International Research Journal of Finance and Economics
ISSN 1450-2887 Issue 88 (2012)

http://www.internationalresearchjournaloffinanceandeconomics.com

# Variance Ratio Test and Weak-Form Efficiency of Bahrain Bourse

**Mohamed Khaled Al-Jafari**
*Dean of Postgraduate Studies*
*The Arab Academy for Banking and Financial Sciences, Damascus, Syria*
E-mail: aljafarimohamedkhaled@yahoo.com
Tel: ++963932951695

**Hatem Hatef Abdulkadhim**
*Department of Finance and Banking, University of Kalamoon*
*Former Dean at Al-Qadisiya and Al-Kufa Universities, Iraq, Deratiyah, Syria*
E-mail: hatem.altaee@uok.edu.sy
Tel: ++963932354432

**Abstract**

The main objective of this study is to investigate whether stock prices in Bahrain Bourse follow a random walk process as required by the efficient market hypothesis. Therefore, this study investigates the weak-form of market efficiency in Bahrain stock market by testing the Random Walk Hypothesis (RWH) through multi-approaches specifically unit root, runs and variance ratio tests on the daily price of all share index of Bahrain from February 2003 to November 2010. The empirical results reject the RWH at weak-form level, indicating that stock prices do not fully reflect all historical information and that prudent investors will realize abnormal returns by using past historical data of stock prices and trading volume.

**Keywords:** Bahrain Bourse, Weak-Form, Efficient Market Hypothesis, Run Test, Unit Root Tests, Variance Ratio Test.
**JEL Classification Codes:** C12, D53, G12, G14

## 1. Introduction

The subject of market efficiency and random walk theory is considered one of the most researched topics in finance literature. An efficient market can be described as the one which security prices adjust rapidly to new information. On the other hand, the random walk theory indicates that stock price movements are unpredictable and it follows a random erratic behavior. Kendall (1953) and Fama (1965) are considered one of the earlier scholars who concluded that stock prices move randomly and past movements were of no use in predicting future movements. Later on, Fama (1970) divided the overall efficient market hypothesis (EMH) into three forms: the weak–form EMH, the semi-strong-form EMH, and the strong-form EMH. The Weak-Form of the EMH is the least restrictive form and assumes that current stock prices reflect all security market information, including the historical sequence of prices, rates of return, trading volumes, and other market generated information. Therefore, we should gain little from using any trading rules that decides whether to buy or sell a security based on past rates of return, or any other past market data. On the other hand, the semi-strong form of the EMH asserts that security prices adjust rapidly to the release of all public information. Therefore, it implies that investors who base their decisions on any important new information after it is public should not derive above-average risk–adjusted profits from their transactions. However, the strong-form of the EMH is the most extreme form. It states that security prices fully reflect all information from public and private sources. This means that no investor has a monopolistic access to information relevant to the formation of prices. Therefore, no investor will be able to consistently derive above-average risk-adjusted rates of return.

The objective of this study is to test the random walk hypothesis on the behavior of Bahrain securities market. It utilizes unit root tests (Augmented Dickey-Fuller test, the Phillips-Perron test and the Kwiatkowski, Phillips, Schmidt and Shin test), run tests and variance ratio test.

This study is organized into six sections as follows: Section 2 describes the Bahrain securities market, while section 3 addresses the literature review. On the other hand, section 4 illustrates data and research methodology. The empirical results and statistical interpretations are presented in chapter 5. Finally, section 6 provides the concluding remarks.

## 2. The Bahrain Bourse

The Bahrain Stock Exchange was established in 1987 and commenced its operation in June of 1989 with 29 Bahraini listed shareholding companies. In recent years, the exchange invested in modernizing its operations by providing direct online trading services to its member brokers and expands listings and improved listed company information for exchange investors. In 2002, the Central Bank of Bahrain became the regulatory and supervisory authority for the exchange activities instead of the Ministry of Commerce. However, in 2010, Bahrain Bourse was established as a shareholding company replacing Bahrain Stock Exchange. Currently, Bahrain Bourse has 50 listed companies classified according to their activities and dominated by commercial banks and investments sectors. The Bahrain Bourse has three indices that track its performance, Bahrain All Share Index, Dow Jones Bahrain Index, and Esterad Index. Bahrain All Share Index is a capitalization-weighted index of all Bahraini public shareholding companies listed on Bahrain Stock Exchange.

