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Testing the Weak-Form Efficiency of the United Arab Emirates Stock Market

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ABSTRACT

This study examines the behavior of stock prices in United Arab Emirates (UAE) stock market. The data consist of the daily prices of the 43 stocks included in the Emirates market index covering the period commencing October 2, 2001 through September 1, 2003. The returns of all the 43 sample stocks do not follow the normal distribution, so the study utilizes only the nonparametric runs to test for randomness. The results reveal that the returns of 40 stocks out of the 43 are random at a 5% level of significance. Hence, the empirical study supports the weak-form EMH of UAE stock market.

These results are surprising and challenging to traditional views because the UAE stock market is newly developed and just recently became official with sound regulations. Furthermore, the market is very small and thin suffering from infrequent trading. However, the results of the paper may be attributed to the essential steps that have already been taken by the authorities to improve the operating and pricing efficiency of UAE stock market during the last two years. The UAE stock market needs to be studied further with longer stock price time series and other tests to test the efficiency of the market.

JEL: G14

Keywords: UAE stock market; Weak-form EMH; Runs test

I. INTRODUCTION

The Efficient Market Hypothesis (EMH) assumes that stock prices adjust rapidly to the arrival of new information, and thus, current prices fully reflect all available information. Fama (1970) formalized the theory, organized the empirical evidence, and divided the EMH into three subhypotheses depending on the information set involved.[1]

The weak-form EMH states that current stock prices fully reflect all historical market information such as: prices, trading volumes, and any market oriented information. The semistrong-form EMH asserts that prices fully reflect not only the historical information but also all public information including non-market information, such as earning and dividend announcements, economic and political news. Finally the strong-form EMH contends that stock prices reflect all information from historical, public, and private sources, so that no one investor can realize abnormal rate of return.

Stock market efficiency is an important concept, both in terms of an understanding of the working of stock markets and in their performance and contribution of the development of a country's economy. If the stock market is efficient, the prices will represent the intrinsic values of the stocks and in turn, the scarce savings will be optimally allocated to productive investments in a way that benefits both individual investors and the country economy (Copeland and Weston, 1988).

The EMH has very important implications for both investors and authorities. Assuming the EMH holds, investors should doubt the strategy "beat-the-market" and adopt the strategy "hold-the-market." The authorities on their part, should believe that the best policy is to reduce market interventions to the minimum level.

This study aims at testing the weak-form EMH in the United Arab Emirates (UAE) stock market. The study is organized in four sections as follows: Section II addresses the random walk model as the most commonly used model to test the weak-form EMH; Section III describes the UAE stock market; Section IV presents the data and methodology; and Section V reports the empirical results and suggests some useful conclusions.

II. THE RANDOM WALK MODEL (RWM)

The statement that prices, in an efficient market, "fully reflect" available information conveys the general idea of what is meant by market efficiency. However this statement is too general to be tested, encountering a need to develop mathematical models of market equilibrium that would be used in testing market efficiency (Fama,1965). The RWM is one of those models; it assumes that successive price changes are independent and identically distributed random variables, so that future price changes cannot be predicted from historical price changes. Hence, the RWM has some testable implications for the weak-form EMH.

The RWM and the weak-form EMH were tested heavily and frequently in both developed and developing countries. There are several comprehensive reviews of the empirical evidence such as: Fama (1970); Granger (1975); Hawawini (1984); Fama, (1991); and Lo (1997).

In addition to the many articles that had tested specific stock markets individually, there are some studies that had also compared the efficiency of several stock markets. For example, Solink (1973) studied 234 stocks from eight European stock markets; Ang and Pohlman (1978) studied 54 stocks from five Far Eastern stock markets; Cooper (1982) examined 50 stock markets scattered throughout the world; Errunza and Losq (1985) investigated the behavior of stock prices for nine of well established and newly emerging LDC (less developed countries) securities markets; Urrutia (1995) tested the RWM in four Latin American emerging equity markets, Huang (1995) studied the stock markets of nine Asian countries; and finally Dahel and Laabas (1999) examined the efficiency of four GCC (Gulf Cooperation Council).

Through the 1960s and 1970s, the weak-form EMH was strongly supported by evidence from US and UK markets. The conclusions were less clear for other countries' stock markets. However, in the 1980s and 1990s, supporting evidence of the EMH was disputed by overwhelming empirical evidence accumulated against the efficient market hypothesis. This evidence was based upon a number of detected anomalies, such as the January effect, the holiday effect, the weekend effect, the small size effect, and volatility tests (Fama, 1991, Hwawini, 1994, and Lo, 1997).

