Testing Random Walk Behavior in the Damascus Securities Exchange

Ghada ABBAS

Department of Banking and Financial Management
Higher Institute of Business Administration (HIBA)
P.O.Box: 12890 Damascus-Syria, E-mail: ghada.abbas@yahoo.fr

Abstract
The majority of empirical literature on random walk behavior has interested on developed and emerging markets. However, few studies have been carried out to test the randomness of returns series on less developed markets. Damascus securities exchange is a young and nascent market in the Middle Eastern, started its operations in 2009; therefore, there is no empirical evidence testing the validity of random walk process. This paper examines whether daily stock returns on Damascus Securities Exchange follow a random walk for the period of 2009 to 2014. This study applies two parametric tests namely serial-correlation test and variance ratio test, and two non -parametric tests, i.e. runs test and BDS test. It is found that daily returns do not confirm to a random walk during the period under examination. This result is consistent in both parametric and non-parametric tests. The broad conclusion emerging from this study is that price returns might be predictable; hence, it is possible for investors to earn higher return than average by using historical successive prices.

Key words
Random Walk, Market Efficiency, Parametric Test, Serial Correlation, Variance Ratio, Non-Parametric Test, Runs Test, BDS Test, Damascus Securities Exchange

1. Introduction

The behavior of stock market returns is a theme long discussed in financial literature. The random walk theory, first developed by Bachelier (1900), states that financial series could be approximated by a random walk model. This theory and its implications for the behavior of stock market returns has since initiated ongoing debate regarding whether stock price changes follow a random walk process, then, it is not possible to predict future prices movements.

Poshakwale (1996) asserts that the theory of random walk behavior is closely related to the Efficient Market theory. If the stock market is efficient, the successive price changes must be independent and, then, prices follow a random walk. Fama (1970, 1991) is considered one of the most important researchers who presented a formal review of theory and evidence for random walk theory and market efficiency. In an efficient market, the current prices reflect all relevant information and, hence, stock returns will show unpredictable behavior. In other words, the new information arriving on the market is immediately incorporated into stock prices and it is impossible to earn abnormal returns or to outperform the market. This could be an indication that financial markets operates with high degree of efficiency (Gitman *et al.,* 2011). According to the set of information assumed to be incorporated in prices, Fama (1965) classified market efficiency in three forms: the strong form, the semi-strong form, and the weak form. The strong form of the market efficiency states that the stock prices reflect all the available publicly and privately information. The semi-strong form holds that the stock prices reflect all relevant publicly available information and, therefore, the fundamental analysis of such information will be of little value in helping investors to outperform the market. According to the weak form of the efficient market theory, the sequence of past price returns contains all historical information, so investors can't generate excess returns using technical analysis. If the

weak form of market efficiency holds, and thus prices are independent of the pattern of historical stock prices, the stock price behavior should be a random walk, and stock returns should not be correlated. This paper focuses only on the last form of market efficiency, i.e. the weak form.