## 3. Literature Review

There are several studies that were performed on the Middle Eastern stock markets. For instance, Jaradat and Al-Zeaud (2011) found that Amman stock exchange (ASE) is inconsistent with the RWH and is not weak-form efficient. Similar results were obtained by Maghyereh (2003) who found that ASE does not conform to random walk model and informationally inefficient. This contradicts Civelek (1991) who found that the industrial sector of ASE is weak-form efficient. On the other hand, Al-Jafari (2011) examined the RWH of Kuwait equity market (KSE) using parametric and nonparametric tests. He found that KSE is informationally inefficient at the weak-form level. Also, Al-Jafari and Altaee (2011) concluded similar results when testing the Egyptian equity market and found it to be inefficient and stock prices do not fully reflect all historical information. Salameh et al., (2011) tested the weak-form efficiency of twelve Arab stock exchanges. The empirical results showed that all twelve Arab stock markets did not behave randomly under the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) unit root test. Also, Awad and Daraghma (2009) concluded that the Palestinian securities market is inefficient at the weak-form level. On the other hand, Omran and Farrar (2006) investigated the RWH for five Middle Eastern countries. Their finding rejected the RWH for all markets. Also, Abdmoulah (2010) tested the weak-form efficiency for 11 Arab stock markets using GARCH-M (1,1) and found that all markets are weak-form efficient. Similarly, Marasheh and Shrestha (2008) examined the United Arab Emirates securities market. They found that data contains unit root and follow a random walk, meeting the criterion of weak-form market efficiency. Similar results were obtained by Mustafa (2004) who concluded that the UAE market is weak-form efficient. Butler and Malaikah (1992) examined stock returns behavior in Saudi Arabia and Kuwait during 1985-1989. They found that the Saudi stock market is inefficient, while the Kuwaiti stock market is efficient. This is contrary to Hassan et al., (2003) who found that Kuwaiti stock exchange is weak-form inefficient. Similarly, Abraham et al., (2002) examined the weak-form efficiency for Kuwait, Saudi Arabia and Bahrain markets using the variance ratio test and the runs test for the period October 1992 to December 1998. Results of both tests rejected the RWH in all three markets concluding that they are weakly inefficient markets.

## 4. Data and Methodology

Lo and MacKinlay (1988) suggest the use of a variance-ratio (VR) statistic to test the random walk hypothesis. However, this procedure is not sufficient on its own to assess weak-form efficiency. In fact, when the random walk hypothesis is rejected, the alternative hypotheses are that the series analyzed are serially correlated. Therefore, further testing must be completed to provide an accurate assessment of weak-form efficiency. This has been commonly done with a runs test.

This section describes the data and comments on the descriptive statistics. It also illustrates briefly the utilized methodology tests in this study.

### 4.1. Data

Daily data for Bahrain All Share Index were obtained from the Monthly Bulletin and reports found on the Web site of Bahrain Bourse (www.bahrainbourse.com.bh). The data covers the period from February 2003 till the end of November 2010.

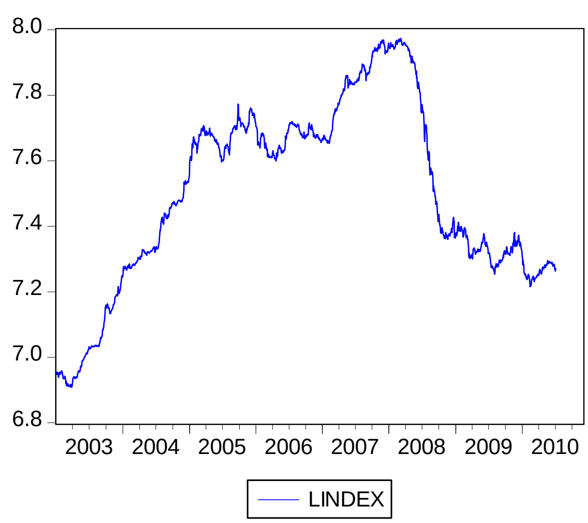
The returns are calculated on closing to closing prices as follows:

$$R_t = \ln\left[\frac{P_t}{P_{t-1}}\right] \tag{1}$$

Where $P_t$ and $P_{t-1}$ are the closing prices of stock index at time t and t – 1, respectively and ln is natural logarithm.

