The Effect of Infrequent Trading on Market Efficiency: The Case of the Middle East Stock Markets

Bashar Abuzarour*
Research Assistant

Department of Business Administration
University Campus, Rio
Patras, Greece

Abstract

Emerging markets are typically characterized by low liquidity, thin trading, and possibly less well informed investors with access to unreliable information and considerable volatility. Therefore, in the context of MENA region, one would expect the inefficiency and illiquidity of the local capital markets to raise a firm's marginal cost of capital, when it forced to raise capital locally. Little is known about stock price behavior in these economies. It is well known that infrequent trading can affect the results of empirical studies on efficiency by introducing serious bias into the results of empirical work. In addition, inferences drawn from tests of market efficiency are rendered imprecise in the presence of infrequent trading. As the observed indices in thinly traded markets may not represent the true underlying index value, there is a systematic bias toward rejecting the efficient market hypothesis. This paper investigates the effect of infrequent trading on market efficiency and the validity of the random walk hypothesis (RWH) for three emerging Arabian equity markets Jordan, Egypt, and Palestine. Miller, Muthuswamy, and Whaley (1994) approach will be used to estimate the true underlying index.

* E-mail: bashar38@yahoo.com phone #: 0030 693 4406294

1- Introduction

Efficient market theory and the random walk model have been at the center stage of debate in financial literature for several decades; the implications of market efficiency for investors, investment strategies, financial markets, and the economy are profound indeed and deserve the interest they have generated. The increasing globalization of financial markets has increased interest in emerging markets. Researchers have focused on whether these markets are informationally efficient or whether anomalies exist. In the context of MENA region, questions of market efficiency are of concern both to MENA equity investors, and companies in the region that make capital budgeting decisions. Specifically, if stock market found to be not efficient and segmented and a firm is forced to raise capital locally, then its cost of capital is likely to be higher than that of a company with unrestricted access to the regional and international capital markets. Therefore, one would expect the restriction to the local capital markets to raise a firm's marginal cost of capital. Hence, increased financial integration within the MENA region is expected to bring considerable benefits to MENA investors. A more liquid and well regulated capital market, offers lower borrowing costs for MENA firms wishing to raise funds locally. Moreover, international financial institutions will be willing to diversify their portfolios by tapping the MENA financial markets which will benefit from portfolio capital inflows, if the convergence asset returns in the world markets leads international investors to increase their MENA markets holdings, in order to diversify across countries with a wide range of risk and returns.

However, evidence from other emerging markets is not the same. Urrutia (1995) using the variance ratio test rejects the RWH for Latin American emerging markets of Argentina, Brazil, Chile, and Mexico whereas the runs test indicates weak form efficiency. Antonios, Ergul, and Holmes (1997) study the Istanbul stock exchange and find it to be inefficient in the early times and efficiency improved as the country started liberalization and deregulation. Ojah and Karemera (1999) find that the Latin American equity returns follow a random walk and are generally weak form efficient. Very few studies target countries from the Middle East particularly Arabian stock markets. Bulter and Malaikah (1992) study the Kuwaiti and Saudi stock markets. They find the Saudi stock market to be inefficient, while the Kuwaiti stock market is found to be efficient. El-

Erian and Kumar (1995) examine the RWH in emerging markets by choosing two countries from the Middle East region (Jordan and Turkey) and three other emerging markets from a different region. They find that there is serial dependence among the day-to-day price changes in the stock market of Jordan and Turkey, indicating that the random model does not hold for these markets. Abraham et al (2002) test the RWH for three Gulf equity markets; namely Saudi Arabia, Kuwait, and Bahrain after adjusting for infrequent trading. They find that both RWH and weak form efficiency are rejected for the Gulf markets when the observed index levels are used. In contrast, inferences are reversed with the use of the corrected true indices. Omran and Farrar (2001) test the validity of the random walk hypothesis (RWH) in five Middle Eastern emerging markets, Jordan, Morocco, Egypt, Israel, and Turkey. Their results reject the RWH for all markets; instead they suggest that the stock returns in these markets exhibit calendar effects.

