Abstract—In this paper we present the results of testing the existence of information efficiency in the Romanian stock market, considering the financial market efficiency theory [1] as an important factor in the investment decision process. We focus on testing a weak form of market efficiency, by analyzing the daily evolution of the Romanian BET-FI index for 8 years. Our findings demonstrate the absence of the weak-form of efficiency and the predictable characteristic of the market.

Keywords—ADF test, BDS test, Hypothesis testing, Ljung-Box test, Market efficiency

I. INTRODUCTION

EVERY investor on the stock market is seeking to discover the appropriate trading signals that will lead to consistent positive results for an as higher as possible number of trades.

A significant amount of resources is allocated to build systems that try to uncover the channels of predictability of future prices for the desired financial instruments.

The historical trading data showed to be of great importance in the process of predicting the future price movements, offering different scenarios that appeared to have a certain recurrence over time.

It is very important for a model to be validated using historical data in order to be considered for live trading. It is a way to test the strategy, to verify its performances and as a testbed for improving the strategy in order to obtain higher returns, but the results depend on the market efficiency. For someone who analyzes the evolution of a price for a security, the key question is whether the movement is random or not. If the evolution is random, the probability to build a profitable strategy declines.

More inefficient a market is, more predictable trading opportunities arise [2]. Tests for the market efficiency should be carried in order to discover the dimension of the predictable trading opportunities. The availability of trading opportunities represents the degree of market inefficiency. The possibilities of arbitrages are also a sign that information is slowly absorbed into the prices, as another proof of inefficiency for the market.

We conducted the tests in this paper to determine the existence or absence of the market efficiency in one of its form applying a methodology proposed by A.Todea[3].

The remainder of this paper is as follows. In Section 2 we present the related work in the field of market efficiency study. Section 3 presents the results of our research. Section 4 offers the conclusion.

II. MARKET EFFICIENCY RELATED WORK

The Efficient Market Theory developed by Fama[1] considers the stock markets are informationally efficient, meaning that all the information that can influence the price of the stocks becomes very quickly available to all the participants in the market so it cannot be used as an advantage by anyone.

Tests for market efficiency help in the discovery of predictable trends. The market efficiency hypothesis has three levels: the weak form of efficiency, the semi-strong form and the strong form. In a market that is characterized by a weak form of efficiency the past prices of a stock are reflected in the current price, so no one will be able to predict the future price based only on historical prices. The market efficiency in a semi-strong form states that even if the public information about a company is available to everyone, there is no way to take advantage of this knowledge. In a strong form of market efficiency not even the private/insider information could be used to take profit of it.

There are many studies in the literature concerning the market efficiency hypothesis in the financial markets. The mature markets in the developed countries tend to be more efficient than the emerging markets. Correspondingly, the studies conducted in the mature markets refer to the validation of a strong or semi-strong form of efficiency, while most of the researches concerning the emerging markets are testing the weak form of efficiency. We oriented our bibliographic research especially on the emerging countries studies, in order to gain an image of the markets in countries that have the similar stages of development as Romania.

Evidences in a study[4] focused on Eastern European countries and the US markets show that markets in Poland, Czech Republic and Hungary tend to converge to the US market, the efficiency in a weak form being found in all of them.

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M. Aga [5] tested the efficient market hypothesis on the Istanbul Stock Exchange, using a regression model found the presence of the weak form of efficiency. The tests were conducted using a time series of their own built index, considering the most relevant evolutions of the stocks.

Another study[6] conducted on the Turkish markets, but considering the Toda Yamamoto Causality Test found a semi strong form of market efficiency on the money market in Turkey, but not in the stock market.

A research on the Athens Stock Exchange index FTSE/ASE 20 studied the market efficiency in Greece [7], and the conclusion was the existence of a weak form of efficiency.

In a report made for the Romanian stock market in 2006 [8] there was no evidence for the presence of a weak form of efficiency, considering as the main factor the lack of liquidity.

Todea [9] clearly rejected the random walk hypothesis on the Romanian market in 2005, concluding the market has periods of random walk behavior alternating with periods where a correlation and autocorrelation is present, identifying a high forecasting potential.

Considering the above mentioned studies we concluded that our tests should be focused on the possibility of finding the existence of a weak form of efficiency on the Romanian market.

Depending on the results we will conclude if the forecasting potential of the market remained at a high level.

III. RESULTS OF THE ROMANIAN MARKET EFFICIENCY TESTS

We used the tests proposed by Todea [3] to verify the market efficiency of a Romanian Stock Exchange index: BET-FI. It incorporates only five financial companies, but they are the most liquid stocks at BSE, usually representing more than 50% of the daily trading volume.