There is an abundant theoretical and empirical literature relating to the random walk theory and efficient market hypothesis. Empirical studies investigated the random walk behavior of stock returns in the world's stock markets. Some of these researches have interested on individual markets. Others have concentrated on regional equity markets and, hence, to present international evidence on the random walk theory. A careful survey of this literature reveals that there is no consensus among researchers regarding the behavior of stock market returns. In general, the results of previous researches provide evidence in favor of random walk hypothesis in stock market for the developed markets. European markets, such as Germany (Conrad and Jutter 1973), United Kingdom (Poon 1996, Evans 2006), Spain (De Peña and Gil-Alana, 2002), Ireland, Portugal, Sweden (Worthington And Helen Higgs 2004) are consistent with the random walk hypothesis, while France meet only some requirements for a random walk (Borges, 2008). But the random walk hypothesis is strongly rejected for the U.S. (Fama and French 1988, Lo and MacKinlay 1988, and Mukherji 2011). On the other hand, the empirical results reported from developing countries are mixed and conflicting. Some researches provide evidence of weak form efficiency and cannot reject the random walk hypothesis in emerging markets. Regarding stock markets in the Latin American region, findings provide mixed evidence on the weak form efficiency for the stock markets in Argentina, Brazil, Chile, and Mexico (Urrutia, 1995). Whereas the others provide strong evidence against the validity random walk hypothesis, and reject the weak form efficiency in the developing and emerging countries such as Brazil (Ely, 2011), Chile and Mexico (Karemera *et al.,* 1999), Korea (Ayadi and Pyunn 1994), China (Chong *et al.*, 2012), India (Gupta and Basu, 2007), Chile, Mexico, Brazil, Peru, Argentina, Columbia and Venezuela (Worthington and Higgs 2003). In the case of Middle Eastern and North Africa Markets (MENA), the results of empirical literature lead to reject the randomness of stock returns for all countries investigated; Saudi Arabia, Kuwait, and Bahrain (Abraham et al. 2002), Morocco, Tunisia and Egypt (Collins *et al.*, 2011), Bahrain (Al-Jafari, 2011) Kuwait, Oman, Saudi Arabia and Bahrain (Al-Khazali *et al.*, 2007).

Most previous researches regarding the behavior of stock returns have been performed on developed and emerging markets. Stock markets in the Middle East have received less attention than that elsewhere. In nascent stock markets, price volatility is very high and trading is typically thin. Damascus securities exchange is a young and nascent stock market in the Middle East with less than 50 companies listed. It started its operation in 2009. Therefore, one would expect to find similar inefficiencies on it. Empirical researches that examined the randomness of the (DSE) are rare. It is, therefore, interesting to investigate the random walk characteristic of the Syrian equity market in order to provide evidence for individual and institutional investors, regulators and academics. This study contributes to the empirical literature on random walk behavior and market efficiency in general, and on Middle Eastern region in particular.

The purpose of this study is to test the validity of random walk characteristic on the DSE using most recent and available data. Unlike many of previous studies, that did not take into account the possible non-linearity of stock returns, this study examines the random walk behavior applying different techniques to detect linear and non-linear dependence. These techniques include (i) the parametric test where serial correlation and variance ratio tests are performed to test for random walks under the varying distributional assumptions of homoscedasticity and heteroscedasticity; and (ii) the non-parametric tests namely runs test and BDS test are used to test for serial correlation.

2. Damascus Securities Exchange (DSE)

Damascus Securities Exchange is the only stock market in Syria. It is regulated and monitored by the Commission on Financial Markets and Securities. Since DSE is a young and nascent stock market, it does not have a long history. It was established and started trading in 10th March 2009 with only six listed companies. The number of listed companies has since evolved gradually over time, but it remains below expected. This is due to the fact that DSE opening coincided with the global financial crisis and followed by the political crisis (regional and local). In September 2014, the number of listed companies has increased to around twenty three with a market capitalization around 133 billion Syrian pound. Table 1 shows the number of listed companies and the market capitalization during the period from 2009 to 2014.

Table 1. Number of listed companies and market capitalization for years 2009-2014

	2009	2010	2011	2012	2013	2014
N. of listed companies	12	19	21	22	22	23
Market Cap. (Billion S.P.)	61.14	144.36	82.69	74.04	118.94	133

Source: Annual Report of DSE for years 2009-2013, and 3rd quarterly report for 2014.

Listed companies are classified into five sectors: banking, industrial, services, insurance and agricultural. A major characteristic of DSE is the domination of banking sector (13 banks out of 23 listed companies). The Stock market is divided into two market segments; a Main market and a Growth market. The Growth market is further divided into two categories: Growth market (A) and Growth market (B). The companies listed in the Main market have better indicators than those in the Growth market. Moreover, companies in the Main market differ by their larger capital and bigger number of shareholders as well as the conditions they meet in accordance with the Listing Regulations issued by the DSE. Companies shall be transferred between markets in compliance with the Listing Rules published by the Exchange. The overall market performance of DSE is measured by the Weighted Price Index (DWX). It is the only index available. The index sample consists of all the companies listed in the Main market and the Growth market (A).

