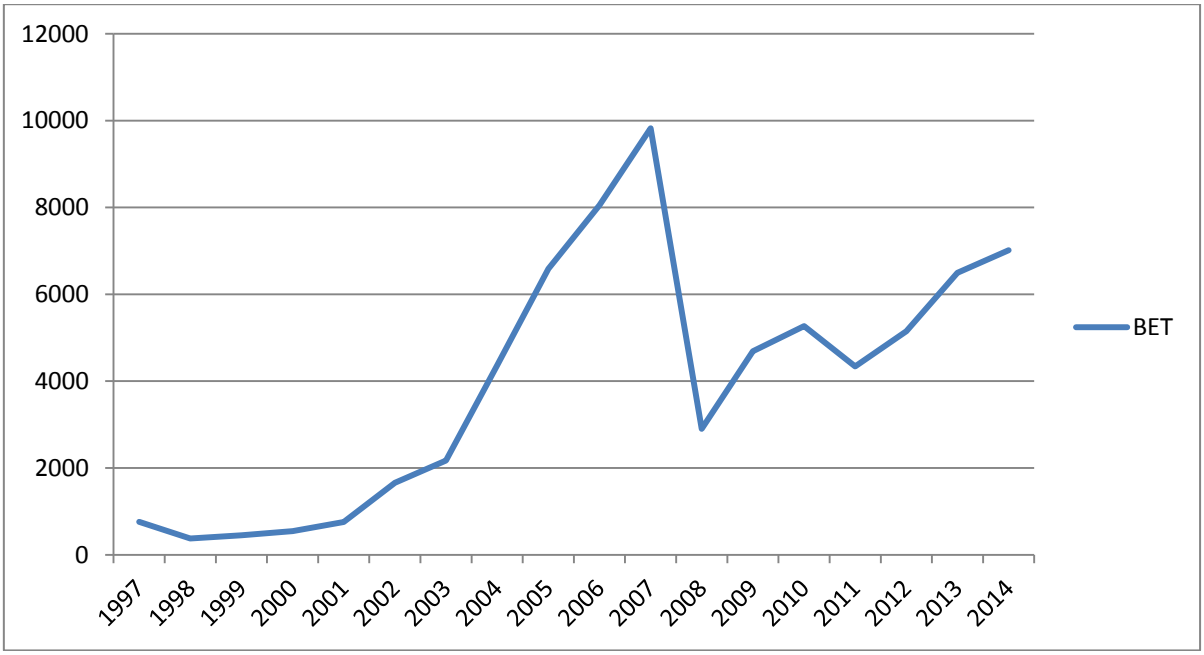

Figure 1 Evolution of the BET index (1997 – 2014)

Source: www.bvb.ro, own calculation

The positive development of the BET index at the end of 2007 conceiled the premature signs of systemic risk generated by the turbulences in the mature markets and resulted in major movements of the foreign capital, that caused significant volatility of prices of the listed companies, which lead to extreme BVB decisions (suspending the trading on October 8, 2008 because of the irrational panic among local investors).

The market partially recovered in 2009 – 2014 after the 2008 crash, the BET index value at the beginning of July 2014 (7015.24) being with 28% lower than the historical maximum value from 2007 (9825.38). During the same period, the relevant indexes of the mature markets outgrew historic values (DIJA value was over 17 000 points at the beginning of July 2014).

Bellow, we test the informational efficieny (weak-form) of the Romanian capital market, using the closing values of the BET index for the period January 1st, 2002 – May 15th, 2014, based on which we calculated the daily return and applied the tests for EMH (*the unit root test, Jarque-Bera test, multiple variance test ratio, GARCH model and tests for market anomalies*).

At the beginning, we test whether the series obtained by applying the logarithm to the closing values of the BET index is stationary, using the Dickey Fuller test. For the selected series, the statistical value of t equals -3.305009, meaning that the null hypothesis cannot be rejected for a 1% significance level, and will be accepted for levels of 5% and 10%. Therefore, the Dickey Fuller test shows that the logarithmical series of the BET closing values is not a random walk (this means the local capital market is not even a weak-form efficient market). For levels of 5% and 10%, the null hypothesis is rejected, so the series has a unit root. We shall find the integration degree of that series.

