A "Random-walk" through the Saudi Arabian financial market: Is the Tadawul efficient?

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ABSTRACT

This paper examines the Efficient Market Hypothesis (EMH) and Random-walk Hypothesis (RWH) using the Variance-ratio test and Runs tests for seventeen sectors of the Saudi Arabia Tadawul stock exchange between April 2007 and May 2011. Under the assumptions of homoscedasticity and heteroskedasticity RWH is rejected for all sectors including the Tadawul Exchange. All Variance- ratios are statistically significantly smaller than one. Variance-ratios smaller than unity indicate that variances decline proportionately with time. Using the non-parametric runs test, only Banking, Building, Insurance and the Telecommunication sectors indicate weak-form efficiency contrary to previous research results. This research concludes that the development of the Saudi capital market is dramatically improving its technical infrastructure and starting to show evidence of weak-form efficiency in some sectors. Nevertheless results from this research suggest that prices do not fully reflect available information and prices changes are not independent nor distributed randomly. The implication for both investors and authorities is that some returns may be predictable and opportunities for arbitrage and abnormal profit making may be available, contrary to RWH and EMH.

Keywords: Random-walk hypothesis, Serial correlation, Tadawul, Weak-form efficiency

INTRODUCTION

The prime function of all capital exchanges is to provide an efficient market in which financial resources will be optimally allocated towards productive investments ultimately benefiting both investor and the economy. The purpose of this paper is to examine the efficiency of stock price behaviour, by sector, in the Tadawul Exchange. The Tadawul Exchange is Saudi Arabia's only stock market located in its capital city, Riyadh.
Since 2001 the development of the Saudi capital market has dramatically improved its technical infrastructure. A greater variety and depth of financial product sophistication and choice has emerged together with improved regulatory supervision provided by the establishment of the Capital Market Authority (CMA) in 2003. The CMA provides a legal and regulatory framework designed to open up the Saudi capital market to support the government's stated goal of privatization, promote greater efficiency and transparency, and increase public participation in financial markets. Financial liberalization is evolving, but this begs the question, is the market efficient?

The Efficient Market Hypothesis (EMH) is associated with the idea of a "random walk", whereby the distribution of stock returns are generated by stochastic processes and existing share prices always incorporate and reflect all relevant information. Shares always trade at their fair value on stock exchanges. Weak-form efficiency is a desirable characteristic for financial markets to achieve, particularly for emerging markets competing in a global economy. The availability of accurate economic information enhances the efficient mobilization and allocation of capital. The knock-on effect ultimately improves the economic development of the country, raising liquidity for future productive economic activities, as well as raising the benchmark for future equity analysis, corporate governance and transparency of dealings.

The incentive behind this research therefore is driven by the fact that most studies focus on the well-established western financial markets where data are readily available. This study has carefully collected and collated recent financial data to analyse a less well-known, yet increasingly important financial market in the Middle East North Africa (MENA) region. When the Tadawul All-Share Index (TASI) peaked in 2006 it was the world's tenth largest stock market by value, despite having only 78 listed stocks (SAMBA Financial Group, 2009). By the end of September 2011 the Saudi Market had a market capitalization of SAR1.2 trillion. This accounts for approximately half of the market capitalization of the broader Gulf Cooperation Countries (GCC): Bahrain, Kuwait, Kingdom of Saudi Arabia, Oman, Qatar and the United Arab Emirates (Emirates 24/7, 2011). The Tadawul Exchange is the largest in the GCC. The market comprises of 149 companies spread across 15 different sectors. It is against this backdrop that this paper investigates the random walk hypothesis and weak-from efficiency in the Saudi Arabia stock market. The following section provides a literature review. Section three describes the data and methodology used in this study. Section four reports the analysis and results. Finally, section five provides discussion and concluding observations.