3. Data and methodology of research

3.1. Data

The data used in this study consist of daily index values for Damascus securities exchange. The sample period includes 780 observations covering the period from December 2009 until September 2014. The dates of the initial observations, which are December 31, depend on the data available, and the dates of the last observations are 16 September. Data was obtained from the official web site of the DSE (www.dse.com). The natural log of the relative closing prices is computed for the daily intervals to produce a time series of continuously compounded returns, such that:

$$R_t = lnP_t - \ln P_{t-1} \tag{1}$$

Where P_t and P_{t-1} represent the stock index price at time *t* and *t-1*, respectively.

3.2. Methodology

Two complementary tests are used to test for random walks hypothesis with independent and identically distributed increments in returns series. The parametric tests used in this study include the serial correlation test of independence and the variance ratio. This study also employed two non-parametric tests namely the runs test for serial independence and the BDS test of nonlinearity, which are robust to distribution of the returns. The choice of these tests is appropriate especially in the light of the observation made in the present study that returns series are non-normally distributed (table 2).

3.2.1. Parametric tests

3.2.1.1. Ljung and Box (1979) Auto-correlation test

Ljung and Box Q-test is used to test for serial independence in the returns. This test is widely used to examine the relation between current value and previous values of returns. If the serial correlation coefficients are not significantly different from zero then the returns are assumed to follow random walk. The test statistic is defined as follow:

$$Q_{LB} = N(N+2) \sum_{k=1}^{K} \frac{\hat{\rho}_{k(\hat{\varepsilon}t)}^2}{N-k} \tag{2}$$

Where N is the number of observations $\hat{\rho}_{(\varepsilon t)}$ is the sample autocorrelation at lag k, and K is the maximum number of lag being tested.

The Box-Ljung test rejects the null hypothesis if $Q_{LB} > x^2_{1-\alpha,h}$, where $x^2_{1-\alpha,h}$ is the chi-square distribution table value with h degrees of freedom and α significance level.

3.2.1.2. Lo and MacKinlay Variance Ratio test

The variance ratio test, developed by Lo and MacKinlay (1988), is based on the assumption that the variance of increments in the random walk series is linear in the sample interval. In other words, if the logarithms of the stock prices are generated by a random walk, the variance of the returns should be proportional to the sample interval. If returns series follows a random walk process, the variance of its q-differences would be q times the variance of its first differences.

$$\mathbf{var}\left(r_t - r_{t-q}\right) = q.\mathbf{var}(r_t - r_{t-1}) \tag{3}$$

Where q is any positive integer. The variance ratio is determined as follows:

$$VR(q) = \frac{\frac{1}{q}.\mathbf{var}\left(r_t - r_{t-q}\right)}{\mathbf{var}(r_t - r_{t-1})} = \frac{var_q}{var_1} \tag{4}$$

Hence, the null hypothesis to test random walk will be: the variance ratio is equal to unity under the random walk hypothesis [VR(q)=1] against the alternative hypothesis: VR(q) is not equal to one [VR(q) ≠1].

Thus, the VR methodology consists of testing the random walk hypothesis against stationary alternatives by exploiting the fact that the variance of random walk increments is linear in all sampling intervals. Lo and MacKinlay (1989) have indicated that the variance ratio test is more powerful than the well-known Dickey-Fuller unit root.

3.2.2. Non-parametric test

Parametric tests for dependence such as tests for correlation are sensitive to deviations away from normality. Since financial series are generally characterized by non normality and non linearity, it is important to perform a test for dependence that holds for any returns distribution. Two non-parametric tests, which impose no prior requirements concerning the distribution of returns, are used in this study. The BDS test will be used to detect nonlinear correlations in the returns series. This test is a useful to identify serial dependence in time series. The runs test relies only on the successive returns signs, regardless of their dimension and there are no prior assumptions about the distribution of the returns.