A number of statistical tests have been used in the literature to examine the validity of weak-form EMH and the RWM. Those tests tend to fall into two groups. The first group entails a comparison of risk-return results for trading or filter rules that make investment decisions based on past market information versus results from a simple buy-and-hold strategy. The second group involves statistical tests of independence between rates of return. Autocorrelation tests and runs tests are the most popular ones in this group (Reilly and Brown, 2003, p.179-181).

Some studies used the spectral analysis, which shows any isolated deviation from the random walk model and can be used to identify cycles that are responsible for inefficiencies identified in a series. On the other hand, there is a relatively new test introduced by Lo and Mackinlay (1988), the variance ratio, which tests the randomness in a time series of stock price taking into consideration the problem of heteroscedasticity.

III. THE UNITED ARAB EMIRATES CAPITAL MARKETS

The United Arab Emirates (UAE) stock market is relatively new and small, which contains both official and unofficial markets. The official market started in 2000 and represented two governmental stock markets, Dubai and Abu Dhabi, under the supervision of the Emirates Securities and Commodities Authority. While, the unofficial, or OTC, market works through several brokerage firms with most of them affiliated to banks.

There are about fifty five actively traded stocks belonging to several sectors, which are: 18 stocks that are in the bank sector, 14 are in the insurance sector, and the rest are in the services, commercial and manufacturing sectors.[2] Out of the fifty-five traded stocks, 13 stocks are listed on the Dubai Financial Market, 29 stocks are listed on the Abu Dhabi Securities Market, and the remaining 3 stocks are traded through the unofficial market.

Since its inception as an unofficial market in the late 1970s, the UAE stock market has experienced several volatile periods in terms of share trading activity and price levels, as follows (Bin Sabit, 2000):

1) The period of (1975 – 1982) had witnessed the creation of many companies due to rising oil prices and the strong interest of the Federal Government to build a strong national economy.

2) The crash of the Kuwaiti stock market, the crisis of Al-Manakh market in 1983, and the falling of oil prices in 1986 had a negative impact on the UAE capital market.

3) The UAE capital market rose again during the period of 1993 – 1998, due to the establishment of many new companies and hence new issues of AED with par value.

4) Once again the UAE capital market experienced a deep decline in the summer of 1998 due to several reasons including: lack of regularity, manipulation of the market by block traders and professional investors, negative speculative trading by all the participants, lack of financial disclosure, and the drop in oil prices. Since the summer of 1998, the market has suffered sharp declines in both trading volume and trading value to such an extent that the market prices of most traded stocks have decreased under their par values.[3]

In response to the stock market crisis in 1998, the UAE government responded by officially reorganizing its stock market. The Emirates Securities and Commodities Authority (ESCA) was established February 1st, 2000 pursuant to federal law # 4 of 2000 under the chairmanship of the Minister of Economy and Commerce. Its function is to regulate and develop the primary and secondary markets, monitor the operations of the market, and create a favorable environment for investment.[4]

The Dubai Financial Market (DFM) was officially founded in March 2000 as the first organized stock market in UAE. DFM has been trying to increase the investment alternatives available to investors, and sources of financing available to companies. It has thirteen listed stocks, two bonds: one is a corporate issued by Emirates Airlines in 2001 and the other one is issued by Dubai government in May 2003 and five mutual funds. DFM has twelve accredited brokers.[5]

Abu Dhabi Securities Market (ADSM) started operating in November 2000. ADSM is larger than DFM: ADSM has twenty-nine listed stocks. However, neither bonds nor mutual funds are yet included. Most of the companies listed are located in Abu Dhabi, with six that are located in Ras Al-Khaima, one in Qatar, and one in Sudan. ADSM has fourteen listed brokers.[6]

Since the establishment of the official UAE stock market in 2000, it has been growing at the expense of the OTC market. ESCA enacted a set of statutory orders and regulations that pertain to arbitration, listing, brokers' practice, disclosure, transparency, financial markets operations, trading, clearance and depository. In 2001 ESCA launched an official capital weighted average market index with 1000 points, called Emirates index, consisting of all listed stocks.[7] Today, ESCA has accomplished an electronic link between the two formal stock markets, DFM and ADSM.