This paper examines the effect of non-trading on market efficiency for three emerging Arabian equity markets in the Middle East, Jordan, Egypt, and Palestine, using the variance ratio test and the nonparametric runs test during the period from 1992 to 2004. A major difficulty in interpreting the results from tests on thinly traded markets is the confounding effect of infrequent trading on the observed index. Thus rejection of the RWH or the efficient market hypothesis could simply be a result of having used the observed index. Infrequent trading is widespread in most emerging markets and it is particularly so in the case of the markets under examination here.

- *Infrequent trading*

It is well known that infrequent trading can affect the results of empirical studies on efficiency by introducing serious bias into the results of empirical work. Furthermore, conventional tests on efficiency have been developed for testing markets which are characterized by high levels of liquidity, sophisticated investors with access to high quality and reliable information and few institutional impediments. On the other hand, emerging markets are typically characterized by low liquidity, thin trading, and possibly less well informed investors with access to unreliable information and considerable volatility. A number of studies have investigated the impact of thin trading and discussed its consequences. These studies include Fisher (1966), Dimson (1979), Cohen (1978,

1979), Lo and MacKinlay (1990), Stoll and Whaley (1990), and Mathuswamy and Whaley (1994).

Infrequent trading has two forms: The first occurs when stocks are traded every consecutive interval, but not necessary at the close of each interval. This form of infrequency, often dubbed "nonsynchronous trading" has been studied by Scholes and Williams (1977a, 1977b) and Muthuswamy (1990). Infrequent trading is also said to occur when stocks are not traded every consecutive interval. Fisher (1966), Dimson (1979), Cohen *et al.* (1978, 1979), Lo and MacKinlay (1990), and Stoll and Whaley (1990b) focus on this "non-trading" and its consequences. The key to distinguishing nonsynchronous trading from non-trading is the interval over which price changes or returns are computed. When returns are measured on a monthly basis, virtually all stocks will have been traded at least once, but not all stocks will have been transacted exactly at the close of trading on the last trading day of the month. That is nonsynchronous trading. When returns are measured over trading intervals as short as for example fifteen minutes, however, all stocks in the market are unlikely to have been traded at least once in every consecutive fifteen minutes interval. That is non-trading. As the trading interval shrinks, nonsynchronous trading becomes non-trading. The problem is created by the fact that the value of an asset over a certain time cannot be directly observed, if the asset does not trade in that period. Since most indices are computed on the basis of the most recent transaction prices of the constituent stocks, the reported index becomes stale in the presence of infrequent trading; the result is that the observed index does not reflect the true value of the underlying stock portfolio. One of the consequences of infrequent trading is the spurious serial correlation it induces in the observed index returns. Therefore, observed dependence is not necessarily evidence of predictability, but rather may be a statistical illusion brought about by thin trading. A number of different approaches have been suggested to correct for infrequent trading. Stoll and Whaley (1990) use the residual from an ARMA (p,q) regression as a proxy of the true index, whereas; Bassett, France, and Pliska (1991) propose the use of a Kalman filter to estimate the distribution of the true index. Jokivuolle (1995) suggests a modified version of the Stoll and Whaley approach to estimate the true unobserved index from the history of the observed index. The correction consists of decomposing the log of the observed index in

its random and stationary components, using the Beveredge and Nelson (1981) methodology. In this the random component can be shown to equal the log of the true index. In this paper we will use the methodology which was proposed by Miller, Muthuswamy, and Whaley (1994) to correct for infrequent trading. Separating the effects of infrequent trading allows us to draw a definitive conclusion regarding market efficiency and random walk. The remainder of this paper proceeds as follows: section 2 provides an overview of the three Arabian stock markets under study. Analytical details of the correcting method to estimate the true index and test methodologies for assessing the RWH and weak form efficiency are described in section 3. Section 4 identifies the data sources, presents the empirical results, and contrasts the findings between the observed and the corrected indices. Conclusions follow.

2- Characteristics of the markets

The Arabian equity markets included in this study are Jordan, Egypt, and Palestine. Concerning Palestine Stock Exchange, maybe this paper is the first empirical work which studies the properties of this new emerging Arabian equity market.