3.2.2.1. Run Test

The runs test determines if the daily return series follow random walk model. It is used to detect statistical dependencies which may not be detected by the auto-correlation test. The null hypothesis of the test is that the observed series are random. The test rejects the null hypothesis if the number of expected runs is significantly different from the number of actual runs and then the returns series is not generated by random process. The number of expected runs $E(R)$ is computed as:

$$E(R) = \frac{2n_a n_b}{n_a + n_b} + 1 \tag{5}$$

Where $n_a \, and \, n_b$ respectively denote the number of observations above and below the sample mean. The test statistic is calculated as:

$$Z = \frac{r - E(r)}{\sigma_r} \qquad (6)$$

Where r is the observed number of runs, $E(r)$, is the expected number of runs, and σ_r is the standard deviation of the number of runs. A sequence with too many or too few runs suggests that the sample is not random. The values of σ_r is computed as follows:

$$\sigma_r = \left[\frac{2n_a n_b (2n_a n_b - n_a - n_b)}{(n_a + n_b)^2 (n_a + n_b - 1)}\right]^{1/2} \qquad (7)$$

3.2.2.2. The Brock, Dechert and Scheinkman (BDS) test

Brock *et al.* (1996) developed a test for time dependence in a series, which is known as BDS. This test examines whether a sequence of variables are random walk with the property of being independent and identically distributed. Under the BDS test, the null hypothesis is that the increments are independently and identically distributed, where the alternative hypothesis assumes a variety of possible deviations from independence including non-linear dependence. In particular, under the null hypothesis of IID, the BDS statistic is:

$$W(T, m, e) = \frac{\sqrt{T}\{C(T, m, \varepsilon) - C(T, 1, \varepsilon)^m\}}{\sigma(T, m, \varepsilon)} \qquad (8)$$

where $C(T, m, \varepsilon)$ is the correlation function (integral), $T=N-m+1$, N is the length of the series, m is the embedding dimension, ε is a sufficiently small number, and $\sigma(T, m, \varepsilon)$ is an estimate of the asymptotic standard error of $\{C(T, m, \varepsilon) - C(T, 1, \varepsilon)^m\}$.

The BDS test usually needs a large sample to ensure proper performance. It is usually thought that 500 observations is the minimal sample size for the BDS test to have reliable performance, and ε takes values between one half and two times the standard deviation.

4. Data analysis, empirical results and discussion

4.1. Data analysis

In order to provide a better understanding of the data utilized in this study, statistics summarizing the characteristics of the returns data in table 2 are provided.

Table 2. Descriptive Statistics for DWX daily returns

Mean	Median	Maximum	Minimum	Std.Dev	Skewness	Kurtosis	Jarque-Bera	Probability
0.034	-0.054	3.796	-2.126	0.782	0.794	6.114	397.013	0.000

Descriptive analysis of returns reveals that DSE gives 3.4% of return at a risk level of 78.2%, which is giving low return with high risk level. The distribution of the returns series does not follow a normal curve. Skewness value is positive (0.794) and close to one, signifying the greater probability of large increases in returns than falls. Kurtosis statistic is positive (6.114), which point out that returns are leptokurtic distributed, indicating higher peaks then expected from normal distribution. Jarque-Bera statistic and corresponding p-values are also used to test the null hypotheses that the daily distribution of market returns is normally distributed. *P*-values are smaller than the 1% level of significance suggesting the hypothesis of a normal distribution of returns can be rejected. On the basis of descriptive analysis, it can be concluded that market returns are not well approximated by the normal distribution, and there is then ground for rejection of the random walk characteristic.

4.2. Empirical results and discussion

4.2.1. Serial correlation test results

Table 3 summarizes the serial correlation coefficients up to 15 lags, $Q_{(LB)}$-statistics and associated Probability for Daily returns of DWX. It is found that the daily returns exhibit correlated return patterns. The serial correlation coefficients of returns for all lags are positive and significant at the 1% significance level. Coefficients are different from zero for the first six lags. However, the serial correlation of returns decreases gradually as the lag length increases. Additionally, based on the Q-statistics, the null hypothesis of no autocorrelation on the index returns for all lags selected is strongly rejected at the 1% significant level. Further, the results of the autocorrelation tests provide an evidence to reject the null hypothesis of random walk for the daily market returns.