Table 1 shows some performance indicators of DFM and ADSM in second quarter 2002 compared to second quarter 2003, which reflect the recent developments of the UAE stock market.

Table 1
Performance indicators of UAE stock market

Indicators	DFM		ADSM	
	2nd Q. 2002	2nd Q. 2003	2nd Q. 2002	2nd Q. 2003
1. Market Value (in $ M.)	8,419.53	11,209.63	19,135.03	24,287.11
2.Trading Value (in $ M.)	96.30	150.83	43.22	203.51
3. Number of stocks listed	12	12	20	28
4. Number of traded shares (million)	25.03	34.89	7.36	45.96
5. Number of trading days	77	77	64	64
6. Average daily trading	1.25	1.96	0.68	1.62
7. Turnover ratio (%) (1)	1.14	1.35	0.23	0.84
8. Price Index (points)				
-Domestic	-----	-----	1,295.29	1452.60
-AMF (Dec.2001=100) (2)	107.61	122.24	102.08	112.43

Source: Data Base For Arab Financial Markets, Arab Monetary Fund, Second Quarterly bulletin 2003. P. 65 (ADSM) and P. 68 (DFM) (In Arabic)
(1) Computed as Follows = Market value of traded shares/Market value of outstanding shares; and
(2) AMF refers to Arab Monetary Fund that covers the most active shares of 12 Arabic stock markets. This index is a market weighted average.

There are few empirical studies applied to the UAE capital market. Three of those are related to testing market efficiency. The first study is Ebid (1990) that investigates the characteristics and behavior of UAE stock market using weekly data of twenty-one stocks over the period of September 30, 1986 to July 31 1990. The study utilizes serial correlation with time lags of 1, 2, 3, and 4 weeks and concludes that the UAE stock market is inefficient at the weak level.

The second study is Al-Awad and Hassan (2001), which investigates the predictability among stock prices in the UAE in two groups. The first group consists of the bank sector, the insurance sector, and the services sector using the data sector indices over the period of November 1997 to May 2000. The second group consists of small banks, medium banks, and large banks using the data of group indices over the period of November 1997 to August 2000.

The study uses both Granger Causality tests and impulse response functions to test the predictability in the short run. It finds strong linkages among stock price indices, which signifies that the UAE stock market is inefficient. On the other hand, the study utilizes the co-integration methodology to test the predictability in the long run and does not find a strong relationship among different indices. However the study could not conclude that the UAE stock market is efficient and attributed the results to

the fact that the UAE stock market is newly developed and just recently has become official with sound regulations.

The third study examines examining the randomness of stock prices in the UAE stock market (Moustafa, 2001). The data consist of eighteen chronological price sequences of different lengths over the period commencing January 26th, 1999 through March 25th, 2001. Using the runs test, the empirical results do not support the weak-form EMH of UAE stock market.[8]

IV. DATA AND METHODOLOGY

A. Hypotheses

This study intends to investigate the efficiency of the UAE stock market. The null hypothesis states that the Random Walk Model (RWM) can explain prices of the stocks traded in UAE, so the UAE stock market is efficient at a weak-form level.

Ebid (1990) is the first study testing the efficiency of UAE stock market using the serial correlation even though it does not examine the normality of the stock price changes (returns). The serial correlation is a parametric test assuming normality of the stock price time series. Employing statistical tests of significance that assume normality, when it does not exist, can produce misleading results Urrutia (1995).

Unlike Ebid (1990); the current paper tests two hypotheses to determine the efficiency of the UAE in the weak form. The first hypothesis involves determining whether the stock returns follow a normal distribution or not. The null and alternative hypotheses are:

H_0: The stock returns in UAE stock market follow a normal distribution.
H_1: The stock returns in UAE stock market do not follow a normal distribution.

The second hypothesis involves determining, whether the stock returns are random across time. The null and alternative hypotheses are:

H_0: The stock returns in UAE stock market are random over the time period of the study.
H_1: The stock returns in UAE stock market are not random over the time period of the study.

B. Data

Al-Awad and Hassan (2001) tested the efficiency of the UAE stock market using stock indices instead of individual stocks. As pointed out by several researchers, such as Fama (1965) and Poterba and Summers (1988), stock index returns may show positive autocorrelation if some of the securities in the index trade infrequently. Due to the fact that the UAE stock market is a thin market with a low trading volume, particularly after the crisis of 1998, the current paper utilizes the individual stock prices, instead of stock index returns, to test the efficiency.