In order to obtain a better understanding of the behavior of stock prices, a preliminary analysis of the data is carried out in this section. Figure (1) shows the plot of the return data based on the index covering the aforesaid period.

**Figure 1:** Time Series Plots of Bahrain Stock Market Index in Logarithm



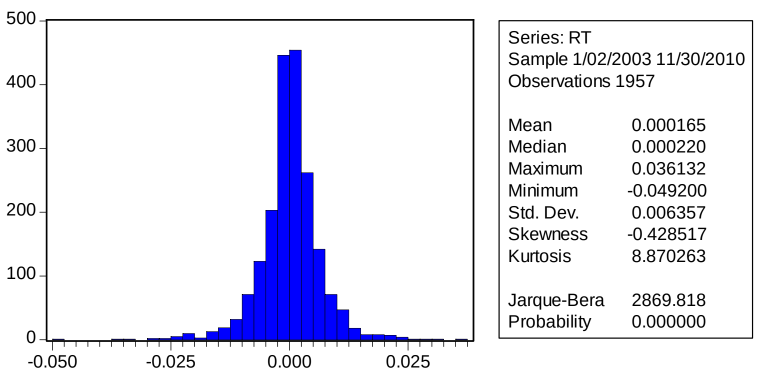
It is clear from this plot that the data exhibited strong volatility. The market experienced positive return until the second half of the year 2008, after that the index experienced high downward movement. In fact, all of GCC countries including Bahrain exhibited a sharp rising trend fueled by increased liquidity resulting from high energy prices. The increase of petrodollars led to irrational investment enthusiasm and speculative behavior among investors causing high increase in the equity prices (Ariss et al., 2011, p.982). The inequilibrium between the supply of and the demand for stocks caused by high liquidity, as a result most of the GCC indices exhibited a sharp decline. The estimated growth rates for the whole period and sub periods might shed lights on the behavior of the index during the period 2003 to 2010.

**Table 1:** Annual Growth Rates of the Index

| Period | Rate of growth | t-statistics | p-value |
|---|---|---|---|
| 2003-2006 | 0.001229 | 155.5459 | 0.00000 |
| 2006-2008 | -0.00047 | -32.6708 | 1.9E-168 |
| 2003-2010 | 0.000137 | 12.72555 | 1.06E-35 |

Descriptive statistics on the weekly index returns of Bahrain Bourse, using Eviews7, are reported in Table (2). These include the mean, maximum, minimum, standard deviation, skewness, kurtosis, Jarque-Bera, and probability value. *N* denotes the number of observations. Estimates are given for the full sample period 2003-2010.

**Table 2:** Summary Statistics of Bahrain Daily Price Index




In general, values for skewness equal to zero and kurtosis value of three represents that observed distribution is normally distributed. From the figures, it's clear that there is strong departure from normality in the unconditional distribution of the return with negative skewness. The negative skewness implies that the stock index returns are flatter to the left compared to the normal distribution. The Jarque-Bera statistic rejects the hypothesis of a normal distribution of returns at 1% significant level.

### 4.2. Statistical Methods

As mentioned earlier, this paper utilizes unit root tests, run tests and variance ratio tests. Therefore, a brief illustration of these tests is provided in this section.

#### 4.2.1. Unit Root Tests

Unit root tests are commonly used to test the stationary property of a time series data. In this study three different unit root tests are employed to test the null hypothesis of a unit root. These tests are: the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test. However, under the assumption of the random walk, the price series must have a unit root while the return series must not.