The results of auto-correlation tests are in line with the findings of the earlier studies for the MENA Stock Markets, which identified different factors that cause the auto-correlation between returns series including thinness of trading, illiquidity, market fragmentation, delay in operations, high transaction cost, and price limits (Butler and Malaikah 1992, Khababa 1998, Abraham and al. 2002).

Table 3. Auto- correlation test

Autocorrelation	Partial Correlation	lag	AC	PAC	Q-Stat
.|***** |	.|*****|	1	0.677	0.677	358.57
.|*** |	.| |	2	0.435	-0.043	506.62
.|** |	.| |	3	0.309	0.057	581.42
.|* |	.| |	4	0.207	-0.026	615.21
.|* |	.| |	5	0.176	0.073	639.49
.|* |	.| |	6	0.120	-0.050	650.86
.| |	.| |	7	0.072	-0.005	654.98
.| |	.| |	8	0.066	0.034	658.47
.| |	.| |	9	0.066	0.020	661.93
.|* |	.| |	10	0.093	0.060	668.71
.|* |	.|* |	11	0.151	0.103	686.86
.|* |	.| |	12	0.181	0.042	712.97
.|* |	.| |	13	0.186	0.024	740.62
.|* |	.| |	14	0.150	-0.036	758.60
.|* |	.| |	15	0.096	-0.035	765.97

4.2.2. Variance ratio test (VR) results

Table 4 shows the results of the Lo-MacKinlay *VR (q)* test, as well as the homoscedasticity test statistics $Z(q)$ and the heteroscedasticity consistent test statistics $Z^*(q)$, where *q* represents multiples of each sampling frequency, are calculated for each data set for the cases *q= 2,…,16.*

Table 4. Variance ratios *VR(q)* test and test statistics *Z(q)* and $Z^*(q)$

Period	2	4	6	8	10	12	14	16
VR(q)	0.8757	0.6163	0.4582	0.3662	0.2859	0.2154	0.1923	0.1825
Z.(q)	-3.4687[*]	-5.7239[*]	-6.1167[*]	-5.9795[*]	-5.9022[*]	-5.8409[*]	-5.5136[*]	-5.1836[*]
Z[*](q)	-2.8327[*]	-4.0812[*]	-4.4704[*]	-4.4444[*]	-4.4386[*]	-4.4386[*]	-4.2178[*]	-3.9915[*]

* Significant at one per cent level

From Table 4, it can be seen that all variance ratios significantly less than one for all *q* periods at 1% significance level. A variance ratio that is less than one suggests that the return series is negatively serially correlated. Thus, the null hypothesis that the values of DWX moved randomly in the studied period. This would lead to the conclusion that the DSE could be inefficient for all investment horizons up to 16 days. A key observation is that the variance ratios decline with an increase in *q*. The random walk hypothesis is rejected in

terms of the hypothesis of homoscedasticity in all sampling intervals. Furthermore, the evidence from the $Z^*(q)$ statistic indicates that, for all cases, the non-randomness in DWX daily data cannot be attributed to the heteroscedasticity in the data series. At the one per cent level, in all the sampling intervals, the null hypothesis of random walk is rejected. This indicates that, for all the intervals, the rejection of random walk is due to the autocorrelation of the daily increments in the return series. The findings of variance ratio test is consistent with previous researches for other MENA markets such Jordan, Tunisia and Morocco (Lahmiri, 2013), Abu Dhabi, Bahrain, Dubai, Kuwait, Oman, Qatar and Saudi Arabia (Al-Ajmi *et al.*, 2012).

