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Weak Form Efficiency of the Amman Stock Exchange: An Empirical Analysis (2000-2013)

Izz eddien N. Ananzeh[1]

[1] Finance, Philadelphia University, Jordan

Correspondence: Izz eddien N. Ananzeh, Finance, Philadelphia University, Jordan. E-mail: iananzeh@yahoo.com

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Abstract

The Efficient Market Hypothesis (EMH) has been a lot of debates in the literature of finance because of its important implication, and there is no clear-cut case regarding the efficiency of the financial markets for both developed and emerging markets. This empirical study conducted to examine EMH at the weak form level of Amman stock Exchange (ASE) by using daily observations for the period span from 2000 to 2013. Recent econometric procedures utilized for testing the randomness of stock prices for ASE. The results of serial correlation reject the existence of random walks in daily returns of the ASE, and the unit root tests also conclude the return series of ASE are stationary and inefficient at the weak-level. Also the runs tests verify that the stock returns series on ASE are not random, and our final conclusion reports that the ASE is inefficient at the weak form level.

Keywords: efficient market hypotheses, randomness, run test, serial correlation

1. Introduction

The financial markets should be efficient in order to take his role in terms of attracting investment, the Efficient Market Hypothesis (EMH) developed firstly by Paul Samuelson in 1965 and Fama in 1970, and in the literature of finance there is a lot of the discussion concerning this subject because of its important implications in the financial markets.

The market efficiency used to clarify the relationship between information and stock prices. The market is still efficient if the market price of any stocks reflected correctly and completely all relevant information.

Both researchers Fama (1970), and before him Paul Samuelson in 1965 points out that the EMH presume that the current prices of any stocks reflect all available relevant information, and the movement of the stock prices should follow the hypothesis of the random walk. This means that the process of stocks price changing are behave independently and identically distributed (IID).

Fama (1970) classified the efficiency of the market into three levels depending on the extent of availability of data and information: weak-form, semi-strong form and strong form.

Weak-form of EMH supposes that the all historical information should be fully reflected on current stock prices such as: (historical series of prices, and the trading volumes).

Semi-strong form of EMH, supposes that not only all historical information should be fully reflected on current stock prices, but also the new publicly available information such as: (the announcements for dividend, accounting practices, and all news whether its economic or political) should be fully reflected on current stock prices. Finally, the strong-form of EMH supposes that besides the previous criteria's which mentioned in previous version of EMH all information's from both sources whether it private or public sources should be fully reflected on current stock prices.

The random walk model (Random-Walk) is one of the tests used to determine whether stock prices follow a random movement or not, in the case if followed the random walk means the inability to use historical stock prices to predict the current prices and thus the market is still efficient and vice versa. In the case of the possibility of using historical prices to predict future prices, the possibility of using trend analysis to make abnormal return, and to consider the market is still inefficient

In all countries the Regulatory power are looking to adopt best policies in order to decrease the interferences in the financial market to the minimum level, and trying to reach the required financial efficiency for its markets. This is a great incentive for investors to increase the size of their investments as well as to attract new investors to these markets, which is leading this market towards achieving the desired objectives. For the last decades the random walk theory and also EMH remained popular. EMH concept is very important to achieve awareness and better understanding of the performance of the functions of the financial markets, and market efficiency in developing countries and emerging countries have taken more importance to speed up the trends in international investment flows to these markets and remove obstacles that facing.

The process of testing the stock market efficiency is a strong predictor for the development of these markets. So this study came in order to test the efficiency of Amman Stock Exchange (ASE) at the weak-form by using different statistical methods and compared it with previous studies in this market specifically, and other emerging markets in general to find out the latest developments happened in this market.

The rest of this study organized as follows: the review of literature presented in Section two; section three present the data and methodology of our study; empirical results presented in Section four; and finally Section five reports the conclusion.

2. Literature Review

The efficient market hypothesis (EMH) still been tested because of its huge applications in financial markets operations, and since the beginning of last decade years a number of researchers studied the presence of EMH in various markets, and was reached different results.

The first effort belong to Louis Bachelier In 1900, through submitting his PhD thesis , in which he states that the share prices are random and suggest that the prices would be unpredictable. Since that time and until the early sixties of the last century a few works was detected, but this subject was debated intensively from beginning of 1960's.

The real effort in this field presented by Samuelson in 1965 by developing the theoretical formulation of the EMH, and he debated that the unpredictability of sequential price changes does not represent a solid ground for testing market efficiency.