#### 4.2.1.1. Augmented Dickey-Fuller (ADF) Test

The ADF tests assumes that *y* series follows an AR(p) process and add *p* lagged difference terms of the dependent variable *y* to the right side of the test regression. ADF test uses the following three regressions models:

$$Model\ I: \Delta y_t = \delta y_{t-1} + \beta \sum_{i=1}^{p} \Delta y_{t-1} + \mu_t \quad (2)$$

$$Model\ II: \Delta y_t = c_0 + \delta y_{t-1} \sum_{i=1}^{p} \Delta y_{t-1} + \mu_t \quad (3)$$

$$Model\ III: \Delta y_t = c_0 + c_1 t + \delta y_{t-1} + \beta \sum_{i=1}^{p} \Delta y_{t-1} + \mu_t \quad (4)$$

Model I, does not include intercept (drift) and trend terms. Model II includes constant term $c_0$, while model III include constant term and a trend term $c_1$. For all models, p is the number of lagged variables terms and $\mu_t$ is white noise.

The hypotheses in Augmented Dickey-Fuller (ADF) test are stated as follows:

***H*₀**: there is a unit root in the series.

***H*₁**: there is no unit root in the series (stationary).

#### 4.2.1.2. Phillips-Perron Test

Phillips and Perron (1988) propose to estimate the long-run variance by the Newey-West (1987) estimator. This test is perhaps the most common test used next to the ADF-tests. PP tests are similar to ADF tests. The difference between the PP and the ADF tests in how they deal with serial correlation and heteroskedasticity in the errors. The idea of the Phillips-Perron test is to run a non Augmented Dickey-Fuller regression, and then to adjust for the bias that might occur due to correlation in the innovation term. Phillips-Perron test is a non parametric test with the following specifications:

$$P_t = \mu + \delta P_{t-1} + \varepsilon_t \quad (5)$$

$$P_t = \mu + \beta (t - \frac{1}{2} T) + \alpha P_{t-1} + \varepsilon_t \quad (6)$$

Where $P_t$ is the natural logarithm of the price index at time t, μ is a constant, α and β are parameters to be estimated and $\varepsilon_t$ is the error term. Equation (5) includes only the constant term, whereas equation (6) contains a constant term μ and a linear trend term $\beta (t - \frac{1}{2} T)$. The hypotheses of Phillips-Perron (PP) tests are stated as follows:

$H_0$: there is a unit root in the series.

$H_1$: there is no unit root in the series (stationary).

#### 4.2.1.3. The Kwiatkowski, Phillips, Schmidt and Shin Test (KPSS)

A useful alternative test is that introduced by Kwiatkowski, Phillips, Schmidt and Shin (1992). The KPSS test represents a useful alternative to hypothesis, and may conflict with tests that assume nonstationarity as a null hypothesis, thus indicating that there may be real doubt as to the properties of the time series. The KPSS test accounts for the problem of autocorrelation in a similar, although parametric, way to PP test.

In the KPSS model, series of observations is represented as a sum of three components, namely deterministic trend, a random walk, and a stationary error term. To perform the test, we first obtain the residual ε from the regression of *y* on a constant and a trend. It assumes that the process for *y*:

$$y_t = \delta t + Y_t + \varepsilon_t \quad (7)$$

With auxiliary equation for $\gamma_t$

$$\gamma_t = \gamma_{t-1} + \mu_t \quad (8)$$

where $y_t$ denotes series of observations of variable of interest, $t$-deterministic trend, $\gamma_t$ – random walk process, $\varepsilon_t$– error term of equation (7), by assumption is stationary, $\mu_t$ denotes the error term of equation (8), and by assumption is a series of identically distributed independent random variables of $E(\mu_t)$ = 0, and constant variance, $\hat{\sigma}_\mu^2$. A test for $\hat{\sigma}_\mu^2 = 0$ is a test for stationarity (Maddala and Kim, 1998).