LITERATURE REVIEW

There are three versions of the EMH: the weak-form suggests that prices of traded securities already reflect all past publically available information. The semi-strong form claims that prices reflect both all publically available information and that these prices instantly respond to reflect new public information. The final form, the strong form EMH, claims that prices

further include insider information. (A review and evidence supporting the hypothesis can be seen in Fama, 1970). The EMH is also linked with the concept of "random walk". Random walk is a stock market theory, originally examined by Kendall & Babington Smith, (1953) and popularised by Malkiel, (1973). It purports that past movements or direction of stock prices, or indeed the overall market, cannot be used to predict its future movement. Stock prices are independent of each other and have the same probability distribution. The random walk theory is a precursor to the EMH and provides a rationale for market efficiency.

There are several comprehensive reviews of empirical evidence of Random Walk Model and weak-form EMH for both developed and emerging countries: Fama, (1970), Granger, (1975), Hawawini, (1984), Fama, (1991), and Lo, (1997). The original empirical work supporting the notion of randomness in stock prices looked at such measures of short-run serial correlations between successive stock-price changes. In general, this work supported the view that the stock market has no memory – the way a stock price behaved in the past is not useful in deciding how it will behave in the future (Cootner, 1964). More recent work by Lo & MacKinlay, (1999) find that short-run serial correlations are not zero and the existence of too many successive moves in the same direction enable them to reject the hypothesis that stock prices behave as random walks. There does seem to be some momentum in the short run stock prices. Moreover, Lo, Mamaysky, & Wang, (2000) also find, through use of sophisticated non-parametric statistical techniques that can recognise patterns, some of the stock price signals used by technical analysts such as 'head and shoulders' formations and 'double bottoms', may actually have some modest predictive power (Malkiel B. , 2003).

Results by Butler & Malaikah, (1992) using serial correlation and runs tests find the Saudi and Kuwaiti markets between 1985-89 not to be weak-form efficient. They suggest that institutional factors in the Saudi market contribute to this market inefficiency. These institutional factors include lack of liquidity, market fragmentation, trading and reporting delays, and the absence of official market makers. Abraham, Seyyed, & Alsakran, (2002) using the Beveridge & Nelson, (1981) decomposition of index returns to control thin trading, the runs tests, and the variance ratio tests, also find evidence of weak-form efficiency in the Saudi and Kuwaiti as well as the Bahraini equity markets. Urrutia, (1995) researches other emerging financial markets of Argentina, Brazil, Chile and Mexico and rejects the existence of a random walk when using a variance-ratio test. He finds all markets to be weak-form efficient when using a runs test. Grieb & Reyes, (1999) tested the Brazilian and Mexican markets using variance-ratio tests and find evidence of random walk only for Brazil. Elango & Hussein, (2008) find that all GCC markets reject the null hypothesis that the returns follow a normal distribution. Using the Runs tests they also concluded no evidence supporting random walk hypothesis or weak-form efficiency. On the other hand Al-Abdulqader, Hannah, & Power, (2007) suggests an improvement in the Saudi market may be due to improvements in technology and regulatory developments.

Within this paper the Random Walk Hypothesis (RWH) and weak-from efficiency is investigated using the Variance Ratio (VR) and the Runs tests. These procedures are robust and have been widely used in the international academic literature Butler & Malaikah, (1992), Urrutia, (1995) ; Grieb & Reyes, (1999), Ojah & Karemera, (1999), Abeysekera, (2001), Moustafa, (2004), Squalli, (2006). Variance ratio testing is a standard tool in random walk testing. However this procedure is not sufficient on its own to access weak-form efficiency. In fact, when random walk hypothesis is rejected, serial correlation may be positive or negative. Positive serial correlation in returns for emerging countries may simply describe market growth.

Many studies have shown evidence of negative serial correlation (return reversals). Fama & French, (1988) found that 25 to 40 per cent of the variation in long holding period returns can be predicted in terms of negative correlation with past returns. Similarly Poterba & Summers, (1988) found substantial mean reversion in stock market returns at longer horizons. Therefore a second statistical analysis of the sample, (the Runs Tests), is followed to gain further empirical evidence for testing the presence of weak-form efficiency in the Saudi Arabian stock exchange.