Table 1 Dickey Fuller test for BET index (01.01.2002-15.05.2014)

Null Hypothesis: LBET has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.305009	0.0148
Test critical values:	1% level	-3.432188	
	5% level	-2.862238	
	10% level	-2.567185	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LBET)
Method: Least Squares
Date: 05/27/14 Time: 11:01
Sample (adjusted): 1/01/2002 5/15/2014
Included observations: 3226 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBET(-1)	-0.001641	0.000497	-3.305009	0.0010
D(LBET(-1))	0.100065	0.017503	5.717095	0.0000
C	0.014342	0.004169	3.440038	0.0006

R-squared	0.013736	Mean dependent var	0.000664
Adjusted R-squared	0.013124	S.D. dependent var	0.016490
S.E. of regression	0.016381	Akaike info criterion	-5.384446
Sum squared resid	0.864862	Schwarz criterion	-5.378793
Log likelihood	8688.112	Hannan-Quinn criter.	-5.382420
F-statistic	22.44430	Durbin-Watson stat	1.991800
Prob(F-statistic)	0.000000		

Source: www.bvb.ro, own calculation

In order to find the integration degree, we test whether the first difference series (that represents the daily returns) is stationary and we find that we reject the null hypothesis (as the absolute value of the t-statistic is greater than the critical values):

Table 2 Dickey Fuller test for BET daily returns (01.01.2002-15.05.2014)

Null Hypothesis: DLBET has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-51.25729	0.0001
Test critical values:	1% level	-3.432188	
	5% level	-2.862238	
	10% level	-2.567185	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLBET)
Method: Least Squares
Date: 05/27/14 Time: 12:51
Sample (adjusted): 1/01/2002 5/15/2014
Included observations: 3226 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLBET(-1)	-0.898048	0.017520	-51.25729	0.0000
C	0.000596	0.000289	2.061659	0.0393

R-squared	0.449012	Mean dependent var	-1.79E-06
Adjusted R-squared	0.448841	S.D. dependent var	0.022099
S.E. of regression	0.016406	Akaike info criterion	-5.381683
Sum squared resid	0.867794	Schwarz criterion	-5.377914
Log likelihood	8682.654	Hannan-Quinn criter.	-5.380332
F-statistic	2627.310	Durbin-Watson stat	1.991968
Prob(F-statistic)	0.000000		

Source: www.bvb.ro, own calculation

Furthermore, in order to test the market efficiency of the Romanian capital market we test whether the BET index daily returns follow a normal distribution, using the Jarque Bera test. The results are presented below:

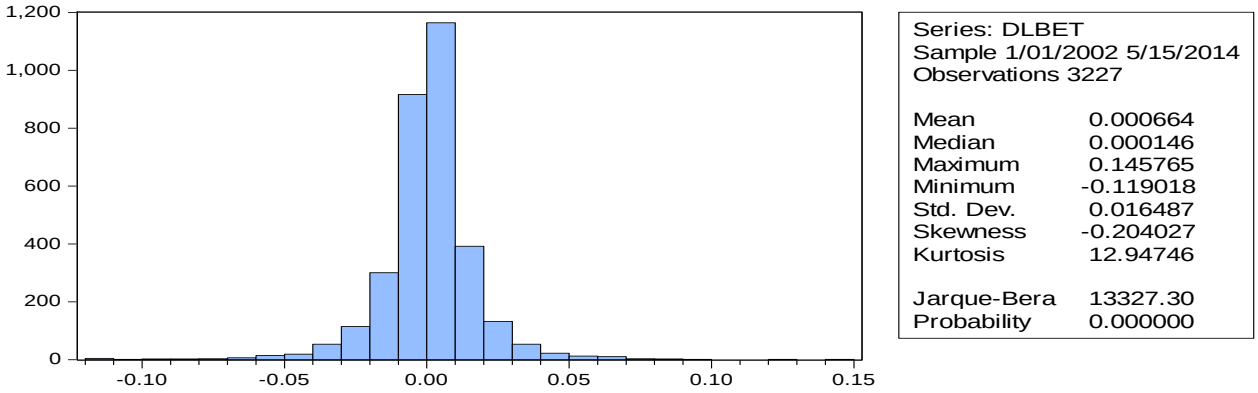

Figure 2 Jarque-Bera test for daily returns of BET index (01.01.2002-15.05.2014)

Source: www.bvb.ro, own calculation

We can see that the distribution of BET index daily returns is not normal, as the median is slightly positive (0.000664), the standard deviation is 0.016487, the skewness is negative (meaning the distribution is left-side asymmetrical, so the returns are higher than those associated with a normal distribution). Moreover, the distribution has fat tails, as the kurtosis is 12.94746, higher than the value associated to a normal distribution (equal to 3). So, using the Jarque-Bera test, we found that the Romanian capital market is not weak-form efficient (as the daily returns do not follow a normal distribution).