After a few months of Samuelson (1965), Fama (1965) defined for the first time the efficient market, by analyzing stock market prices and reach the conclusion that they followed a random walk.

Fama (1970) present a definitive paper on the EMH, and in order to testing the market efficiency he suggests three models (Random Walk, Submartingale, Fair Game). Also he divided the test of EMH into three forms; weak, semi-strong, and the strong form.

The empirical evidence on developed markets confirming the weak-form efficiency of the EMH, for instance, Cootner (1962), Fama and Blume (1966),Williamson (1972), Granger (1975), Barnes (1986), Nicolaas (1997), Cooper (1982), Lo (1997), and Groenwold et al. (2003). In another side there is many empirical evidence supported the weak form efficient market hypothesis regarding to both emerging and developed countries for example; Granger (1975), Barnes (1986), Fama (1991), Lo (1997), and Groenwold et al. (2003), Worthington and Higgs (2004), and Moustafa (2004).

We found conflicting results by reviewing the empirical literatures in emerging markets through testing the market efficiency at the weak form, and in this contest some researchers support the EMH while many others oppose the EMH by employing different methodologies.

For example Barnes (1986), Sharma and Kennedy (1977), Karemera et al. (1999), Moorkerjee and Yu (1999), Abeysekera (2001), and Abraham et al. (2002) conducting their studies by using either runs test or unit root test .

Fawson et al. (1996), Dickinson and Muragu (1994), Alam et al. (1999), Moorkerjee and Yu (1999), and Groenwold et al (2003) adopted variance ratio tests Q-test, while variance ratio tests adopted by Urrutia (1995), Karemera et al. (1999), Chang and Ting (2000), Abraham et al. (2002), and Lima and Tabak (2004) and others. Spectral analysis employed by Sharma and Kennedy (1977), and Fawson et al (1996). Autoregressive Conditional Heteroscedasticity (ARCH) test employed by Seddighi, and Nian (2004).

Karemera et al. (1999) employ Variance Ratio Tests and Unit Root to inspect the Weak Form Efficiency for twenty emerging markets, and he found random walk behavior in majority of markets. Grieb and Reyes (1999) also found random walk behavior in Brazil and Argentina stock markets from the sample tested which covered also Mexican stock market.

Dahel and Laabas (1999) only reported that Kuwait stock market support the weak form of efficient market hypothesis from the tested sample which covered also Saudi Arabia, Bahrain, and Oman.

Buguk and Brorsen (2003) reported that Turkish stock exchange support the weak form efficient market hypothesis.

Squalli (2005) tested the market efficiency for financial market of United Arab Emirates by employing Variance Ratio Test and Run Test. Their result generally rejected the null hypotheses of random walk.

Based upon previous introduction of financial literature there is no clear-cut case regarding the efficiency of the financial markets for both developed and emerging markets, and it seems more reasonable to further investigation by conducting new empirical study covering our country Jordan which is one the emerging market that located in the Middle East.

3. Data and Methodology

3.1 Data

Our empirical analysis is carried out by using daily data, and the sample period spans from 2000 to 2013 for 3440 observations. The data set is consisting of closing daily returns of Amman Stock Exchange (ASE) weighted index in time series analysis.

The daily rate of returns calculated by the following formula:

$$RT_t = Ln(\frac{\Pr_t}{\Pr_{t-1}}) \tag{1}$$

Where $\Pr_t$: refer to the end-of-day closing price of the ASE index, $\Pr_{t-1}$: refer to closing price of previous day, Ln : refer to natural logarithm.

3.2 Methodology

The Random Walk Hypothesis (RWH) is the main implication of weak-form of efficient market hypothesis which implies that historical stock prices can't be utilized to predict future prices, and the movements of a stocks price are random and serially independent. In the empirical works, there are many techniques used to determine the patterns in time series. Under the RWH we can describe the financial market is efficient at the level of weak-form if the current stock prices fully reflect all historical information, and can't be used as a prediction tool for stock price movements in the future.

Our study follows the previous literature by employing a various econometrics techniques in order to test the independence of stock prices. In order to test the random walk hypothesis (RWH) the research problem is set to identify if the stock prices on ASE is predictable or not through examining the serial dependence of stock returns, we utilize a various parametric and non-parametric methods; unit root tests, autocorrelation test, and run test.

3.2.1 Autocorrelation Function Test (ACF)

Firstly, we employ autocorrelation function test (ACF) to disclose the validity of random walk hypothesis in ASE.