2.1 *Egypt*

The stock market activity in Egypt goes back as far as 1881. Alexandria stock exchange was the fifth one established in the world after those of Inverness (1536), Amsterdam (1609), London (1666), and Paris (1808). Cairo stock exchange was established later in (1903). However, a significant change affected the stock market in Egypt in the late 1950s, as this period witnessed the start of massive and successive waves of nationalization that radically changed the structure of the economy and this in turn had a devastating effect on the stock market. The stock exchange collapsed and the primary market became rudimentary. Until the 1970s the market remained fairly inactive. But then reforms were implemented to reactivate the private sector and aimed at attracting foreign investment and mobilizing domestic investment as well. But the bias in the tax code against investment in securities, the structural deficiencies and practices, the absence of a governing securities law, the inadequacy of accounting, auditing and financial disclosure, and the lack of protection for small investors kept the role of the stock exchange minimal during the period. Since the early years of the last decade, Egypt

has witnessed major and radical changes in its economic climate. The Egyptian government adopted a program of economic reform in 1991 aimed at increasing the growth rate of the economy. This objective is not likely to be achieved without increasing the level of investment. In turn, this investment can be obtained through creating a strong stock market that is capable of attracting local and foreign investment. As a result, the stock market in Egypt witnessed major changes during the last decade. Table (1) provides some indicators of the stock market in Egypt.

Table 1

Market indicators for Egyptian stock market

	1998	1999	2000	2001	2002	2003
market value(*millions $*)	24,381.37	33,038.65	30,791.26	24,308.57	26,338.69	27,847.48
listed companies	861	1,033	1,071	1,110	1,150	967
shares traded(*millions shares)*	410.69	846.09	952.66	1,184.01	832.86	1,368.13
value traded(*millions $*)	5,367.55	9,725.66	11,798.64	5,912.89	6,443.71	4,349.12
turnover (%)	0.22	0.29	0.38	0.24	0.24	0.16
market value(%GDP)	0.35	0.45	0.40	0.30	0.32	-
value traded(%GDP)	0.08	0.13	0.15	0.07	0.08	-

Source: Arab Monetary Fund (AMF) bulletin, several issues

2.2 *Jordan*

Amman stock market was founded on January 1st 1978. Since its formation, the market has experienced some growth in a number of aspects such as market liquidity and market size. Given the importance of Amman stock market in the national economy, major changes have been introduced in the Jordanian capital market. At the forefront of these changes is the June 2000 implementation of the Electronic Trading System (ETS). This event can be considered as a qualitative leap because it means more transparency and safety for traders and investors. The system ensures a fair and orderly entrance of all buying and selling in the electronic system and an accurate matching of supply and demand in the determination of securities prices. Since the establishment of the Jordanian capital market, investors have been enjoying a zero tax rate on capital gains and

dividends. However, in 1996 the Government imposed a 10 percent tax rate on dividends. Table (2) provides some indicators for Amman stock market.

Table 2

Market indicators for Amman stock market

	1998	1999	2000	2001	2002	2003
market value (*millions $*)	5,862.66	5,834.74	4,943.16	6,314.16	7,087.03	10,962.89
listed companies	150	152	163	161	158	161
shares traded (*millions shares*)	248.56	263.61	178.32	335.11	455.72	1,000.23
value traded (*millions $*)	654.62	549.34	405.91	934.38	1,334.67	2,607.14
turnover (%)	0.11	0.09	0.08	0.15	0.19	0.24
market value(%GDP)	0.80	0.77	0.63	0.77	0.83	-
value traded(%GDP)	0.09	0.07	0.05	0.11	0.16	-

Source: Arab Monetary Fund (AMF) bulletin, several issues

2.3 *Palestine*

Palestine stock exchange (PSE) was incorporated as a private shareholding company in early 1995, with Palestine Development and Investment Company (PADICO) and (SAMED) as its major investors. After the Palestinian National Authority (PNA) approved a PADICO-sponsored design and work plan in July1995, a project team was put together by Palestine Stock Exchange and entrusted to establish a fully electronic exchange and depository. EFA Software Services, a Canadian company provided both the trading, settlement and clearing systems. By August 1996 the Exchange was fully operational and on November 7th of that year, Palestine Stock Exchange signed an operational agreement with the Palestinian National Authority, allowing for the licensing and qualification of brokerage firms to take place. On February 18th 1997, Palestine Stock Exchange conducted its first trading session. Twenty-eight shareholding companies have been approved for listing. The current list of companies spans a wide range of sectors including pharmaceuticals, utilities, telecommunications, and financial services. As a self-regulating organization, the Exchange is charged with enforcing its rules and regulations, covering such matters as listing requirements, secondary trading, settlement and clearing as well as the conduct and operations of member securities firm. In order to attract foreign investment in Palestine, Palestine Stock Exchange does not impose any

restrictions on foreign investment. Table (3) presents some indicators for Palestine Stock Exchange.