Table 2
The sample stocks of the study

	Company Name	Year and Place of Inception	# of Prices
1.	Abu Dhabi Commercial Bank*	1985 Abu Dhabi	565
2.	Abu Dhabi Islamic Bank*	1997 Abu Dhabi	565
3.	Commercial Bank International*	1991 Abu Dhabi	420
4.	First Gulf Bank*	1979 Abu Dhabi	353
5.	National Bank of Abu Dhabi*	1968 Abu Dhabi	565
6.	Union National Bank*	1982 Abu Dhabi	565
7.	Commercial Bank of Dubai**	1969 Abu Dhabi	122
8.	Dubai Islamic Bank**	1975 Dubai	565
9.	Emirates Bank International**	1977 Dubai	565
10.	Masherq Bank**	1967 Dubai	565
11.	National Bank of Dubai**	1963 Dubai	565
12.	Abu Dhabi Aviation*	1982 Abu Dhabi	565
13.	Emirates Telecommunications*	1976 Abu Dhabi	351
14.	National Marine Dredging*	1979 Abu Dhabi	565
15.	Oasis International Leasing*	1997 Abu Dhabi	565
16.	Qatar Telecommunications*	1998 Qatar	377
17.	Sudan Telecom*	1993 Sudan	119
18.	Abu Dhabi National Hotels*	1975 Abu Dhabi	565
19.	National Corporation of Tourism*	1996 Abu Dhabi	565
20.	Abu Dhabi Ship Building*	1996 Abu Dhabi	129
21.	Abu Dhabi for Building Materials*	1974 Abu Dhabi	565
22.	Abu Dhabi National Foodstuff*	1999 Abu Dhabi	565
23.	Gulf Cement *	1977 Ras Khaima	445
24.	Gulf Pharmaceutical Industries*	1980 Ras Khaima	251
25.	RAK for White Cement *	1980 Ras Khaima	297
26.	RAK for Poultry *	1976 Ras Khaima	284
27.	Union Cement *	1972 Ras Khaima	343
28.	Dubai Investment**	1995 Dubai	565
29.	Emaar Properties**	1997 Dubai	565
30.	Shuaa Capital**	1979 Dubai	565
31.	National Central Cooling **	1998 Dubai	565
32.	Union Properties**	1993 Dubai	565
33.	Abu Dhabi National Insurance*	1972 Abu Dhabi	43
34.	Al Ain Alahleia Insurance*	1975 Abu Dhabi	565
35.	Al Khazna Insurance *	1996 Abu Dhabi	565
36.	Al Wathba National Insurance*	1996 Abu Dhabi	565
37.	AL Dhafra Insurance *	1979 Abu Dhabi	565
38.	Emirates Insurance*	1982 Abu Dhabi	565
39.	United Insurance*	1976 Ras Khaima	97
40.	Dubai Insurance**	1970 Dubai	565
41.	Dubai National Insurance**	1992 Dubai	565
42.	National General Insurance**	1980 Dubai	193
43.	Union Insurance***	1998 Ajman	565

Source: Prepared by the author
* Listed in Abu Dhabi Securities Market; ** Listed in Dubai Financial Market
*** The only stock has not listed in either market yet

The paper uses the daily prices[9] of all forty-three traded stocks included in Emirates Market Index published by the ESCA. The prices have been collected from the Al Khaleej daily newspaper covering the period commencing October 2, 2001 through September 1, 2003. As shown in Table 2 the time series of the return prices of each stock consists of 564 observations, with the exception of some stocks that are listed in either DFM or ADSM, and hence in the ESCA market index after October 2, 2001.[10]

C. Statistical Methods

As mentioned previously there are several statistical methods used to test the random walk hypothesis. The paper concentrates on serial correlations and runs tests. These two techniques are well known and widely used to determine whether there is randomness in successive values of price changes.

Serial correlation (or autocorrelation) tests measure the correlation coefficient between a series of returns and lagged returns in the same series. A significant positive serial correlation implies that a trend exists in the series, whereas a negative serial correlation indicates the existence of a reversal in price movements. A return series that is truly random will have a zero serial correlation coefficient. The beta coefficient from the following regression equation measures the serial correlation of stock *i* with a lag of *k* periods:

$$r_{i,t} = \propto_i + B_i\, r_{i,t-k} + \varepsilon_{i,t} \qquad (1)$$

Where $r_{i,t}$ represents the return of stock i at time t, $\propto_i$ and B_i are constants, $\varepsilon_{i,t}$ represents random error, and k represents different time lags. The serial correlation tests assume normal distribution for the stock price changes (or returns).