DATA AND METHODOLOGY

The time series daily indices for each sector of the Tadawul exchange between 19th April 2007 and 12th May 2011 are gathered. Table 1 (appendix) shows the descriptive statistics. High volatility of sector returns during the sample period is identified by a standard deviation above the mean coefficient. The daily sector stock returns are generally negatively skewed distribution, though close to the mean zero. This sample exhibits a leptokurtic distribution as it has a relatively high positive kurtosis (above 3) and therefore suggesting the stock returns are more flattened to the left (fat tail) and more peaked relative to a normal distribution. The higher the Jarque-Bera statistic, the less likely the sample data is normally distributed. The Jarque-Bera statistic is significant and rejects the symmetry of the data distribution.

The Saudi Arabia Tadawul Exchange is composed of 149 companies, though 62 per cent of the total capitalisation share is dominated by the Petrochemicals and Banking sectors, as shown on Table 2 (appendix). This emerging market has great potential for equity risk diversification. The relevance of this paper is to investigate whether the returns on the Tadawul market are predictable?

A popular empirical approach to answering this question is the Lo & MacKinlay, (1999) overlapping variance ratio test, which examines the predictability of time series data by comparing variances of differences of the data (returns) calculated over different intervals. Assuming the data follow a random walk, the variance of a period difference should be times the variance of the one-period difference. Evaluating the empirical evidence for or against this restriction is the basis of the variance ratio test. Using EViews7 the Lo and MacKinlay variance ratio test for homoskedastic and heteroskedastic random walks, using the asymptotic normal distribution is performed.

The Variance-ratio is calculated as follows:

$$\mathrm{VR}(q) = \frac{\sigma^{2(q)}}{\sigma^{2}(1)} \qquad (1)$$

Where $\sigma^{2(q)}$ is the unbiased estimator of $1/q$ of the variance of the qth difference and $\sigma^{2}(1)$ is the variance of the first difference. The modified test statistics presented below are from Liu & He, (1988). Equation (2) test statistic $\mathrm{Z}(q)$ is developed under the hypothesis of homoskedasticity. Equation (3) test statistic $\mathrm{Z}^*(q)$ is robust to heteroskedasticity.

$$\mathrm{Z}(q) = \frac{VR(q) - 1}{(v^*/(q))^{1/2}} \sim N(0,1) \qquad (2)$$

$$\mathrm{Z}^*(q) = \frac{VR(q) - 1}{(v*(q))^{1/2}} \sim N(0,1) \qquad (3)$$

Where $\mathrm{v}(q)$ and $\mathrm{v}^*(q)$ represent the asymptotic variances respectively under homoscedasticity and heteroskedasticity. The null hypothesis is that $\mathrm{VR}(q) = 1$ or that the chosen index follows a random walk. When the random walk hypothesis is rejected and $\mathrm{VR}(q) > 1$, returns are

positively serially correlated. When the random hypothesis is rejected and VR(q) < 1, returns are negatively serially correlated. This situation is often described as a mean-reverting process and consistent with the findings of Summers,(1986) and Fama & French, (1988). This has been interpreted as an efficient correction mechanism in mature markets (Fama & French, 1988) and as a sign of a bubble in emerging financial markets (Summers, 1986).

Tables 3 to 5 (appendix) show the Variance Ratio tests results for sectors including the Tadawul. The sampling intervals for these sectors are 2, 5, 10, 20 and 40 observation days. For each interval the tables present the estimates of the Variance Ratio VR(q), and the test statistics for the null hypotheses of homoscedastic , Z(q), and heteroskedastic, Z*(q), increments. Under the assumption of homoscedasticity (Zq) presented on the Table 3 to 5, the Random Walk Hypothesis (RWH) is rejected for all sectors including the Tadawul Exchange. All of variance ratios are statistically significantly smaller than one. Variance ratios smaller than unity indicate that variances decline proportionately with time. This rejection of the RWH for sector indices may be due to heteroskedasticity or serial correlation.