Table3.

Market indicators for Palestine Stock Exchange

	1998	1999	2000	2001	2002	2003
market value(*millions $*)	7,301.00	8,632.40	11,098.70	7,921.50	7,502.50	7,693.70
listed companies	18	20	22	23	23	26
shares traded(*millions shares*)	16.78	68.89	93.35	33.46	18.67	40.35
value traded(*millions $*)	68.64	150.24	188.98	74.53	45.09	58.33
turnover (%)	0.94	1.74	1.70	0.94	0.60	0.76
market value(%GDP)	1.81	1.83	2.42	1.99	2.33	-
value traded(% GDP)	0.02	0.03	0.04	0.02	0.01	-

Source: Palestine Stock Exchange main website

As a result of political problems in Palestine since September 2000 until now, the Palestinian economy suffered a sharp recession. For instance, the unemployment ratio reached 81% in 2002, GDP dropped from 4712.6 million US$ in 1999 to 3213.8 in 2002, all these developments reflected negatively on the investment environment in Palestine, hence affected the performance of the Palestinian stock market sharply.

As for regulatory framework, a number of Arab countries have proceeded to separate between the supervisory and executive roles, the first being discharged by a public affiliated body, while the second being mostly carried out by the private sector. In this area, most Arab countries enacted capital market laws aimed at restructuring the markets and leading to the separation between the supervisory function in charge of regulating the issuance and trading of financial paper on the one hand. And the management of the stock exchange through which such papers are traded and the agency in charge of registering the transfer, sale, and purchase of those papers and keeping a registry of records and ownership titles, on the other hand. This is the case for the Jordan and Egypt stock markets, while for Palestine the two roles continue to be simultaneously in the hands of the capital market itself.

In terms of accessibility to foreign investments, investments by-law in most Arab countries have witnessed a number of changes mostly aimed at attracting foreign investments, meeting the domestic financing requirements and smoothing the transfer of

advanced technologies in their markets. In this context, the markets under study here do not impose any restrictions on foreign investments in financial papers. Trading takes place in these markets through fully computerized dealing systems, as most Arab capital markets took vast steps to modernize their dealing systems and to introduce modern technologies in share trading operations with a view to improve performance, enhance speed and accuracy in the conduct of business and increase transparency and operators' confidence. Palestine for example inaugurated distant-dealing services, which constitutes one of the innovative services witnessed by those markets and offered a mechanism enabling accredited brokers to conduct contracts without the need to be present on the physical floor.

3- Methodology

Empirical studies utilize several techniques to test for market efficiency. In this paper we follow previous empirical work and employ the most common statistical and econometric methods used in the recent literature after adjusting the observed index for infrequent trading. To test for the independence of successive price changes we employ runs test, non-parametric tests for detecting the frequency of the changes in the direction of a time series. Another test used to test for the random walk hypothesis (RWH) is the variance ratio test developed by Lo and Mackinlay (1988), which measures the randomness of a return series.

3.1 *Variance ratio test of random walk*

A consequence of informational efficiency is that asset returns should manifest properties of a random walk process is that the variance of the increments to the random walk process linearly increases with the sampling interval. Lo and Mackinlay (1988) proposed a simple specification test for evaluating the random walk properties of asset prices. Specifically, if X_t is a pure random walk, the ratio of the variance of the qth difference scaled by q to the variance of the first difference must be unity. A variance ratio that is grater than one suggests that returns series is positively serially correlated or that the shorter interval returns trend within the duration of the longer interval. A variance ratio that is less than one suggests that the returns series is negatively serially correlated or that

the shorter interval returns tend toward mean reversion within the duration of the longer interval. The variance ratio VR (q) is defined as:

$$VR\,(q) = \frac{\sigma^2(q)}{\sigma^2(1)} \tag{1}$$

Where σ^2 (q) is 1/q the variance of the q- differences and σ^2 (1) is the variance of the first differences.

$$\sigma^2(q) = \frac{1}{m}\sum_{i=q}^{nq}(x_i - x_{i-q} - q\hat{\mu})^2 \tag{2}$$