The null hypothesis to be tested is that no significant correlation exists between price changes, i.e. H_o: $B_1 = B_2 = \ldots\ldots\ldots B_j = 0$. To test the serial correlation coefficient $B_{t,t-k}$ for significance, several test statistics may be used. One example is the Ljung-Box Q statistic which is asymptotically distributed as the chi-square distribution (Gujarati, 1995, p. 717).

The runs test is a nonparametric test of randomness in a series. Unlike the serial correlation, the runs test does not require the normal distribution of the stock returns. A run is defined as price change sequence of the same sign, e.g., - - 0 + + + would constitute three runs where "- -" represents a price decrease, (0) represents no change, and "+ + +" represents a price increase.

The premise behind the runs test is that too few or too many runs, as compared with the number of runs expected in a random series, indicate nonrandomness. If there are too few runs, it would mean that the stock returns in the time series do not change signs frequently, thus indicating a positive serial correlation and in turn, may imply that the price changes do not follow a random walk model. Similarly, if there are too many runs, they may suggest negative autocorrelation (Gujarati, 1995, P. 419).

Assuming price change independence, the total expected number of runs of all three types, E (R), can be estimated as:

$$E(R) = \frac{[N(N+1) - \sum_{i=1}^{3} n_i^2}{N} \quad (2)$$

Where N is the total number of observations (price changes or returns) and n_i are the number of price changes of each sign (+, -, 0).[11] For large sample sizes (e.g. greater than 30), the sampling distribution of E(R) is approximately normal and the standard error of E(R) is given by:

$$\sigma(R) = \frac{\sum_{i=1}^{3} n_i^2 [\sum_{i=1}^{3} n_i^2 + N(N+1)] - 2N \sum_{i=1}^{3} n_i^2 - N^3}{N^2(N-1)} \quad (3)$$

The standard normal Z-test statistic used to conduct a runs test is given by:

$$Z = \frac{(R \pm 0.5) - E(R)}{\sigma(R)} \quad (4)$$

where R denotes the actual number of runs, E(R) is the expected number of runs, and (0.5) is the continuity adjustment. For large N, Z will be normally distributed with mean zero and variance one. Thus, the standardized normal variable Z two-tailed test will be used for tests of significance.[12]

V. EMPIRICAL RESULTS AND CONCLUSION

To test the random walk hypothesis and weak-form efficiency of UAE stock market, the paper conducted the following steps:

1. Calculating the returns as follow: $r_{i,t} = (p_{i,t} - p_{i,t-1}) / p_{i,t-1}$, where $r_{i,t}$ is the return of stock i at trading day t, $p_{i,t}$ is the stock price at trading day (t) and $p_{i,t-1}$ is the stock price at the preceding trading day (t-1), ignoring the cash dividends, stock dividends, and the rights due to lack of data.[13]

2. Testing the normality of the stock returns to decide on using serial correlation or runs test**.** The Lilliefors Test[14] was used to examine normality by comparing the sample cumulative distribution function S(x) and the normal one F(x). The test statistic is as follows: D= max |F(x) – S(x)|, where *D* is the largest absolute difference between S(x) and F(x). If sample and normal cumulative probabilities are equal then the distribution is normal (Keller and Warrack, 2000, p. 613 – 618)**.** The results of the test, as shown in Table 3, indicate that the returns of all 43 sample stocks do not follow normal distribution, given that the returns of stocks: 15, 21, 23, 25, 27, 31, 33, 39, 42, and 43 are the closest to normal distribution as compared to others.

Both Kurtosis and skewness support the results of the Lilliefors Test. The results of the skewness test in Table 3 show that the returns of most stocks have significant positive skewed distributions, few have negative ones, and all have asymmetric distributions. On the other hand, the results of the Kurtosis test show that the returns of most of the sample stocks have leptokurtic distributions. Thus, we reject the null hypothesis of normality.