Tables 3 to 5 also exhibit the value estimates (Z*q) under the assumption of heteroskedasticity. The null hypothesis of random walk for all periods is rejected for all sectors. These results are robust and the variance ratios also decline proportionately over time. These results for the Saudi market are supported both by Butler & Malaikah, (1992) for the period 1985-89, and Elango & Hussein, (2008) for the period 1992-98. Since the prices and returns reported on Tables 3 to 5 (appendix) are negatively serially correlated throughout the holding periods, this can be interpreted as mean-reversing and a sign of a bubble in such an emerging market. Lo & MacKinlay, (1988) who find positive autocorrelation for the New York Exchange and American Stock Exchange stock indices, and Poterba & Summers, (1988), who also find positive autocorrelation for the same exchanges but for short horizons only. Additional testing must be completed to provide further evidence to support the rejection of RWH in all sectors. According to Abraham, Seyyed, & Alsakran, (2002), when a parametric serial correlation test is inappropriate, it can be replaced with a non-parametric testing. The Runs Test is one such appropriate non-parametric test.

A Runs test is a non-parametric test that is designed to examine whether successive price changes are independent, that is, whether the order of occurrence of two values of a variable are random. The importance of this test is that it is not required for the data to be normally distributed. This procedure can therefore be used to test whether returns in an emerging market such as Saudi Arabia are predictable. The null hypothesis is for weak-form efficiency (or temporal independence) to be in the series. In general, a run involves the sequencing of similar events separated by different events, such as increases in returns separated by decreases. A sample with too many or too few runs suggests that the sample is not random. Too fewer runs may suggest a time trend or a systematic arrangement due to temporal dependence. Alternatively too many runs may suggest cyclical or seasonal fluctuations or clustering. Within this test, the number of runs is determined by the change in returns with respect to its position to the mean (median) return. The mean is generally effective in measuring the central tendency for symmetrical distributions but can be weak when outliers exist. Since the data are not normally distributed, the median can represent a more effective measure of central tendency especially when distributions are skewed in this case (Squalli, 2006). To perform the Runs tests, the runs can be carried out by comparing the actual runs to the expected runs.

Let *n* represent the number of observations, n_a and n_b respectively represent observations above and below the sample mean (or median), and r represent the observed number of runs. The expected number of runs is represented by:

$$E(r) = \frac{n+2n_an_b}{n} \quad (4)$$

The standard error can therefore be written as:

$$\bar{\sigma}\,(\mathrm{r}) = \left[\frac{2n_an_b(2n_an_b-n)}{n^2(n-1)}\right]^{1/2} \quad (5)$$

The asymptotic (and approximately normal) Z-statistic can be written as follows:

$$\bar{Z}(\,r) = \frac{r-E(r)}{\bar{\sigma}(r)} \quad (6)$$

The Table 6 (appendix) shows when the mean is used as a base, that all but Banking, Building, Insurance and Telecom sectors reject the null hypothesis of weak-form efficiency. Using the median as a base, Table 7 (appendix) confirms these results. Al-Abdulqader, Hannah, & Power, (2007) show evidence of stronger EMH than in previous studies, suggesting that some improvement in the Saudi maket efficiency may be due to regulatory and technological advances. Butler & Malaikah, (1992) for Saudi Arabia found the Saudi stock market inefficient.

DISCUSSION AND CONCLUDING OBSERVATIONS

The Capital Market Authority (CMA) was established in 2003. It provided a legal and regulatory framework designed to open up the Saudi capital market to support the government's stated goal of privatization, promote greater efficiency and transparency, and increase public participation in financial markets. A greater variety and depth of financial product sophistication and choice emerged together with improved regulatory supervision. In late 2007 the CMA relaxed restrictions on share ownership to GCC nationals. In 2008 a much larger step was taken when the CMA announced that it would allow Non-GCC foreigners to buy shares listed on the Tadawul by entering into swap agreements with authorized Saudi intermediaries. Saudi investors retain legal ownership of the shares while transferring economic benefits to foreign investors. A number of media reports in late 2011 have hinted at an imminent major announcement allowing full and direct foreign ownership in the Tadawul market.