Where:

$$m = q(nq - q + 1)\left(1 - \frac{q}{nq}\right)$$

And

$$\sigma^2(1) = \frac{1}{(nq-1)}\sum_{i=1}^{nq}(x_i - x_{i-1} - \hat{\mu})^2 \tag{3}$$

Where:

$$\hat{\mu} = \frac{1}{nq}(x_{nq} - x_0)$$

They developed test statistics both for homoscedastic and heteroscedastic increments. Because it is the heteroscedasticity in the data that is of interest, we use the more robust heteroscedastic test statistic that uses overlapping intervals. The test statistic is:

$$\overset{*}{Z}(q) = \frac{VR(q) - 1}{\left[\Phi^{*}(q)\right]^{\frac{1}{2}}} \approx N(0,1) \tag{4}$$

Where:

$$\overset{*}{\Phi}(q) = \sum_{j=1}^{q-1}\left[\frac{2(q-j)}{q}\right]^{2}\hat{\delta}(j)$$

And

$$\hat{\delta}(j) = \frac{\sum_{i=j+1}^{nq}\left(x_i - x_{i-1} - \hat{\mu}\right)^2\left(x_{i-j} - x_{i-j-1} - \hat{\mu}\right)^2}{\sum_{i=1}^{nq}\left[\left(x_i - x_{i-1} - \hat{\mu}\right)^2\right]^2}$$

3.2 *Non-parametric runs test*

The runs test determines whether successive price changes are independent. Unlike its parametric equivalent the serial correlation test, the runs test does not require returns to be normally distributed. A run is a sequence of successive price changes with the same sign. If the returns series exhibit grater tendency of change in one direction, the average run will be longer and the number of runs fewer than that generated by random process. To assign equal weight to each change and to consider only the direction of consecutive changes, each change in returns was classified as positive (+), negative (-), or no change (0). The runs test can also be designed to count the direction of change from any base; for instance, a positive change could be one in which the return is grater than the sample mean, a negative change one in which the return is less than the mean, and zero change representing a change equal to the sample mean. The actual runs (*R*) are then counted and

compared to the expected number of runs (m) under the assumption of independence as given in equation (5) below;

$$m = \frac{\left[N(N+1) - \sum_{i=1}^{3} n_i^2 \right]}{N} \tag{5}$$

Where N is the total number of return observations and n_i is a count of price change in each category. For a large number of observations (N>30), m approximately corresponds to a normal distribution with a standard error (σ_m) of runs as specified in equation (6).

$$\sigma_m = \left[\sum_{i=1}^{3} n_i^2 \left\{ \sum_{i=1}^{3} n_i^2 + N(N+1) \right\} - 2N \sum_{i=1}^{3} n_i^3 - N^3 \right]^{\frac{1}{2}} \tag{6}$$

The standard normal Z-statistic ($Z = (R-m)/\sigma_m$) can be used to test whether the actual number of runs is consistent with the independence hypothesis. When actual number of runs exceed (fall below) the expected runs, a positive (negative) Z value is obtained. Positive (negative) Z value indicates negative (positive) serial correlation in the return series.

3.3 *Estimating the true index-correcting for infrequent trading*

To separate the effect of infrequent trading, we apply a correction to the observed index by using a methodology proposed by Miller, Muthuswamy, and Whaley (1994). To correct for infrequent trading, this methodology basically suggests that to remove the impact of thin trading a moving average model (MA) that reflects the number of non-trading days should be estimated and then returns be adjusted accordingly. However, given the difficulties in identifying the non-trading days, Miller et al. have shown that it

is equivalent to estimate an AR (1) model from which the non-trading adjustment can be obtained. Specifically, this model involves estimating the following equation:

$$R_t = a_1 + a_2 R_{t-1} + \varepsilon_t \tag{7}$$

Using the residual from the regression, adjusted returns are estimated as follows:

$$R_t^{adj} = \frac{\varepsilon_t}{(1 - a_2)} \tag{8}$$

Where R_t^{adi} is the return at time *t* adjusted for thin trading.

Miller, Muthuswamy, and Whaley find thin trading adjustment reduces the negative correlation among returns. The model above assumes that non-trading adjustment is constant over time. While this assumption may be correct for highly liquid markets, it is not the case for emerging markets. Therefore, equation (7) will be estimated recursively.