Autocorrelation function (ACF) test measures the degree of correlation between the current stocks returns and its lagged observations or the degree of independence which given by:

$$\rho_k = \sum_{t=1}^{n-k}(RT_t - \overline{RT})(RT_{t+k} - \overline{RT}) / \sum_{t=1}^{n}(RT_t - \overline{RT})^2 \tag{2}$$

Where k refers to the lags number, and r indicates to the real rate of return which calculated as follows:

$$RT_t = \ln\left(\frac{\Pr_t}{\Pr_{t-1}}\right) \times 100 = \alpha + \mu \tag{3}$$

We apply this test to examine the significance of serial correlation coefficients, and if the stocks returns are serially correlated we will reject the null hypothesis which means that ASE is inefficient at weak form level.

Ljung–Box (Q) statistic which given bellow to test the joint hypothesis that all autocorrelations are significantly different from zero:

$$Q_{LB} = n(n+2)\sum_{t=1}^{k}(\rho_t^2 / n - t) \tag{4}$$

k : refer to the lag length, n : refer to the sample size, under the null hypotheses of zero autocorrelation at the first k autocorrelations which is distributed as chi-squared. $(\rho_1 = \rho_2 = ... = \rho_n)$

3.2.2 Unit Root Tests

We employ two Unit Root tests to test the stationarity of stock returns which is necessary for random walk hypothesis. The parametric test Augmented Dickey-Fuller (1979), and the nonparametric test Phillips-Peron (PP) unit root test (1988).

Firstly the estimation of ADF test is based on the following formula:

$$\Delta RT_t = \alpha_0 + \alpha_1 RT_{t-1} + \alpha_2 T + \sum_{T=1}^{n}\alpha_i \Delta RT_{t-i} + \varepsilon_t \tag{5}$$

Where RT_t refers to the time series; t refer to the time trend; Δ refer to the first difference operator; and ε_t refer to the error term with zero mean and constant variance.

The null hypotheses of the unit root test $\alpha_1 = 0$. Phillips and Perron in 1987 made a modification for ADF $t - statistic$ with Z_t statistic, which correct for any serial correlation and conditional heteroskedasticity in the errors ε_t, and based in the following estimation. Campbell and MacKinlay (1997).

$$\Delta RT_t = \alpha \ + \beta(RT_{t-1}) + \varepsilon_t \tag{6}$$

3.2.3 Run Test

Run test is a nonparametric test employs to examine the serial dependence in the stock returns, and designed to investigate if the observed sequence is random or not. Run Test a potent test for examining the RWM because the test ignores the properties of distribution and independent of the constant variance of data and normality, and the test running whereby the number of sequences of sequential positive and negative stock returns is tabulated and compared versus its sampling distribution under the RWM hypothesis.

A run as computed as a sequence of price changes of the same sign preceded and followed by the price changes of different sign. Under the null hypothesis that sequential are serially independent and random, and if the expected number of runs is different from the actual number of runs then we will reject the null hypothesis of randomness.

The formula used to estimate the total number of expected runs with the following mean:

$$\eta = N(N+1) - \sum_{i=1}^{3} n_i^2 \Big/ N \tag{7}$$

N: refer to the sample size, and n_i refer to the total number of price changes (returns) in each category.

When the observation more than 30 observations the sampling distribution of η is approximately normally distributed and the standard deviation $(\sigma\eta)$ for runs is given by:

$$\sigma_\eta = \left[\sum_{i=1}^{3}\left[\sum_{i=1}^{3} n_i^2 + N(N+1)\right] - 2N(\sum_{i=1}^{3} n_i^3 - N^3) \Big/ N^2(N-1)\right]^{1/2} \tag{8}$$

We can be utilized standard normal Z- statistics to implement run test by following formula:

$$Z = (r \pm 0.05 - \eta) / \sigma_\eta \tag{9}$$

Where r refers to the actual number of the runs, μ refers to the expected number of the runs, and 0.5 is a continuity adjustment.

4. Empirical Results

We are classified our empirical results according to the different statistical techniques used in this study.

4.1 Descriptive Statistics

In order to examine the distribution of the return series, this is one of the key assumptions of RWM. The descriptive statistics was calculated form the natural logarithm of daily rate of returns for ASE and presented in the Table 1.

From the Table 1 we can see easily that the frequency distribution of the ASE daily return series is not normal. The mean for the return series is positive, and with positive kurtosis. This means that the frequency distributions of return series are leptokurtic indicating higher peaks than expected from normal distributions, and this is an indication that the distribution is not normal. Also Jarque-Bera test result confirms that distribution daily stock returns for ASE is not normal. All of the above are deviate from the previous condition of RWM.