4.2.3. Runs test results

To control the non-normality of returns and the presence of outliers in returns series, the run test is performed by means of median as base. The actual number of runs and the confidence interval limits are computed using the actual return series. The results of the runs test are reported in table 5. Results show that the actual number of runs (247) is significantly smaller than the hypothesized number of runs (391) at 1% level. The significant negative Z values indicate the positive correlation in DWX daily returns. Thus, the runs tests results refute the randomness of DWX performance. In other words, the behavior of DWX returns is not explained by the random walk theory. These results support that of the autocorrelation test and provide additional reason to suspect that DSE is weak-form inefficient.

Table 5. Runs test results

Test value (Median)	Cases < Test Value	Cases >= Test Value	Total Cases	Actual N. of Runs	Expected N. of Runs	Z	Asymp. Sig. (2-tailed)
-.05364-	390	390	780	247	391	-10.319-	0.000

4.2.4. BDS test results

In order to test whether these return series are random walk with the property of being independent and identically distributed, The BDS test is performed at various embedded dimension (*m*) from 2 through 6 and also at various distance like *0.5s, , 1s, 1.5s* and *2s* where *(s)* denotes the standard deviation of the return. The results with embedding dimensions of 2 to 5 should be given the most serious consideration. This is because the small sample properties of BDS test degrade as one increase the dimension (Brock and al., 1996).

Table 6. Results of BDS Test

Dimension	0.5	1	1.5	2
2	22.83738*	23.15642*	23.00197*	35.75227*
3	29.33109*	25.84092*	23.60736*	34.85708*
4	38.57623*	28.94099*	24.55469*	33.48233*
5	55.48137*	33.10206*	25.70456*	31.68139*
6	85.56153*	38.59336*	27.21279*	29.91337*

An asterisk denotes significance at one percent level.

The results of applying the BDS test to the DWX daily returns series are reported in table 6. The calculated test statistics are quite high, indicating that the null hypothesis of independently and identically distribution is rejected at the 1% level. This finding adds more evidence against randomness of DWX daily returns and suggests the non-linearity of returns.

5. Conclusions

This paper tests the Random Walk behavior of stock returns for Damascus securities Exchange. Both Parametric (Autocorrelation test and variance ratio) and non-parametric tests (runs test and BDS test) are used to test for random walks in DWX daily returns. Overall results from the empirical analysis indicate that the various tests for random walks provide strong evidence on the absence of random walks. The deviation from random walk may be due to thin trading, illiquid market and lack of experience of market participant.

A major implication of this evidence for investors is that the DSE market returns are predictable from historical prices and volume traded. It is, therefore, possible to beat the market and make abnormal profits. However, investors should be aware that, in such inefficient and illiquid market, making large losses is also probable. Furthermore, as DSE is a young and nascent market, it is important for the Securities and Exchange Commission to take measures that improve informational efficiency and establish investor confidence.

References

1. Abraham, A., F.J., Seyyed and S.A. Aisakran. (2002). Testing the Random Walk Behavior and Efficiency of the Gulf Stock Markets. *Testing the Financial review, 37*, 469-480.

2. Al-Ajmi, J. and Kim, J.H. (2012). Are Gulf stock markets efficient? Evidence from new multiple variance ratio tests. *Applied Economics, 44* (4), 1737-1747.

3. Al-Jafari, M. (2011). Testing the weak form efficiency of Bahrain Securities Market. *International Research Journal of Finance and Economics, 72*, 14-24.

4. Al-Khazali O.M., D.K. Ding and C.S. Pyun. (2007). A New Variance Ratio Test of Random Walk in Emerging Markets: A Revisit. *The Financial Review, 42*, 303-317.

5. Ayadi, O.F. and C.S. Pyun. (1994). An application of Variance Ratio Test to the Korean Securities Market. *Journal of Banking and Finance, 18*, 643-658.

6. Bachelier, L. (1900). Théorie de la speculation, *Annales Scientifiques de L'École Normale Supérieure*, Ph.D. Thesis, 17, 21-86..

7. Borges, M. (2008). Efficient Market Hypothesis in European Stock Market. *Working Paper. WP 20/2008/DE/CIEF*, 1-20.

8. Brock, W., W. Dechert, J. Sheinkman and B. LeBaron. (1996). A Test for Independence based on the Correlation Dimension. *Econometric Reviews, 15*, 197-235.