Despite this 'progress' empirical results show that there has been little change in respect to the efficiency of the market. The Variance Ratio Tests rejected the RWH for all sectors. However the non-parametric Runs Tests show evidence of weak-form efficiency for only the Banking, Building, Insurance, and Telecom sectors. These four sectors collectively make-up sixty-one of the total one hundred and forty-nine companies of the Tadawul Exchange. Maybe the institutional changes since 2003 are having some contributory impact on the efficiency of the market. Results from this research suggest that prices do not fully reflect available information and prices changes are not independent nor distributed randomly. The implication for both investors and authorities is that some returns may be predictable and opportunities for arbitrage and abnormal profit making may be available, contrary to RWH and EMH.

APPENDIX

Table 1 - Descriptive statistics

Sector	Mean	Median	Max.	Min.	S.Dev.	Skew.	Kurtosis	Jarque-Bera	Prob.	Sum	Obs.
AGRI	0.02	0.036	9.52	-9.62	1.73	-0.38	10.70	3010.28	0.00	27.14	1207
BANK	-0.01	0.000	9.12	-9.77	1.69	0.06	10.64	2939.17	0.00	-14.72	1207
BUILD	-0.02	0.020	13.38	-9.91	2.09	-0.46	9.98	2496.46	0.00	-28.25	1207
CEMENT	0.01	0.000	9.75	-9.87	1.47	-0.21	15.03	7284.19	0.00	6.50	1207
ENERGY	0.01	0.000	9.55	-9.81	1.66	0.24	10.79	3063.22	0.00	17.62	1207
HOTEL	0.03	0.000	24.89	-12.12	2.47	1.40	21.90	18364.56	0.00	36.10	1207
INDUST	0.03	0.000	18.19	-11.64	2.02	-0.14	13.87	5945.72	0.00	35.50	1207
INSUR	-0.01	0.000	9.67	-12.63	2.24	-0.66	6.91	856.30	0.00	-9.20	1207
INVEST	-0.05	0.000	20.35	-9.79	2.15	0.08	14.35	6477.95	0.00	-54.79	1207
MEDIA	-0.04	-0.023	14.38	-9.99	2.02	0.18	10.00	2471.48	0.00	-46.48	1207
PETROL	0.04	0.019	34.38	-21.12	2.53	1.22	37.41	59844.15	0.00	48.68	1207
REAL	-0.04	0.000	13.96	-9.94	1.75	-0.08	13.84	5907.26	0.00	-42.39	1207
RETAIL	0.04	0.000	12.19	-9.86	1.68	-0.15	13.31	5353.75	0.00	43.59	1207
TELECOM	-0.02	0.000	9.88	-9.97	1.67	-0.22	11.50	3640.79	0.00	-22.00	1207
TRANS	-0.02	0.000	9.76	-9.89	2.06	-0.05	9.36	2034.64	0.00	-21.86	1207
TAD	0.00	0.013	9.51	-9.81	1.66	-0.44	11.63	3783.40	0.00	-0.19	1207

Table 2 - Saudi Arabia Stock Market Capitalization by Sector as of November 2011

Sector	Market Capitalisation (Riyals)	% of total market	Number of Companies
Petrochemical Industries	453,074,740,551.90	37.43	14
Banks and Financial Services	299,778,325,580.00	24.77	11
Telecommunications and IT	111,456,000,000.00	9.21	5
Energy and Utilities	56,561,118,048.75	4.67	2
Cement	52,877,185,000.00	4.37	10
Agriculture and Food Industries	48,087,798,819.00	3.97	15
Industrial Investment	40,217,768,793.70	3.32	13
Real Estate Development	39,584,004,296.00	3.27	8
Multi-Investment	31,941,270,009.90	2.64	7
Insurance	24,938,325,023.75	2.06	31
Building and Construction	20,360,238,115.80	1.68	15
Retail	19,610,125,000.00	1.62	9
Transport	5,755,430,000.00	0.48	4
Media and Publishing	3,616,250,000.00	0.3	3
Hotel and Tourism	2,487,320,104.00	0.21	2
Total	1,210,345,899,342.80	100	149