4- Data and results

4.1 *Data*

The data consist of daily index values for the three Arabian stock markets of Jordan, Egypt, and Palestine, From January 1st 1992 to September 27th 2004 for Jordan, January 1st 1998 - September 23rd 2004 for Egypt, and July 8th 1997 - October 19th 2004 for Palestine. The data were provided by Amman Stock Market for Jordan, Palestine Stock Exchange for Palestine, and from the main web page for Cairo and Alexandria stock market for Egypt. Summery statistics for each of the markets considered are provided in table (4). For the time period under study the three markets experienced positive returns, all markets exhibits significant deviations from normality as seen from the reported Jarque-Bera test statistic.

Table 4

Summary statistics of the three Arab stock markets daily index returns (%) Jordan, Palestine, and Egypt

Daily index returns are computed as $R_t = 100*\ln(P_t/P_{t-1})$

	Jordan	Palestine	Egypt
Mean	0.0355	0.0820	0.0425
Median	-0.0090	0.0000	-0.0289
Maximum	4.7465	27.2330	18.3692
Minimum	-4.3097	-25.3643	-10.9751
Std. Dev.	0.7341	1.8370	1.6658
Skewness	0.3075	0.5314	0.7695
Kurtosis	7.7149	73.4889	15.2906
Jarque-Bera	2940.0390	244349.3000	10650.5000
Probability	0.0000	0.0000	0.0000
Observations	3121	1180	1666

4.2 *Results*

The results are presented in two parts. In the first part, the variance ratio test for the RWH for each market is carried out and comparisons are made between observed and corrected true index. A non-parametric runs test is explained and efficient markets hypothesis assessed in context of infrequent trading in part two.

4.2.1 *Variance ratio test*

The variance ratio test described in section 3 used to test the RWH for each of the three markets. The variance is computed for multiples of 2, 4, and 8 days as holding periods with one-day return used as a base. Results for the observed and the corrected indices are shown in panel A and B of table (5) respectively.

Table 5

$$Z(q) = \frac{VR(q) - 1}{\sqrt{\frac{2(2q-1)(q-1)}{3q(nq)}}} \approx N(0,1)$$

Variance ratio estimated for the three Arab stock markets, Egypt, Jordan, and Palestine.

The variance ratios are defined as the ratio of $(1/q)\sigma_q^2$ to σ_1^2 for values of q= 2, 4, and 8, where σ_i^2 is the variance of the index return defined as $\ln(p_t/p_{t-i})$.Panel B shows the results for the index, corrected for infrequent trading.

	Number of days		
Market	2	4	8
Panel A: Log relatives of the observed index levels			
Egypt	5.8647**	3.0547**	0.7301
	(9.7293)	(3.1065)	(-0.365)
Jordan	3.1048**	1.1292	1.4556
	(4.2095)	(0.1953)	(0.6161)
Palestine	0.5215	1.2764	2.9378**
	(-0957)	(0.4178)	(2.6206)
Panel A: Log relatives of the corrected index levels			
Egypt	0.7530	1.8926	0.3960
	(-0.4940)	(1.3495)	(-0.8167)
Jordan	0.9147	1.9924	1.8521
	(-0.1706)	(1.5004)	(1.1523)
Palestine	3.1828**	4.0028**	2.4742**
	(4.3656)	(4.5397)	(1.9935)

** Indicates rejection of the RWH at the 0.05 level

Figures in parentheses are asymptotic Z statistics (i.e. VR (q) = 1)

$$Z(q) = \frac{VR(q) - 1}{\sqrt{\frac{2(2q-1)(q-1)}{3q(nq)}}} \approx N(0,1)$$

The standard Z-statistic is

When the observed indices are used, one finds that Egypt shows signs of predictability for two-days and four-days holding periods, Jordan for two-days holding period only while Palestine shows predictability for eight-days holding period at 5% level. In other

words, there is evidence to reject the RWH and the independence of returns for all markets under study here during the sample period when the observed indices are used.

However, when the corrected indices are used as shown in panel B of table 5 both Egypt and Jordan do not show any predictability for all holding periods. Therefore, we can not reject the RWH for these two markets. These results are in consistence with the evidence from other emerging markets in MENA region (Abraham *et al*. 2002, Omran *et al*. 2001). While for Palestine, the results show signs of predictability for all holding periods.

