Proceedings of 6th International Business and Social Sciences Research Conference
3 – 4 January, 2013, Dubai, UAE, ISBN: 978-1-922069-18-4

Testing the weak form market efficiency: Empirical Evidence from Palestine Exchange (PEX)

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Abstract

The study aims to empirically examine the weak-form efficiency of Palestine Exchange(PEX). The random walk theory is thoroughly investigated to analyze past stock returns and to find if investors are equal in terms of the return they achieve with respect to the level of information they hold. Observations of indices' returns are the key input for the empirical data analysis. The study employs the serial correlation and the Augmented Dickey-Fuller test (ADF) as parametric tests. The runs test is also used as a non-parametric test. The results of the parametric tests are consistent with the alternative hypothesis that the stock market is weak-form inefficient. Results of the runs test also supports the inefficiency of the market as the main index found to be moving non-randomly.

Keywords: efficient market hypothesis, weak-form market efficiency, random walk model, serial correlation, runs test, Augmented Ducky Fuller (ADF) test, and PEX

1. Introduction

The efficient markets hypothesis (EMH), popularly known as the Random Walk Theory, is the proposition states that current stock prices fully reflect available information about the value of the firm, and there is no way to earn excess profits by using this information. It deals with one of the most fundamental and exciting issues in finance – why prices change in securities markets and how these changes take place. It has very important implications for investors as well as for financial managers. The concept of "efficient market" was first investigates in 1965 in a paper by E.F. Fama who said that in an efficient market, *on the average, competition will cause the full effects of new information on intrinsic values to be reflected "instantaneously" in actual prices.* (Fama. E.F, 1991).

Investors require compensation for the postponement of current consumption as they put their money into a stock market. A market in which prices always fully reflect available information is called "efficient" (Fama, 1970). In an efficient market an investor gets what he pays for and there are no profit opportunities available to professional money managers or experienced investors. The market genuinely "knows best," and the prices of securities traded are equal to the values of the dividends which these securities pay, also known as fundamental values.

In the stock market, the intrinsic value of a share is equivalently measured by the discounted value of future cash flow that investors will earn. If the stock market is efficient, equity prices must reflect all available information which is relevant for the evaluation of a company's future performance, and therefore the market price of share must be equal to its inherent value (Sayyed, 2010). In weak form efficient market, prices of the shares instantly and fully reflect all information of the past prices. This means future price movements cannot be predicted by using past prices. It is simply to say that, past data on stock prices are of no use in predicting future stock price changes. Everything is random. In this kind of market, should simply use a "buy-and-hold" strategy, and there is no way to make excess profit. The random walk theory is the best-tested and best-verified theory to assess the efficiency of a stock market at the weak-form. Random walk asserts that there is no pattern to stock price changes. In particular, past stock price changes don't enable one to predict future price changes.

In Palestine, the Palestine Exchange (PEX) was founded in 1995. Empirical studies relied on trading data of the PEX market are very rare. As a result, this study serves to bridge a gap in literature and provides a reliable background for further future investigations regarding the Palestinian Economy in general and its financial sector in particular.

The paper is organized in that related literature about weak form market efficiency is presented in section 2. Relevant studies regarding emerging and Arab stock markets are summarized also in section 2. Section 3 is about the methodology and research design, statistical tests and results are provided in this section. They study ended with concluded remarks in section 4.

2. Related Literature

Stock market efficiency implies that stock prices respond instantly and accurately to relevant information. As information arrives randomly, stock prices must also behave or fluctuate unpredictably.

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 Middle East 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. (Bashar, 2006).

One study undertaken by Kashif, Syed, Muhammad, and Rana (2010) examined the stock market efficiency of 14 Asian stock markets including China and Japan. The authors used the autocorrelation, Runs test, Unit root test and the Variance ratio test to analyze the random walk model. Serial correlation was detected in their analysis and results of runs test support the non-randomness of the series. Further, the unit root test revealed that return series are non-stationar, their study concluded that monthly prices don't follow a random walk and therefore the stock market in each country is inefficient at the weak-level and investors can benefit from arbitrage opportunities.

Most of the studies on EMH are conducted on the world's largest stock markets. In recent years, efficiency in emerging markets has been investigated widely. Very few studies, target countries from the Middle East region, most of them concentrated on return predictability and markets integration and linkages. In addition, most of these studies are usually focused on their individual or a small set of countries for a short horizon.