The KPSS statistic is based on the residuals *et* from the OLS regression of $y_t$ on the exogenous variables. The test statistic is defined as:

$$KPSS = T^{-2} \sum_{i=1}^{T} S_t^2 / \sigma_T l \tag{9}$$

Where $St = \sum_{i=1}^{t} \varepsilon_i$ the partial sum of residuals, $T$ is the number of observations, and the $\sigma_T l$ represent an estimate of the long run variance of residuals. Large value of KPSS lead to rejection of the stationarity null hypothesis, since that means the series deviate from its mean. In the (KPSS) unit root test hypotheses are stated as follows:

$H_0$: there is no unit root in the series (stationary).

$H_1$: there is a unit root in the series.

### 4.2.2. The Run Test

In order to test for weak-form efficiency, we use the run test as it does not require returns to be normally distributed. This provides a solid alternative to parametric serial correlation tests in which distributions are assumed to be normally distributed.

To perform this test, let, $n_a$ and $n_b$ respectively represent observations above and below the sample mean (or median), and $r$ represents the observed number of runs, with $n = n_a + n_b$.

$$Z(r) = \frac{r - E(r)}{\sigma(r)} \tag{10}$$

The expected number of runs can therefore be calculating by the following formula:

$$E(r) = \frac{n - 2n_a n_b}{n} \tag{11}$$

The standard error is represented by:

$$\sigma E(r) = \left[ \frac{2n_a n_b (2n_a n_b - n)}{n^2 (n-1)} \right]^{1/2} \tag{12}$$

Because returns are not normally distributed, the presence of structural breaks or outliers in the series can bias the test results. To control for such issues, we complete the runs test using a mean and a median as a base. However, using the median can yield more reliable results when there are outliers.

### 4.2.3. Variance Ratio Test (VR)

This test developed by Cochrane, (1988) and Lo and MacKinlay (1988, 1989) for testing the randomness of stock prices. The VR approach has gained popularity and has become the standard tool in random-walk testing. We can apply the test to both, the stock price index and to the individual stocks (Urrutia, 1995). Lo and MacKinlay (1988) show that the variance ratio test is more powerful than the unit root tests. Also, Ayadi and Pyun (1994) argue that the variance ratio has more appealing features than other procedures. We use overlapping (as opposed to non-overlapping) $q$-period returns in estimating the variances in order to obtain "a more efficient estimator and hence a more powerful test," Campbell et al., (1997, p. 52).

The test is based on one of the properties of the random walk process, namely that the variance of the random walk increments must be a linear function of a time interval ($q$). That is, returns will follow a random walk when the variance of the ($q^{th}$) difference is equal to ($q$) times the variance of the first difference. The VR test is calculated as follows:

Variance ratio test under homoscedasticity, using overlapping observations is:

$$VAR(q) = \frac{\sigma_C^2(q)}{\sigma_a^2(q)} \tag{13}$$

Where $\sigma_c^2(q)$ is an unbiased estimator of 1/q of the variance of the $q^{th}$ – difference and $\sigma_a^2(q)$ is an unbiased estimator of the variance of the $1^{st}$-difference.

The standard normal test-statistics under homoscedasticity, *Z(q)* is:

$$Z(q) = \frac{VR(q)-1}{[\text{Ø}(q)]^{1/2}} \sim N(0,1) \tag{14}$$

Where:

$$\text{Ø}(q) = \frac{2(2q-1)(q-1)}{3q(nq)} \sim N(0,1) \tag{15}$$

Variance ratio test under hetroscedasticity is:

$$Z*(q) = \frac{VAR(q)-1}{[\text{Ø}*(q)]^{1/2}} \sim N(0,1) \tag{16}$$

Where:

$$\text{Ø}*(q) = \sum_{j=1}^{q-1}\left[\frac{2(q-j)^2}{q}\right]\hat{\sigma}(j) \tag{17}$$

$$with\ \hat{\sigma}(j) = \frac{\sum_{t=j+1}^{nq}(p_t + p_{t-1} - \hat{\mu})^2(p_{t-j} - p_{t-j-1} - \hat{\mu})^2}{\sum_{k=1}^{nq}(p_t - p_{t-1} - \hat{\mu})^2} \tag{18}$$

For performing this test, we first calculate the compounded daily returns on the Bahrain all share index, find its variance and repeat the procedure for 2, 4, 8, 10, 16 and 32-day returns. We then calculate the variance ratios for all five times intervals, and test the following null hypothesis:

***H₀***: The variance ratio for all the choosing aggregate intervals, *q* is unity.

An estimated variance ratio less than one implies negative serial correlation, while a variance ratio greater than one, or high $Z$ value implies positive serial correlation. The rejection of single or more therefore rejects null hypothesis of the random walk. To assist contrast with preceding researches, Lo and MacKinlay, (1988), and Campbell, Lo, and Mackinlay, (1997), on other equity markets, the q is chosen as 2, 4, 8, 10, 16, and 32.