Table 1. Descriptive statistics for daily index returns of ASE

Date: 08/08/14 Time: 15:52	
Sample: 1 3440	
	RT
Mean	0.000210
Median	0.000390
Max	0.046860
Min	-0.045260
Std. Dev.	0.009330
Skew ness	-0.309000
Kurtosis	6.850540
Jarque-Bera	2180.460
Prob	0.0
Obs	3440

We are expanding our investigation for randomness by employing two different tests the first one serial autocorrelation (ACF), and Ljung-Box Q:

Table 2 present the result of autocorrelation test using up to 10 lags depending upon Akaike criterion, and depending in the null hypothesis of there is no autocorrelation for return series of ASE.

The significance of autocorrelation coefficients which presented in Table 2 confirms the significance autocorrelation daily stock returns for ASE. The results of both Ljung -Box Q statistics and non-zero auto correlation for return series are jointly significant at the level of 0.01. This is confirming that the ASE is inefficient at the level of weak-form.

Table 2. Autocorrelation and Q-Statistics for daily index returns of ASE

Sample: 1 3440

Included observations: 3440

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
|** |	|** |	1	0.230	0.231	175.98	0.00
| |	*| |	2	-0.030	-0.083	177.37	0.00
| |	| |	3	0.011	0.036	177.89	0.00
| |	| |	4	0.030	0.018	181.37	0.00
| |	| |	5	0.020	0.006	181.88	0.00
| |	| |	6	-0.021	-0.024	183.43	0.00
| |	| |	7	-0.012	0.006	184.44	0.00
| |	| |	8	0.020	0.018	184.85	0.00
| |	| |	9	-0.013	-0.024	185.32	0.00
| |	| |	10	-0.035	-0.004	186.14	0.00

4.3 Unit Root (Stationarity) Tests

We are expanding our investigation by employing two Unit Root tests to test the stationarity of stock returns series which is necessary for random walk hypothesis; Augmented Dickey-Fuller (ADF) unit root test (1979), and Phillips-Peron (PP) unit root test (1988).

Table 3 present the result of both ADF, and PP tests using up to 10 lags depending upon Akaike information criterion, Upon the RWH the stock returns series must have a unit root. The results of two unit root tests presented in Table 3 by rejecting the null hypothesis. This means that the return series of ASE are stationary and inefficient at the weak-level.

Table 3. Unit root test for daily index returns of ASE

Unit Root Tests	T-Stat	P-Value
ADF test	-25.5919	0.00
PP test	-47.6434	0.00

4.4 Run Test

Finally another Run Test is non-parametric test applied in this study to examine the serial dependence (randomness) in the stock returns series, and the results of this test reported in Table 4.

The results presented that the actual runs of stock returns series for ASE are significantly smaller than their corresponding expected runs at 1% level, so that we will reject the null hypothesis that stock returns series on ASE follows RWH.

Table 4. Runs test for daily index returns of ASE

Runs Test	
Test Value[a]	.000
Cases < Test Value	1721
Cases >= Test Value	1722
Total Cases	3440
Number of Runs	1403
Z	-10.885
Asymp. Sig. (2-tailed)	.000

Based in all above, the results of all tests verify that the stock returns series on ASE are not random. Therefore, the stock returns show predictable (or nonrandom walk) behavior.

5. Conclusion

This empirical study conducted to examine EMH at the weak form level of Amman stock Exchange (ASE) by using daily observations for the period span from 2000 to 2013. Recent econometric procedures utilized for testing the randomness of stock prices for ASE. The results of serial correlation reject the existence of random walks in daily returns of the ASE, and the unit root tests also conclude the return series of ASE are stationary and inefficient at the weak-level. Also the runs tests verify that the stock returns series on ASE are not random. The final conclusion reports that the ASE is inefficient at the weak form level.

Our findings are consistent with other similar research Frennberg and Hansson (1993), Abeysekera (2001), Abraham (2002), and Borges (2010).

In addition, our empirical finding consistent with the results achieved by studies conducted in both developed and emerging markets: Cheung, Wong and Ho, (1993), El-Erian and Kumar (1995), Poshakwale (1996), Nourrrendine and Kababa (1998), Mobarek (2000), Abraham (2002), Tas and Dursonoglu (2005), Kader, and Rahman (2005), Mishra (2009), and Borges (2010).

Our result that ASE is inefficient at the weak form level may be attributing to the following reason: lack of transparency and accountability, the regulatory framework is weak, corporate governance not in a good manner. For that we propose for further study in the future for this market to examine whether the market efficiency improved or not.

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