Table 3
The results of testing normality

Stock No.*	# of Returns	Lilliefors Statistic**	Kurtosis Statistic***	Skewness Statistic***
1	564	0.336	143.381	2.122
		(0.037)	(0.205)	(0.103)
2	564	0.248	110.820	1.719
		(0.037)	(0.205)	(0.103)
3	419	0.365	42.579	-2.219
		(0.043)	(0.238)	(0.119)
4	352	0.335	190.706	10.427
		(0.047)	(0.259)	(0.130)
5	564	0.311	9.562	0.190
		(0.037)	(0.205)	(0.103)
6	564	0.401	114.442	7.124
		(0.037)	(0.205)	(0.103)
7	121	0.241	4.688	-0.083
		(0.081)	(0.437)	(0.220)
8	564	0.205	44.313	0.420
		(0.037)	(0.205)	(0.103)
9	564	0.286	65.293	- 4.811
		(0.037)	(0.205)	(0.103)
10	564	0.420	31.450	1.797
		(0.037)	(0.205)	(0.103)
11	564	0.359	445.510	- 20.055
		(0.037)	(0.205)	(0.103)
12	564	0.450	538.218	22.873
		(0.037)	(0.205)	(0.103)
13	350	0.491	342.995	18.408
		(0.047)	(0.260)	(0.130)
14	564	0.392	21.241	1.790
		(0.037)	(0.205)	(0.103)
15	564	0.196	26.762	- 1.303
		(0.037)	(0.205)	(0.103)
16	376	0.306	22.800	1.471
		(0.046)	(0.251)	(0.126)
17	118	0.390	40.443	0.882
		(0.082)	(0.442)	(0.223)
18	564	0.369	20.445	- 1.195
		(0.037)	(0.205)	(0.103)
19	564	0.355	43.987	0.052
		(0.037)	(0.205)	(0.103)

Table 3 (continued)

Stock No.*	# of Returns	Lilliefors Statistic**	Kurtosis Statistic***	Skewness Statistic***
20	128	0.316	18.390	- 0.842
		(0.078)	(0.425)	(0.214)
21	564	0.012	433.311	- 17.999
		(0.037)	(0.205)	(0.103)
22	564	0.370	31.956	1.361
		(0.037)	(0.205)	(0.103)
23	444	0.194	101.762	4.932
		(0.042)	(0.231)	(0.116)
24	250	0.341	56.660	5.110
		(0.055)	(0.307)	(0.154)
25	296	0.047	51.348	7.217
		(0.052)	(0.282)	(0.142)
26	283	0.362	20.045	2.289
		(0.053)	(0.289)	(0.145)
27	342	0.020	53.073	2.817
		(0.048)	(0.263)	(0.132)
28	564	0.210	30.014	0.461
		(0.037)	(0.205)	(0.103)
29	564	0.205	21.646	1248
		(0.037)	(0.205)	(0.103)
30	564	0.264	18.317	0.813
		(0.037)	(0.205)	(0.103)
31	564	0.148	6.152	0.265
		(0.037)	(0.205)	(0.103)
32	564	0.319	33.227	2.838
		(0.037)	(0.205)	(0.103)
33	42	0.124	5.114	0.053
		(0.137)	(0.717)	(0.365)
34	564	0.459	41.685	3.249
		(0.037)	(0.205)	(0.103)
35	564	0.271	10.878	- 0.568
		(0.037)	(0.205)	(0.103)
36	564	0.390	32.565	1.789
		(0.037)	(0.205)	(0.103)
37	564	0.432	58.878	1.864
		(0.037)	(0.205)	(0.103)
38	564	0.345	26.613	1.083
		(0.037)	(0.205)	(0.103)
39	96	0.030	31.103	0.113
		(0.090)	(0.488)	(0.246)
40	564	0.484	178.358	11.336
		(0.037)	(0.205)	(0.103
41	564	0.270	42.350	3.084
		(0.037)	(0.205)	(0.103)
42	192	0.063	25.771	4.879
		(0.064)	(0.349)	(0.175)
43	564	0.026	340.763	17.490
		(0.037)	(0.205)	(0.103)

* The same serial numbers of Table 2.

** The values between parentheses are the Critical Values of the Lilliefors Test at significance level (5%). Those values were calculated as: [0.886/ $(n)^{½}$] where (n) is the sample size over (30). *(Keller and Warrack, 2000, appendix b-21)*.
*** Standard errors in parentheses are computed as:
for Kurtosis = (24/N)1/2; for skewness = (6/N)1/2, where N is the number of observations (returns)

3. Testing for randomness. Due to the empirical distribution of price changes for the sample stocks, stock returns do not appear to follow a normal distribution. Therefore serial correlation could not be used to test the randomness of the stock returns.[15] Instead the runs test is a better method.