# 5. The Empirical Results

## 5.1. Results of the Unit Root Tests

ADF, PP, and KPSS tests were carried on the log of the index using the package Eviews7. The tests were performed at level and first difference. The results of ADF and PP tests are reported in Tables (3) and (4), while the results of KPSS are reported in Table (5).

**Table 3:** ADF and PP Unit root tests results on the logarithm of Bahrain stock market index at level

| Type of test | | t-statistics | Critical value at 1% | Critical value at 5% | Inference |
|---|---|---|---|---|---|
| *ADF* | without intercept | 1.070485 | -2.566144 | -1.940986 | Do not reject |
| *ADF* | with intercept | -2.118919 | -3.433492 | -2.862814 | Do not reject |
| *ADF* | with intercept and trend | -0.813473 | -3.433492 | -2.862814 | Do not reject |
| *PP* | without intercept | 0.732577 | -3.962738 | -3.412106 | Do not reject |
| *PP* | with intercept | -1.849949 | -3.433492 | -2.862814 | Do not reject |
| *PP* | with intercept and trend | -0.915278 | -3.962738 | -3.412106 | Do not reject |

**Table 4:** ADF and PP Unit root tests results on the logarithm of Bahrain stock market index at first difference

| Type of test | | t-statistics | Critical value at 1% | Critical value at 5% | Inference |
|---|---|---|---|---|---|
| *ADF* | without intercept | -36.31295 | -2.566145 | -1.940986 | reject |
| *ADF* | with intercept | -36.32399 | -3.433493 | -2.862815 | reject |
| *ADF* | with intercept and trend | -36.68215 | -3.962740 | -3.412107 | reject |
| *PP* | without intercept | -37.61213 | -2.566145 | -1.940986 | reject |
| *PP* | with intercept | -37.60129 | -3.433493 | -2.862815 | reject |
| *PP* | with intercept and trend | -37.26290 | -3.962740 | -3.412107 | reject |

The empirical results of the KPSS test on logarithm of Bahrain stock market index at level and first difference are reported in Table (5).

**Table 5:** KPSS Unit Root Test Results on the logarithm of Bahrain stock market index at level and first difference.

| KPSS tests | LM-STAT | Critical value at 1% | Critical value at 5% | Inference |
|---|---|---|---|---|
| ***Level*** | | | | |
| with intercept | 1.559153 | 0.739000 | 0.463000 | reject |
| with intercept and trend | 1.214517 | 0.216000 | 0.146000 | reject |
| ***first difference*** | | | | |
| with intercept | 1.390188 | 0.739000 | 0.463000 | reject |
| with intercept and trend | 0.123541 | 0.216000 | 0.146000 | do not reject |

The results in Table (5) indicate that all the null hypothesis of stationary in the daily Bahrain stock price index at level is rejected. Whereas stationary of stock prices series is confirmed at first difference. In other words, the empirical results from KPSS unit root test at first difference imply the difference stationary process in Bahrain stock market index in the trend and intercept only.

The results of ADF, PP, as well as that of KPSS provide evidence that the Bahrain all share index are nonstationary at level and stationary for the first difference. Therefore, the results are consistent with the random walk hypothesis. The KPSS tests offer conflicting results with those of ADF and PP only in the trend and intercept specification at the first difference. However, this result is true at the 5% confidence level but not at the 1% confidence level.

## 5.2. Results of the Run Tests

As evidenced in Tables (6) and (7). The run tests clearly show that Bahrain stock market is weak-form inefficient. The estimated Z-values are significant at the 1% level.