4.2.3 *Runs test for weak form efficiency*

In this section we report results of weak form efficiency using the non-parametric runs test. This test found to be preferable to its equivalent parametric test (serial correlation) under the circumstances here, that returns data do not conform the normal distribution (the Jarque-Bera test statistic is reported in table 4), and we examine in this section the independence of price changes using the runs test. Results of the runs test are reported in table (6), both for observed indices and indices after corrected for infrequent trading. In panel A for observed indices, the actual number of runs (R) in each of the three markets can be seen to fall short of the expected number of runs under the null hypothesis of stock return independence. The resulting negative Z-values for the three Arabian stock markets indicate positive serial correlation. Results show that the successive returns for each of the three markets are not independent at the 5% level (critical value -1.96), which consistent with the finding of Abraham et al. (2002).

When indices are corrected for infrequent trading, the results still the same for both Jordan and Palestine with noticeable reduction in predictability for Jordan. While for Egypt we can not reject the weak form efficiency when we use the corrected index.

Table 6

Results of runs test for the three Arab stock markets, observed vs. corrected index levels, Jordan, Palestine, and Egypt.

The runs test tests for a statistically significant difference between the expected numbers of runs vs. the actual number of runs. A run is defined as a successive price changes with the same sign. *n*(+)/ *n*(-)/ *n*(0) represent the number of successive sequence of positive/negative/zero price changes.

Panel B shows the results for the index, corrected for infrequent trading.

	Jordan	Palestine	Egypt
Panel A: Observed Index Returns			
Observations(*N*)	3121	1180	1666
n (+)	1449	523	774
n (-)	1672	667	892
n (0)	0	0	0
Expected runs (*m*)	1554	583	830
Actual runs (*R*)	1200	468	663
Standard error (*σm*)	27.7858	16.9467	20.2998
Z - statistic	-12.7235**	-6.8091**	-8.2179**
Panel B: Corrected Index Returns			
Observations(*N*)	3118	1177	1663
n (+)	1460	537	799
n (-)	1658	640	864
n (0)	0	0	0
Expected runs (*m*)	1554	585	831
Actual runs (*R*)	1473	445	811
Standard error (*σm*)	27.8024	17.015	20.3527
Z - statistic	-2.9031**	-8.2276**	-0.9940

** Indicates rejection of the null that successive price changes are independent at the 0.05 level

5- Conclusions

It has been known for some time that infrequent trading makes inferences drawn from efficiency tests imprecise, particularly so for thinly traded emerging markets. However, researchers have continued to use the observed index levels in their analysis, and not surprisingly the extant literature on emerging markets has predominantly rejected the efficient market hypothesis. The results of this study, consistent with the results in the literature for similar emerging markets, show that for Jordan, Egypt, and Palestine both random walk hypothesis and weak form efficiency can be rejected on the basis of the tests used in this study: the variance ratio test and the non-parametric runs test when the observed index levels are used. However, when we take account for infrequent trading using Miller, Muthuswamy, and Whaley (1994) methodology to produce the unobserved corrected indices. In contrast, when the corrected indices are used, according to the variance ratio test the RWH can not be rejected for both Egypt and Jordan stock markets. The RWH is rejected for Palestine stock market even after correcting for infrequent trading. However, the runs test indicates that there is no predictability in returns for Egypt when we use the corrected indices. It should be noted, however, that the departure from the null hypothesis of no predictability for the runs test is less pronounced even for Jordan, once the index is corrected for infrequent trading.

This paper indicates that infrequent trading has a significant effect on the efficiency and liquidity of stock markets in the MENA region. The implication of these results for decision makers is that; the removal of restrictions and barriers to the flow of capital in MENA region's financial markets is expected to improve and enhance growth and liquidity in these markets. Since a more liquid capital market offers lower borrowing costs for firms wishing to raise funds locally. Increased inter-MENA liberalization will not only increase a locative efficiency within MENA, as the experience of developed economies shows, but will also provide MENA investors with grater opportunities to diversify their portfolios and reduce risk. Increased liberalization within the MENA region is expected to attract important portfolios and direct investments to the region. It will also reduce borrowing costs for local firms and will simulate economic growth in the region.

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