Runs test has been performed for the returns of the forty-three sample stocks. It may be pointed out that for the runs tests in this study, the distinction between log price differences and price differences is immaterial since only signs, not magnitudes, are involved.

The results of runs test are reported in Table 4. They reveal that the returns of 40 stocks out of the 43 are significant at the five percent level with Z-values within (±1.96) and thus the hypothesis of randomness cannot be rejected. Most of those 40 stocks have negative standardized variables (Z), i.e., fewer actual runs than expected. Therefore, the null hypothesis of randomness cannot be rejected and hence the results support the weak-form EMH of UAE stock market. This indicates that the stock prices traded on the UAE stock market follow the random walk model.

VI. CONCLUSION AND SUGGESTIONS

The study examines the behavior of stock prices in the UAE stock market. The data consists of the daily prices of 43 stocks included in the UAE market index covering the period commencing October 2, 2001 through September 1, 2003. The returns of the 43 sample stocks do not follow the normal distribution, so the study utilizes only the nonparametric runs test to check for randomness. The results reveal that the returns of 40 stocks out of the 43 are random at 5-percent level of significance.

In comparison, the results of the current study are different from those of another study by *Moustafa (2001)*. He examines the behavior of 18 stock prices representing the most actively traded stocks in UAE stock market during the period of January 1999 to March 2001, during the beginning stage of the transition from OTC market to an organized one. The runs tests do not support the weak-form market efficiency in 15 of the 18 stocks at 5-percent significance level. The runs test reveals that all the 18 stocks have negative standardized variables indicating that they have less actual than expected runs.

Hence, the results of the current paper indicate that the prices of the stocks traded in UAE stock market behave in a manner consistent with the weak-form of EMH. These results are surprising because the UAE stock market is newly developed and just recently has become official with sound regulations. Furthermore, the market is very small and thin suffering from infrequent trading, where most of the runs do not indicate significant changes for most of the stocks.

Table 4
The results of the runs test

Stock #	N	R	E (R)	σ (R)	Z
1	564	206	232.70	22.97	-1.16
2	564	235	275.80	20.90	-1.95
3	419	69	76.64	24.99	-0.31
4	352	185	185.20	15.72	-0.01
5	564	234	234.59	22.88	-0.03
6	564	135	145.08	27.06	-0.37
7	121	49	49.25	10.76	-0.02
8	564	249	296.60	19.88	-2.39*
9	564	233	268.40	21.26	-1.67
10	564	166	147.93	26.93	0.67
11	564	292	256.85	21.77	1.57
12	564	214	197.09	24.64	0.69
13	350	102	135.82	18.62	1.82
14	564	179	151.14	26.78	1.04
15	564	362	332.19	18.11	1.65
16	376	259	121.92	20.68	6.63*
17	118	26	26.49	12.83	-0.04
18	564	203	169.87	25.91	1.28
19	564	119	132.78	27.62	-0.50
20	128	41	44.94	11.78	-0.33
21	564	3	4.99	33.41	-0.06
22	564	47	54.91	31.16	-0.25
23	444	15	16.77	29.00	-0.06
24	250	66	82.02	16.81	-0.95
25	296	11	12.76	23.60	-0.07
26	283	35	49.30	20.71	-0.69
27	342	15	16.71	25.25	-0.07
28	564	335	355.23	16.94	-1.02
29	564	225	313.68	19.04	-4.66*
30	564	262	274.13	20.98	-0.58
31	564	334	363.79	16.50	-0.81
32	564	206	205.40	24.25	0.02
33	42	17	18.10	6.25	-0.18
34	564	57	58.59	31.00	-0.05
35	564	195	195.63	24.71	-0.03
36	564	131	130.86	27.71	0.01
37	564	73	82.01	29.94	-0.30
38	564	115	119.37	28.24	-0.15
39	96	6	8.75	13.01	-0.21
40	564	22	24.56	32.53	-0.08
41	564	64	74.91	30.26	-0.36
42	192	24	21.74	17.99	0.13
43	564	8	8.94	33.23	-0.13

* Significant at 5 % level where the absolute observed values of Zs are less or greater than ±1.96.