**Table 6:** Run Test with the Mean as a Base

| $n$ | $n_a$ | $n_b$ | $E$(r) | $r$ | $\sigma_r$ | $Z$(r) | Sig (2 tailed) |
|---|---|---|---|---|---|---|---|
| 1957 | 993 | 963 | .000165 | 844 | 0.00636 | -6.119 | 0.000 |

SPSS19 software is used to obtain the results in this table as well as those in Table (7).

**Table 7:** Run Test with the Median as a Base

| $n$ | $n_a$ | $n_b$ | $E$(r) | $r$ | $\sigma_r$ | $Z$(r) | Sig (2 tailed) |
|---|---|---|---|---|---|---|---|
| 1957 | 979 | 978 | .00021 | 834 | 0.00636 | -6.580 | 0.0000 |

## 5.3. Results of the Variance Ratio Test

Table (8) reports the test results of the variance ratio test.

**Table 8:** Variance Ratio Test at Return Series for the 2,4,8,10,16 and 32Day Returns

| | | | | ***Time horizon q*** | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Data period*** | ***Test stat.*** | ***q* = 2** | ***q* = 4** | ***q* = 8** | ***q* = 10** | ***q* = 16** | ***q* = 32** | |
| Feb. 2003-<br>Nov. 2010 | $VR_q$<br>*Zq*<br>*Zq* * | 1.1951<br>8.6293*<br>5.3037* | 1.3595<br>8.4999*<br>5.4559* | 1.5197<br>7.7725*<br>5.3871* | 1.6162<br>8.0740*<br>5.7361* | 1.9852<br>9.9011*<br>5.7461* | 2.7483<br>9.1960* | 12.125* |

**Notes:** q is the number of daily intervals aggregated to compute the variance ratios. The variance ratios, VR (q), are reported in the first rows, and Zq; statistics are the asymptotic normal test statistics under homoscedasticity; Zq* statistics are the asymptotic normal test statistics under heteroscedasticity. Test statistics marked with * indicate that the corresponding variance ratios are statistically different from 1 at the 1 percent level of significance.

Table (8) presents the variance ratios based on daily values of the index, as well as the corresponding $Z$ and *Zq** statistics for the null hypothesis is that the variance ratios equal one, which means that the stock index prices follow a random walk. Results indicate that almost all of the test statistics for either assuming homoskedasticity or heteroskedasticity-consistent at any number of *q* are significant: this means that stock markets returns show predictability. In other words the random walk hypothesis is rejected. This would lead to the conclusion that the Bahraini stock market could be inefficient for all investment horizons up to 32 days.

## 6. Conclusion

This study examined the random walk behavior and efficiency of the Bahraini stock market using unit root tests, run test and variance ratio test. The empirical results reject the random walk hypothesis at the weak-form level, implying that stock prices do not fully reflect all historical information. The results of this paper conform to the results of most previous studies that were performed on Middle Eastern stock markets. They are similar to those found in Jaradat and Al-Zeaud (2011), Al-Jafari (2011), Al-Jafari and Altaee (2011), Abdmoulah (2010), Awad and Daraghma (2009), Marasheh and Shrestha (2008) Omran and Farrar (2006), Mustafa (2004), Maghyereh (2003), Hassan et al., (2003), and Abraham et al., (2002).

## References

[1] Abdmoulah, W. (2010). “Testing the Evolving Efficiency of Arab Stock Markets”. *International Review of Financial Analysis,* 19, 25-34.

[2] Abraham, A., Seyyed, F. J., and Alsakran, S. A. (2002). “Testing the Random Walk Behavior and Efficiency of the Gulf Stock Markets”. *The Financial Review*, 37, 469 – 480.

[3] Al-Jafari, M. K. and Altaee, H. H. (2011). "Testing the Random Walk Behavior and Efficiency of the Egyptian Equity Market". *Journal of Money, Investment and Banking,* 22, 132-146.

[4] Al-Jafari, M. K. (2011). "Random Walks and Market Efficiency Tests: Evidence from Emerging Equity Market of Kuwait". *European Journal of Economics, Finance and Administrative Sciences*, 36, 19-28.