One research regarding the Arab stock market efficiency was conducted as a PhD thesis by *Bashar Abu Zaror* in 2006. In his paper titled " the efficiency of Arab stock markets", the author concluded that random walk properties were rejected for nine Arab stock markets including PEX. Results obtained from regression analysis, variance ratio, runs tests, and serial correlation tests rejected the randomness and independence of returns. Moreover, the author indicated that prices responded non-linearly to the arrival of new information.

On 2008, Hazim and Min investigated the weak form market efficiency of United Arab Emirates. The authors applied the Augmented Dickey Fuller test and the Phillips-Perron unit root test. They found that the Emirates equity market meets the criterion of weak form efficiency as the market data contains a unit root. Walid Abdmoulah (2010) focused on the efficiency of 11 Arabic equity market. In the analysis, the author tried to answer the question whether the Arab equity markets become more efficient during the last decade thanks to organizational improvements. Using the GARCH-M model, the author concluded that all markets show high sensitivity and are weak-form inefficient.

Abdullah Al-Ashikh (2012) studied the weak form market efficiency of the Saudi stock exchange as one of the largest stock market in the middle east. The author employed the autocorrelation along with the runs test and found that returns exhibit linear serial dependence. Thus, Saudi stock market found to be inefficient at the weak level. Mahmoud and Hussein Ali (2011) analyzed the random walk theory in Amman stock exchange using the serial correlation and the runs test. Their results implied that past returns behavior are inconsistent with the random walk and the Amman stock market is inefficient.

As aforesaid, the analyses of the previous literatures revealed that the developing markets are generally weak-form efficient, whilst the consequences of empirical studies in emerging market have given mix results about the efficiency. Moreover, the review of prior empirical evidences addressed some research question: Is the PEX stock market as an emerging market weak-form efficient or not? For this reason this study comes to answer this important question relying on strong methodology, taking variety of statistical techniques into consideration.

2.1 Palestine Exchange (PEX) at a glance

The Palestine Exchange (PEX), in Nablus, was incorporated as a private shareholding company in early 1995. By August 1996 the Exchange was fully operational, and on November 7th of that year the PEX signed an operating agreement with the Palestine National Authority, allowing for the licensing and qualification of brokerage firms to take place. On February 18, 1997, the PEX conducted its first trading session. In 2010, PEX was converted into a public shareholding company. This transformation was accompanied by the launch of its new corporate Identity, bearing the trade name "Palestine exchange" and the slogan "Palestine for opportunities".

Since its inception, PEX has sought to utilize the latest financial market technology as well as to keep up with the latest laws and regulations to ensure a market with utmost transparency, integrity and investor protection. On December 31,2011 46 companies, with a total market value of US$ 2.78 billion, were listed on the Palestine exchange. These encompassed five economic sectors: banking and financial services, Insurance, Investment, Industry and Services. Half of the listed companies trade in Jordanian dinars, while the other half trade in US dollars. At present only ordinary shares are traded but there remains the possibility and readiness for trading other securities in the future.

Alquds Index is the main index in PEX that include 15 companies out of 46 compnaies. Those 15 companies alone represent 83 percent of total market capitalization. Also, PEX has five sub-sectors indices which are: banking and financial services, Insurance, Investment, Industry and Services index.

2.1.1 Palestine stock market key statistical figures

Period	No. of Trading sessions	Market Cap (US$)	Volume (Shares)	Value (US$)	Revenue (US$)
2010	249	2.4 billion	230 million	451 million	2.8 million
2011	248	2.7 billion	184 million	365 million	2.9 million
Change	-0.40%	13.57%	-19%	-18.9%	2.6%

* Source : Palestine exchange annual report,2011

2.2 Hypothesis

Our goal in this study is to check whether the stock market follows a random pattern or investors can rely on technical analysis to beat the market and achieve abnormal returns.

H0: index value returns exhibit random dependence over the time period of the study.

H1: index value returns don't exhibit random dependence over the time period of the study.

3. Methodology and Research Design

3.1 Data Sample

Data used in this study are daily closing values for each index. Observations were taken from the time period in which each index was established. We then calculate the natural logarithm of the relative daily returns to get a continuous time series of compounded returns as follows: (elaborate more about the data set, time period, and exclusion of companies with no available info …)

⇨ ***Rt= Log (Pt/Pt-1)*100***

3.2 Random walk model tests

3.2.1 Serial correlation (or autocorrelation) test measures 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 coefficients.