In order to test the informational efficiency hypothesis we must take into consideration the characteristics of the emerging markets: the nonlinearity of price movements, low frequency trading and the impact of financial liberation on the market performance. From the forms of efficiency, the weak form might be of interest in the case of the Romanian market.

For testing the random walk hypothesis we have used classic linear tests and non-linear tests with the help of Eviews 5 application. The linear tests used are Dickey-Fuller[10] and Ljung-Box[11]. For testing the non-linear dependency we have used the BDS test[12].

With the Dickey-Fuller test we have probated the possible existence of a unitary root. The test is applied to the rentabilities. In case the obtained value is higher than the critical values, the null hypothesis is accepted, thus the series is stationary, it has a unitary root and the random walk hypothesis is accepted. On the contrary, if the test value is smaller than the critical values, the stationarity hypothesis is rejected.

For the Ljung-Box test we calculated a MA(0) model. The applied Correlogram Q-Statistic test determines the correlations between residual values. If the obtained values are below 0.05, the null hypothesis is rejected, thus there is a correlation. On the contrary, we can accept the null hypothesis, case in which we don’t have any linear dependencies.

The portmanteau BDS test studies the non-linear correlation. We apply it over the residual values of the series and verify the existence of non-linear dependencies. If after conducting the test the result is p=0, the null hypothesis is rejected, thus there aren’t any non-linear dependencies. The accepted alternate/alternative hypothesis is the existence of non-linear dependencies.

The series on which the tests were applied is represented by the calculated rentabilities relative to the daily closing values of the indices, during 2002-2010, and having 1980 observations.

In the next chart (Fig.1) we present the index evolution for the a 10 year period:

The distribution of the rentabilities can be observed with the help of the histogram. We noted a certain positive skewness comparing to the normal distribution, as well as a strong kurtosis (Fig.2).

After applying the Augmented Dickey-Fuller test we have obtained the following results(Table 1):

<table>
<thead>
<tr>
<th>Table 1. ADF test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null Hypothesis: SER01 has a unit root</td>
</tr>
<tr>
<td>Exogenous: Constant</td>
</tr>
</tbody>
</table>
Because the AR(1) model cannot be accepted, the p value being bigger that 0.05, other AR(x) models were sought in order to filter the linear dependency. The best alternative was AR(2).

For determining the possibility of a non-linear dependency existing, we used the BDS test, which is applied to residues from the initial rentability, unadjusted.

### Table 3. BDS Test

<table>
<thead>
<tr>
<th>Dimension</th>
<th>BDS Statistic</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.011659</td>
<td>0.001428</td>
<td>8.164870</td>
<td>0.0000</td>
</tr>
<tr>
<td>3</td>
<td>0.025233</td>
<td>0.002881</td>
<td>8.756840</td>
<td>0.0000</td>
</tr>
<tr>
<td>4</td>
<td>0.037362</td>
<td>0.004353</td>
<td>8.582637</td>
<td>0.0000</td>
</tr>
<tr>
<td>5</td>
<td>0.050119</td>
<td>0.005754</td>
<td>8.709555</td>
<td>0.0000</td>
</tr>
<tr>
<td>6</td>
<td>0.062860</td>
<td>0.007036</td>
<td>8.933484</td>
<td>0.0000</td>
</tr>
<tr>
<td>7</td>
<td>0.074585</td>
<td>0.008174</td>
<td>9.124354</td>
<td>0.0000</td>
</tr>
<tr>
<td>8</td>
<td>0.086258</td>
<td>0.009157</td>
<td>9.419562</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Because the p values are below 0.05, the existence of non-linear dependencies has been confirmed, the residuals being not normally (abnormally) distributed.

Following the statistical tests applied on the daily rentabilities of the Romanian stock index, linear and non-linear correlations were found, the price of the stocks being mostly influenced by the new information that arrives in the market, the random walk hypothesis being rejected. We cannot sustain the existence of a weak form of information efficiency in this case, the usefulness of simple technical analysis not being rejected.

### IV. CONCLUSION

The results obtained lead to the opinion that the Romanian stock market did not succeed in gaining efficiency in the last years, although the technology advanced and investors are becoming more and more educated.

Considering the literature review performed, and comparing the results obtained with the tests realized on other countries in the region (most of them considered to be efficient in a weak form) we conclude that the Romanian stock market is still underdeveloped, the recent years of technological advances being insufficient to determine a growth in its efficiency.

The absence of the efficiency in a weak form is a sign of predictability, making arbitrages possible. Also simple trading strategies should succeed, the number of opportunities for successful trades being larger than in the more developed markets.

Anyway, periods with a higher degree of efficiency are possible to occur, the market passing through different stages of liquidity and behavior in the analyzed period.
REFERENCES