[5] Ariss T., Rima, Rasoul Rezvanian, and Seyed M., Mehdian (2011). “Calendar anomalies in the Gulf Cooperation Council stock Market”, *Emerging Markets Review*, 12, 293-307.

[6] Awad, I., and Daraghma, Z. (2009). “Testing the Weak-Form Efficiency of the Palestinian Securities Market”. *International research Journal of Finance and Economics*, 32, 7-17.

[7] Ayadi, F. O., and Pyun, C. S. (1994). “An Application of Variance Ratio Test to the Korean securities Market”. *Journal of Banking and Finance*, 18, 642-658.

[8] Butler, C. K., 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.

[9] Campbell, J. Y., Lo, A. W., and MacKinlay, A. C. (1997). The Econometrics of Financial Markets (2nd Ed.). Princeton: Princeton University Press.

[10] Civelek, M. A. (1991). "Stock Market Efficiency Revisited: Evidence from the Amman Stock Exchange". *The Middle East Business and Economic Review,* 3, 27-31.

[11] Cochrane, J. (1988). "How Big is the Random Walk in GNP? *Journal of Political Economy,* 96,893-920.

[12] Fama, E. F. (1965). "The Behavior of Stock Market Prices". *The Journal of Business,* 38 (1), 34-105.

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

[14] Hassan, K. M., Al-Sultan, W., and Al-Saleem, J. A. (2003). "Stock Market Efficiency in the Gulf Cooperation Council Countries (GCC): the Case of Kuwait Stock Exchange". *Scientific Journal of Administrative Development,* 1(1), 1-21.

[15] Jaradat, M. and Al-Zeaud, H. (2011). "Testing the Weak-Form Efficiency of Amman Stock Exchange". *International Research Journal of Finance and Economics,* 65, 93-97.

[16] Kendell, M. G. (1953). "The Analysis of Economic Time-Series-Part I: Prices". *Journal of the Royal Statistical Society. Series A (General)* 116(1), 11-34.

[17] Kwiatkowski, D., Phillips, P., Schmidt, P. and Shin, Y. (1992). "Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root", *Journal of Econometrics*, 54, 159-78.

[18] Lo, A. and MacKinlay, A. C. (1988)." Stock Market Prices Do not Follow Random Walks. Evidence from a Simple Specification Test. *Review of Financial Studies*, 1, 1, 41-66.

[19] 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.

[20] Maddala G. S. and Kim, I. M. (1998), Unit Roots, Cointegration and Structural Change, Cambridge University Press.

[21] Maghyereh, A. (2003). "The Random Walk Hypothesis and Evidence from the Amman Stock exchange". Zagreb International Review of Economics and Business, 6 (1-2), 29-41.

[22] Marashdeh, H. and Shrestha, M. B. (2008). "Efficiency in Emerging Markets-Evidence from the Emirates Securities Market". *European Journal of Economics, Finance, and Administrative Science*, 12, 143-150.

[23] Mustafa, M. A. (2004). "Testing the Weak-Form Efficiency of the United Arab Emirates Stock Market". *International Journal of Business*, 29, (3), 310-325.

[24] Newey, W. K. and K. D. West (1987). "A simple Positive Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix". *Econometrica,* 55, 703-708.

[25] Omran, M., and Farrar, S. (2006). "Tests of weak Form Efficiency in the Middle East Emerging Markets". *Studies in Economics and Finance*, 23 (1), 13-26.

[26] Phillips, P. and Perron, P. (1988). "Testing for Unit Root in Time Series Regression". *Biometrika* 75, 335-346.

[27] Salameh, H. M., Twairesh, A. E., Al-Jafari, M. K., and Altaee, H. H. (2011). " Are Arab Stock Exchanges Efficient at the Weak-Form Level? Evidence from Twelve Arab Stock Markets". *European Journal of Economics, Finance, and Administrative Science*, 39, 18-31.

[28] Urrutia, J. L. (1995). "Tests of Random Walk and Market Efficiency". *Journal of Financial Research*, 18, 299-309.