9. Butler, K.C., and Malaikah, S.J. (1992). Efficiency and inefficiency in thinly traded stock markets: Kuwait and Saudi Arabia. *Journal of Banking and Finance, 16*, 197-210.

10. Chong, T.T.L., Lam, T.H., and Yan, I.K.M. (2012). Is the Chinese stock market really inefficient?. *China Economic Review, 23*, 122-137.

11. Collins, G.N., Opong, K.K., Danbolt, J., and Dewotor, F.S. (2011). Testing the weak-form efficiency in African stock market. *Managerial Finance, 37* (3), 195-218.

12. Conrad, K. and Jutter, D. (1973). Recent behaviour of stock market prices in Germany and the random walk hypothesis. *Kyklos, 26*.

13. De Peña, J., and Gil-Alana, L.A. (2002). Do Spanish Stock Market Prices follow a Random walk?. *working paper*, 02/02, Facultad de Ciencias Económicas y Empresariales, Universidad de Navarra

14. Ely, R. (2011). Returns predictability and stock market efficiency in Brazil. *Revista Brasileira de Finanças, 9* (4), 571-584.

15. Evans, T. (2006). Efficiency tests of the UK financial futures markets and the impact of electronic trading systems. *Applied Financial Economics, 16* (17), 1273-1283.

16. Fama, E. (1991). Efficient Capital markets II. *Journal of Finance, 46*, pp. 1575-1643.

17. Fama, E. F and K. R. French. (1988). Permanent and Temporary Components of Stock Prices. *Journal of Political Economy, 98*, 247-273.

18. Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance, 25*, pp. 383-417.

19. Fama, E.F. (1965). The behavior of stock market prices. Journal of business. *Journal of business, 38* (1), 34-105.

20. Gitman, L.J., Joehnk, M.D. and Smart, S.B. (2011). *Fundamentals of Investing* (11 Ed.). Boston: person education.

21. Karemera, D., Ojah, K., and Cole, J.A. (1999). Random walks and market efficiency tests: Evidence from emerging equity markets. *Review of Quantitative Finance and Accounting, 13* (2), 171-188.

22. Khababa, N. (1998). Behavior of stock prices in the Saudi Arabian Financial Market: Empirical research findings. *Journal of Financial Management and Analysis, 11* (1), 48-55.

23. Lahmiri, S. (2013). Do MENA stock market returns follow a random walk process? *International Journal of Industrial Engineering Computations, 4*, 165-172.

24. Ljung G.M. and Box G.E.P. (1978). On a measure of lack of fit in time series models. *Biometrika, 65* (2), 297-303.

25. Lo, A. and A.C. MacKinlay. (1988). Stock Market Prices do not follow Random Walks: Evidence from a Simple Specification Test. *Review of Financial Studies, 1*, 41-66.

26. Lo, A. and MacKinlay, A.C. (1989). The Size and Power of the Variance-Ratio Test in Finite Samples: A Monte Carlo Investigation. *Journal of Econometrics, 40*, 203-238.

27. Mukherji, S. (2011). Are stock returns still mean-reverting?. *Review of Financial Economics, 20*, 22-27.

28. Poon, S. (1996). Persistence and mean reversion in UK stock returns. *European Financial Management, 2* (2), 169-196.

29. Poshakwale, S. (1996). Evidence on Weak Form Efficiency and Day of Weak Effect in the India Stock Market. *Finance India, 3*, pp. 605-616.

30. Urrutia, J.L. (1995). Tests of Random Walk and Market Efficiency for Latin American Emerging Equity Markets. *Journal of Financial Research, 18*, 299-309.

31. Worthington A. and H. Higgs. (2004). Random Walks and Market Efficiency in European Equity Markets. *Global Journal of Finance and Economics, 1*, 59-78.

32. Worthington A. and H. Higgs. (2003). Tests of Random Walks and Market Efficiency in Latin American Stock Markets. *School of Economics and Finance Discussion Papers and Working Papers Series*.