However, the results of the paper may be attributed to the essential steps that have already been taken by the authorities to improve the operating and pricing efficiency of UAE stock market during the last two years. In addition, the results are similar to those of few studies applied to other emerging markets that are similar in terms of economic and political environment. Al-Jefri and Basheikh (1997) confirmed that the Saudi Stock Market is efficient in the weak form applying the runs test to the weekly prices of 48 stocks for the period of May 1985 to December 1991.

Another study, Butler and Malaikah (1992), examined the stock market efficiency in both Kuwait and Saudi Arabia over the period 1985 to 1989. According to the runs test, the paper concludes that the Kuwait market is similar to the active markets where only 14 of the 36 stocks (39%) violate the independence assumptions at the 5% confidence level. Rao and Shankaraiah (2003) is a third example that supports the weak-form efficiency of the Bahrain stock market using autocorrelations and runs tests applied to the daily prices of 12 stocks traded during the year 2000.

However, the results of the current study challenge the results of many studies not supporting the weak-form efficiency of thinly traded markets such as: Norway and Sweden: Jennergren and Korsvold (1975), Singapore: Laurence (1986), Saudi Arabia: Bulter and Malaikah (1992), Madrid: Ratner (1996), China: Mookerjee and Yu (1999), and Amman: Al-Qudah (1997) among others**.** Consequently, this indicates a need to further study the UAE stock market with longer stock price time series and other tests to test the efficiency of the market.

FOOTNOTES

1. Harry Roberts is the first who defined the three levels of market efficiency in 1967 in an unpublished paper titled "Statistical Versus Clinical Prediction of the Stock Market" Brealy and Myers (1991, 4th ed, p.295).
2. The UAE local share directory 2003, issued by The Domestic Capital Markets Group, National Bank of Abu Dhabi. Worth mentioning there are more than 45 stocks traded inactively thought the OTC.
3. More details about the reasons and results of this crisis found in: Al Shamsi (2001, p.123-134).
4. ESCA is a department of the ministry of the economy and commerce and located in Abu Dhabi. Its website is under construction.
5. DFM is located in Dubai and its website is www.dfm.co.ae. Today, the government of Dubai has been establishing Dubai International Financial Center (DIFC), its website is www.difc.ae.
6. ADSM is located in Abu Dhabi and its website is www.adsm.co.ae.
7. This index had started to be published in the daily newspapers on October 2001. As of September 29th it has reached 1,614.19 points and consists of 43 stocks, out of these 13 stocks are listed on the DFM, 29 stocks listed on the ADSM and only one (Union Insurance Company) is currently still not yet listed on either market.
8. The current study is a replication of the one by Moustafa (2001), which was submitted to the first special issue of International Journal of Business about Emerging Financial Markets of the Middle East. The differences are the number of

stocks in the sample and the time period covered by the empirical study. Furthermore, the initial study examined the "trade-to-trade" prices instead of daily prices that are used by the current study.

9. It is not obvious whether the prices are the closing or the average prices on the trading days. However, this point has no effect on the analysis.
10. This data was acquired with the help of Miss Dana Nidal, a recent graduating student from the College of Business and Economics, UAE University. She conducts the data entry of stock prices.
11. There is another mathematical expression of the runs test, which ignores the "0", or "no change" runs, (Lee, Lee, and Lee, 2000, p. 774-776)**.** This expression is not suitable for UAE stock prices because the runs of "no change" are substantial.
12. The test is a two-tailed one because the alternative hypothesis says nothing about the direction of deviation from randomness.
13. Many studies have used logarithmic returns based on the formula: $r_{i,t} = \text{Log } p_{i,t} - \text{Log } p_{i,t-1}$ The logarithmic transformation is justified based on two grounds: (1) absolute price changes suffer the disadvantage that they are to some extent dependent on the actual price level of the stock and (2) the change in the price of a stock is the yield with continuous compounding from holding that stock over the period of time the change is measured [Cooper (1982, p. 517)]. This study uses both the percentage of price change and logarithmic transformation and does not find any significant difference.
14. Lilliefors Test is similar to Kolmogorov–Smirnov Test, but the latter assumes that the mean and standard deviation of the population are known whereas the former calculates the mean and standard deviation of the sample assuming that they are good estimators for the population parameters.
15. There is a nonparametric distribution-free test for serial correlation developed by Corrado and Schatzberg in 1990 and used by some studies such as Mookerjee and Yu (1999).

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