Table 3 - Variance Ratio Test results by sector

Sector	q	VR(q)	Zq	Z*q
Agriculture	2	0.5324	-16.2706*	-8.4354*
	5	0.2288	-12.2478*	-7.0010*
	10	0.1111	-9.1598*	-5.6080*
	20	0.0550	-6.6153*	-4.2698*
	40	0.0284	-4.2268*	-3.1521*
Banking	2	0.5159	-16.8410*	-8.2302*
	5	0.2247	-12.3132*	-6.4807*
	10	0.1161	-9.1090*	-5.0843*
	20	0.0585	-6.5916*	-3.9117*
	40	0.0291	-4.7142*	-2.9884*
Building	2	0.5241	-16.5571*	-7.6403*
	5	0.2327	-12.1865*	-6.2629*
	10	0.1126	-9.1442*	-5.1254*
	20	0.0584	-6.5920*	-3.9715*
	40	0.0303	-4.7089*	-3.0140*
Cement	2	0.5185	-16.7506*	-7.1578*
	5	0.2214	-12.3649*	-6.0226*
	10	0.1150	-9.1202*	-4.8320*
	20	0.0548	-6.6168*	-3.8520*
	40	0.0273	-4.7223*	-2.9803*
Energy	2	0.3990	-20.8959*	-9.2971*
	5	0.1701	-13.1732*	-6.8270*
	10	0.0849	-9.4249*	-5.4017*
	20	0.0432	-6.6949*	-4.3359*
	40	0.0219	-4.7469*	-3.3895*
Hotel	2	0.5050	-17.2200*	-5.5546*
	5	0.2107	-12.5335*	-5.1197*
	10	0.0945	-9.3283*	-4.6762*
	20	0.0499	-6.6497*	-3.9792*
	40	0.0266	-4.7253*	-3.2490*

VR(q) – variance ratio estimate, Z(q) – test statistic for null hypothesis of homoskedasic increments random walk, Z*(q) – test statistic for null hypothesis of heteroskedastic increments random walk; the critical value for Z(q) and Z*(q) at the 5 per cent level of significance is 2.49, asterisk indicates sigificance at this level; sampling intervals (q) are in days.

Table 4 - Variance Ratio Test results by sector

Sector	q	VR(q)	Z(q)	Z*(q)
Industrial	2	0.4630	-18.6757*	-6.6284*
	5	0.2012	-12.6830*	-5.4062*
	10	0.0994	-9.2787*	-4.6017*
	20	0.0501	-6.6486*	-3.7415*
	40	0.0263	-4.7270*	-2.9440*
Insurance	2	0.5318	-16.2894*	-9.4266*
	5	0.2219	-12.3563*	-7.9030*
	10	0.1117	-9.1535*	-6.3364*
	20	0.0572	-6.6007*	-4.8213*
	40	0.0300	-4.7100*	-3.5682*
Investment	2	0.5103	-17.0365*	-5.8438*
	5	0.2082	-12.5726*	-5.1887*
	10	0.1008	-9.2638*	-4.5413*
	20	0.0515	-6.6392*	-3.8170*
	40	0.0265	-4.7259*	-3.1180*
Media	2	0.4922	-17.6629*	-7.9874*
	5	0.2088	-12.5633*	-6.5047*
	10	0.1018	-9.2534*	-5.4540*
	20	0.0506	-6.6451*	-4.4602*
	40	0.0257	-4.7297*	-3.5042*
Petrochemical	2	0.4306	-19.7978*	-3.8817*
	5	0.1897	-12.8642*	-3.2688*
	10	0.0949	-9.3234*	-3.0345*
	20	0.0482	-6.6614*	-2.7134*
	40	0.0248	-4.7339*	-2.3569*
Real Estate	2	0.5114	-16.9987*	-6.5678*
	5	0.2202	-12.3831*	-5.5771*
	10	0.1073	-9.1978*	-4.7230*
	20	0.0549	-6.6161*	-3.7931*
	40	0.0270	-4.7235*	-2.9226*

VR(q) – variance ratio estimate, Z(q) – test statistic for null hypothesis of homoskedasic increments random walk, Z*(q) – test statistic for null hypothesis of heteroskedastic increments random walk; the critical value for Z(q) and Z*(q) at the 5 per cent level of significance is 2.49, asterisk indicates sigificance at this level; sampling intervals (q) are in days.