We continue testing the weak-form efficiency using multiple variance ratio test (the most relevant test used for testing the efficiency of a market), for 2,4, 8 and 16 days intervals, assuming that the errors are heteroskedastics and we obtain the following results:

Table 3 Multiple variance ratio test for daily returns of BET index, considering heteroskedastic errors

Null Hypothesis: DLBET is a martingale
Date: 05/27/14 Time: 17:46
Sample: 1/01/2002 5/15/2014
Included observations: 3226 (after adjustments)
Heteroskedasticity robust standard error estimates
User-specified lags: 2 4 8 16

Joint Tests	Value	df	Probability
Max |z| (at period 2)*	10.64929	3226	0.0000

Individual Tests

Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	0.572486	0.040145	-10.64929	0.0000
4	0.281023	0.070572	-10.18783	0.0000
8	0.134180	0.100849	-8.585308	0.0000
16	0.066758	0.135333	-6.895896	0.0000

*Probability approximation using studentized maximum modulus with parameter value 4 and infinite degrees of freedom

Test Details (Mean = -1.7940013242e-06)

Period	Variance	Var. Ratio	Obs.
1	0.00049	--	3226
2	0.00028	0.57249	3225
4	0.00014	0.28102	3223
8	6.6E-05	0.13418	3219
16	3.3E-05	0.06676	3211

Source: www.bvb.ro, own calculation

Analysing these results, we find that the biggest values are obtained for the 2 days interval (when q=2) and, comparring the absolute value of these calculated measures with 2.49 - the critical value for the Studentized Maximum Modulus distribution (with m parameters and ∞ degrees of freedom), we find that the null hypothesis is rejected, and the series is not a martingal (and, therefore, the market is not weak-form efficient).

If we consider that the errors are homoskedastic, we obtain the following results:

Table 4 Multiple variance ratio test for daily returns of BET index, when errors are homoskedastic

Null Hypothesis: DLBET is a random walk
Date: 05/27/14 Time: 18:10
Sample: 1/01/2002 5/15/2014
Included observations: 3226 (after adjustments)
Standard error estimates assume no heteroskedasticity
User-specified lags: 2 4 8 16

Joint Tests	Value	df	Probability
Max |z| (at period 2)*	24.28187	3226	0.0000
Wald (Chi-Square)	605.5191	4	0.0000

Individual Tests

Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	0.572486	0.017606	-24.28187	0.0000
4	0.281023	0.032938	-21.82797	0.0000
8	0.134180	0.052080	-16.62478	0.0000
16	0.066758	0.077498	-12.04220	0.0000

*Probability approximation using studentized maximum modulus with parameter value 4 and infinite degrees of freedom

Test Details (Mean = -1.7940013242e-06)

Period	Variance	Var. Ratio	Obs.
1	0.00049	--	3226
2	0.00028	0.57249	3225
4	0.00014	0.28102	3223
8	6.6E-05	0.13418	3219
16	3.3E-05	0.06676	3211

Source: www.bvb.ro, own calculation

Analysing these results, we find that the maximum value of the series is obtained for the 2 day-interval and is bigger than the critical value of the Studentized Maximum Modulus distribution (2.49), which means that the series is not a martingal (so, the weak-form efficiency is rejected).

We continue testig the weak-form efficiency of the Romanian capital market using a GARCH (1,1) model, with the return following a ARMA (1,1) process, the results being:

Table 5 GARCH model for BET daily returns (01.01.2002-15.05.2014)

Dependent Variable: DLBET
Method: ML – ARCH
Date: 05/27/14 Time: 19:53
Sample (adjusted): 1/03/2002 5/15/2014
Included observations: 3226 after adjustments
Convergence achieved after 24 iterations
MA Backcast: 1/02/2002
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	-0.107525	0.158637	-0.677807	0.4979
MA(1)	0.216910	0.157163	1.380159	0.1675
Variance Equation				
C	7.28E-06	5.67E-07	12.83261	0.0000
RESID(-1)^2	0.142904	0.006180	23.12202	0.0000
GARCH(-1)	0.836006	0.007095	117.8354	0.0000

R-squared	0.010188	Mean dependent var	0.000664
Adjusted R-squared	0.009881	S.D. dependent var	0.016490
S.E. of regression	0.016408	Akaike info criterion	-5.774186
Sum squared resid	0.867974	Schwarz criterion	-5.764764
Log likelihood	9318.762	Hannan-Quinn criter.	-5.770809
Durbin-Watson stat	2.004120		

Inverted AR Roots	-.11
Inverted MA Roots	-.22

Source: BVB, own calculation

We see that the AR (1) and MA(1) coefficients are not statistically significant different than zero (*as their associated probabilities are 0.4979 and 0.1675*), so BET daily returns can not be approximated using an ARMA process.