Table 5 - Variance Ratio Test results by sector

Sector	q	VR(q)	Z(q)	Z*(q)
Retail	2	0.5274	-16.4410*	-6.6679*
	5	0.2107	-12.5333*	-5.8696*
	10	0.0989	-9.2835*	-4.9523*
	20	0.0506	-6.6450*	-3.9161*
	40	0.0272	-4.7227*	-3.0226*
Telecom	2	0.5076	-17.1279*	-7.9196*
	5	0.2255	-12.3000*	-6.4081*
	10	0.1098	-9.1727*	-5.1282*
	20	0.0548	-6.6166*	-3.9277*
	40	0.0282	-4.7184*	-2.9590*
Transport	2	0.5378	-16.0809*	-8.7014*
	5	0.2148	-12.4682*	-7.1559*
	10	0.1085	-9.1861*	-5.5806*
	20	0.0548	-6.6169*	-4.2394*
	40	0.0268	-4.7245*	-3.1239*
Tadawul	2	0.5028	-17.2959*	-8.1990*
	5	0.2224	-12.3488*	-6.3678*
	10	0.1109	-9.1616*	-5.0197*
	20	0.0562	-6.6073*	-3.8312*
	40	0.0285	-4.7167*	-2.8754*

VR(q) – variance ratio estimate, Z(q) – test statistic for null hypothesis of homoskedasic increments random walk, Z*(q) – test statistic for null hypothesis of heteroskedastic increments random walk; the critical value for Z(q) and Z*(q) at the 5 per cent level of significance is 2.49, asterisk indicates sigificance at this level; sampling intervals (q) are in days.

Table 6 - Runs test results (Mean)

Sector	n	n_a	n_b	r	E(r)	Z(r)
Agriculture	1207	607	600	590	604	-0.834
Banking	1207	621	586	542	603	-3.573*
Building	1207	693	514	532	591	-3.488*
Cement	1207	558	649	580	725	-1.22
Energy	1207	545	662	614	598	0.882
Hotel	1207	566	641	599	602	-0.183
Industrials	1207	582	625	599	603	-0.273
Insurance	1207	653	554	537	600	-3.678*
Investment	1207	651	556	592	600	-0.508
Media	1207	610	597	604	604	-0.025
Petroleum	1207	598	609	582	604	-1.293
Realestate	1207	639	568	582	602	-1.18
Retail	1207	584	623	603	603	-0.05
Telecom	1207	660	547	553	599	-2.685*
Transport	1207	632	575	590	603	-0.759
Tadawul	1207	681	526	566	594	-1.672

* 5 per cent level of significance.

Table 7 - Runs test results (Median)

Sector	n	n_a	n_b	r	E(r)	Z(r)
Agriculture	1207	604	603	590	604	-0.835
Banking	1207	618	589	542	604	-3.581*
Building	1207	604	603	544	604	-3.484*
Cement	1207	633	574	580	603	-1.331
Energy	1207	669	538	612	597	0.851
Hotel	1207	655	552	583	633	-0.992
Industrials	1207	664	543	581	598	-1.014
Insurance	1207	652	555	537	600	-3.687*
Investment	1207	637	570	600	602	-0.153
Media	1207	604	603	606	604	0.086
Petroleum	1207	604	603	584	604	-1.181
Realestate	1207	624	583	590	603	-0.796
Retail	1207	670	537	585	597	-0.71
Telecom	1207	642	565	551	602	-2.952*
Transport	1207	622	585	586	603	-1.034
Tadawul	1207	604	603	578	604	-1.526

* 5 per cent level of significance.

REFERENCES

Abeysekera, S. P. (2001). Efficient markets hypothesis and the emrging capital market in Sri Lanka: evidence from Colombo stock exchange. *Journal of Business Finance and Accounting*, 249-61.