But the volatilty equation is given by: σ_t=0.00000728 + $0.142904\sigma_{t-1}$+ $0.836006\varepsilon_{t-1}^2$, with coefficients being statistically different than 0 for 1% level of significance.

So, we can estimate the BET daily return volatility, a result that can be used to find a strategy to beat the market with no risks associated (a fact that is not consistent with the assumptions of the EMH).

Furthermore, we can test the market efficiency by trying to find possible investment strategies, based on analysis of the monthly average returns of BET index, for the interval January 2002 – April 2014. We define BET monthly return as the ratio of the monthy change (*closing value in the last day of the month less closing value in the first day o the month*) and the closing value in the first day of the month. We define monthly average return by averaging monthly returns for the years considered.

Using this method, we plot the monthly average returns as:

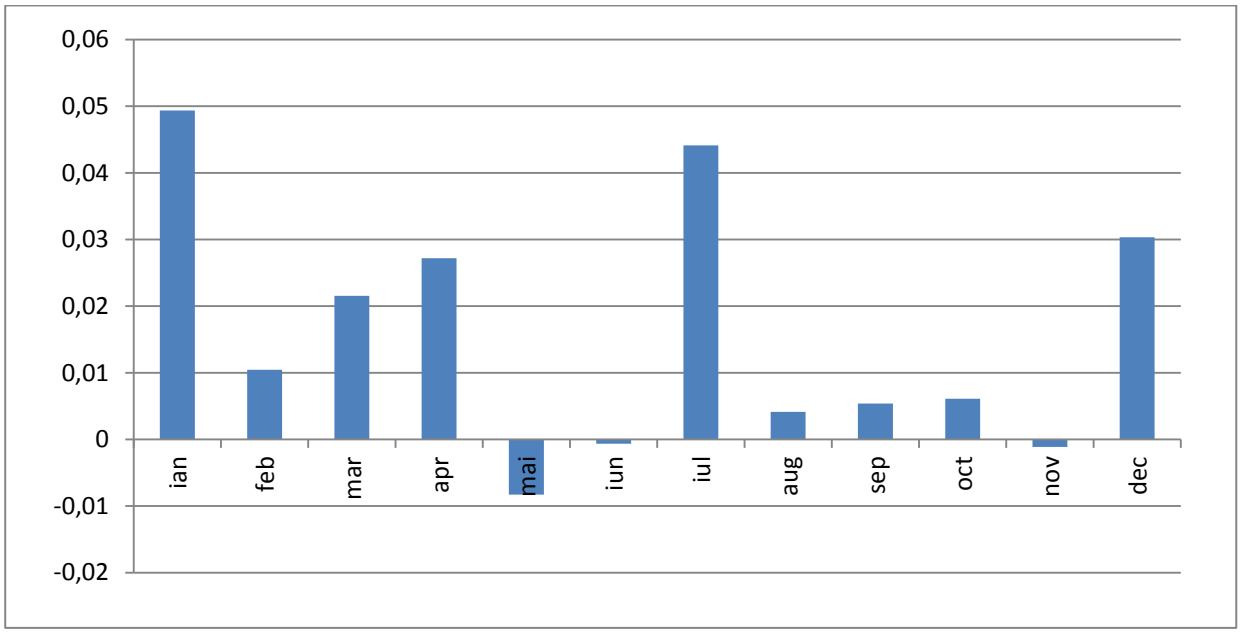

Figure 3 Monthly average returns for Romania (2002-2014)

Source: www.bvb.ro, own calculation

Analysing this figure, we find that the monthly average return is negative for May, June and November and is positive for the rest of the year. The minimum value is -0.08% for May and maximum value is 4.93% for January. We can conclude that the Romanian capital market is not efficient, as we can find strategies exploiting these anomalies (the monthly average returns for January, July and December are bigger than 3%).

4.CONCLUSIONS

In this article, we present the main theoretical concepts of the EMH and use 4 methods for testing the market efficiency of the Romanian capital market (unit root test, Jarque-Bera test, multiple variance ratio test, GARCH model). In order to test the weak-form market efficiency, we consider the closing values of the BET index, for the interval 01.01.2002-15.05.2014.

Using these tests, we find that the Romanian capital market is not weak-form efficient. As a result, we can find investment strategies that can be used to beat the market.

But these results should be analyzed by taking into consideration the characteristics of the Romanian capital market, mainly the lack of liquidity and market depth, as well as the small number of the atractive listed companies, that can fade away the advantages derived from identifying some investment strategies.

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