Abraham, A., Seyyed, F. J., & Alsakran, S. A. (2002). Testing the random walk behavior and efficiency of Gulf stock markets. *The Financial review*, 37, 469-480.

Al-Abdulqader, K., Hannah, G., & Power, D. (2007). A test of the weak form of efficient markets hypothesis for the Saudi stock exchange. *Journal of Emerging Market Finance*, 6, 167-182.

Al-Koughani, N. E. (1995). Random walk in thinly traded stock markets: the case of Kuwait. *Arab Journal of Administrative Science*, 198-209.

Beveridge, S., & Nelson, C. R. (1981). A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement of the business cycle . *Journal of Monetary Economics*, 7, 151-174.

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

Cootner, P. (1964). *Character of stock market prices.* Cambridge: M.I.T.Press.

Elango, R., & Hussein, M. (2008). An empirical analysis on the weak-form efficiency of the GCC markets applying selected statistical tests. *Global Economy and Finance Journal*, 15(8), 1-9.

Fama, E. (1970). Efficient capital markets: a review of theory and empirical work. *Journal of Finance*, 15, 383-417.

Fama, E. (1991). Efficient capital markets: II. *Journal of Finance*, 46, 1575-1617.

Fama, E., & French, K. (1988). Permanent and temporary components of stock prices. *Journal of Political Economy*, 96, 246-273.

Granger, C. (1975). A survey of empirical surveys on capital markets. In E. Elton, & M. Gruber, *International Capital Markets* (pp. 3-36). Amsterdam: North-Holland .

Grieb, T., & Reyes, M. G. (1999). Random walk tests for Latin American equity indicies and individual firms. *Journal of Financial Research*, 371-83.

Grieb, T., & Reyes, M. G. (1999). Random walk tests for Latin American equity indicies and individual firms. *Journal of Financial Research*, 4, 371-83.

Hawawini, G. (1984). European equity markets: price behaviour and efficiency. *Monograph series in Finance and Economics, Saloman Center, NYU*.

Kendall, M., & Babington Smith, B. (1953). *Tables of Random sampling numbers.* Cambridge: Cambridge University Press.

Liu, C., & He, J. (1988). A variance-rtio test of random walks in foreign exchange rates. *Journal of Finance*, 46, 773-85.

Lo, A. W. (1997). *Market efficiency: stock market behaviour in theory and practice.* Chethenham: Elgar, UK.

Lo, A. W., & MacKinlay, A. C. (1999). *A non-random walk down WallStreet.* Princeton: Princeton University Press.

Lo, A., & MacKinlay, A. C. (1988). Stock market pris do not follow random walks: evidence from a simple specification test. *Review of Financial Studies*, 41-66.

Lo, A., Mamaysky, H., & Wang, J. (2000). Foundations of technical analysis: computational algorithms, statistical inference and empirical implementation. *Journal of Finance*, 55, 1705-1965.

Malkiel, B. (2003). *The efficient market hypothesis and its critics.* Princeton: Princeton University Working Paper No.91 April.

Malkiel, B. G. (1973). *A random walk down Wall Street.* New York: Norton & Co.

Moustafa, M. A. (2004). Testing the weak-form efficiency of the United Arab Emirates stock market. *Inernational Journal of Business*, 309-25.

Ojah, K., & Karemera, D. (1999). Random wlaks and market efficiency tests of Latin America emerging equity markets: a revisit. *The Financial Review*, 57-72.

Poterba, J., & Summers, L. (1988). Mean reversion in stock returns: evidence and implications. *Journal of Financial Economics*, 22, 27-60.

Squalli, J. (2006). A non-parametric assessment of weak-form efficiency in the UAE financial markets. *Applied Financial Economics*, 1365-1373.

Summers, L. H. (1986). Does the stock market rationally reflect fundamental values? *Journal of Finance*, 41, 591-601.

Urrutia, J. L. (1995). Tests of random walk and market efficiency for Latin America emerging markets. *Journal of Financial Research*, 299-309.