3.2.2 Runs test is a common test for random walk in which the number of sequences of consecutive positive and negative returns, or runs, is tabulated and compared against its sampling distribution under the random walk hypothesis. Further, 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.

3.2.3 Augmented Dickey-Fuller unit root is a parametric test applied to check the presence of unit root in the time series of past returns. Particularly, the test is used to look for non-stationary in the return time series. Random walk model requires stock returns to be non-stationary; i.e. unit root problem must exist in the series which supports the efficiency on the weak level. When stock price indices are stationary, they are inconsistent with the efficient market hypothesis which shows the presence of profitable arbitrage opportunities. Chien and Jun (2010)

4. Data Analysis and Results

Table 1 : Summary statistics of Palestine security exchange daily index returns

Index	Al-Quds	General	Banking	Industry	Service	Investment	Insurance
Period	**Jan.1998-Oct.2012**	**Jan.2003-Oct.2012**	**Jan.2006-Oct.2012**	**Jan.2006-Oct.2012**	**Jan.2006-Oct.2012**	**Jan.2006-Oct.2012**	**Jan.2006-Oct.2012**
Mean	2.000	1.999	2.000	1.999	1.999	1.999	1.999
Max	2.079	1.997	2.020	2.028	2.093	2.021	2.021
Min	1.950	1.86	1.980	1.909	1.909	1.977	1.978
Std.Dev	0.006	0.007	0.004	0.004	0.007	0.007	0.005
Observations	3086	2316	1671	1671	1671	1671	1671

4.1 Testing the random walk hypothesis using the serial correlation test

Table 2: **Serial correlation test results for daily returns for each index**

Variable (Index)		**Autocorrelation (1 lag)**	**Autocorrelation (2 lags)**
Alquds	Coefficient P-value	0.255 0.000	0.051 0.000
General	Coefficient P-value	0.162 0.000	-0.093 0.000
Banking	Coefficient P-value	0.231 0.000	0.061 0.000
Industry	Coefficient P-value	0.095 0.000	-0.030 0.000
Service	Coefficient P-value	0.138 0.000	-0.019 0.000
Investment	Coefficient P-value	0.190 0.000	-0.016 0.000
Insurance	Coefficient P-value	0.048 0.000	-0.017 ***0.114***

The autocorrelation is used to test the relationship between the times series and its own values at different time lags. In running the test using SPSS 17, we look for the absence of statistical significance in autocorrelation which implies the randomness of the return series and therefore the randomness of return series. According to table 2 above, we find that all indices have P-values of less than 5%. Even when the series are lagged, the returns still exhibit a non-random behavior except for the Insurance sector. As a result, we conclude that historical returns can be analyzed to predict future returns; an evidence to reject the null hypothesis stating that PEX is efficient on the weak form level.

4.2 Testing the random walk hypothesis using the Runs test

Table 3: Runs test results for daily index returns of each index

Variable (Index)	**T-value**	**Cases< TV**	**Cases >= TV**	**Total cases**	**# of runs**	**Z-stat**	**Sig**
Alquds	2.0001	1703	1384	3087	1364	-5.9	0.000
General	1.9997	313	2003	2316	375	-14.8	0.000
Banking	2.0000	816	855	1671	803	-1.6	0.16
Industry	1.9998	834	837	1671	818	-1.9	0. 35
Service	1.9998	837	834	1671	830	-1.3	0.75
Investment	1.9999	852	819	1671	815	-1.03	0.33
Insurance	1.9999	722	949	1671	831	-1.46	0.62

When performing the test using SPSS 17, we search for whether succeeding price returns are autonomous to each other as it appears under the random walk null hypothesis. If there is no effect of preceding returns on following returns, then the observations are independent and follow a random walk. Consulting table 3 above, we find that the P-value of only two indices (Alquds and General index) is less than 0.05. And the five other indices follow a random walk. Nonetheless, As the main index in Palestine equity market is Alquds index and it is found to be non-random. We conclude that the results of the runs test support the Alternative hypothesis that the stock market is inefficient at the weak level.

4.3 Testing the random walk using Augmented Dickey-Fuller unit root (ADF)

Table 4 : Results of ADF test for Palestine Exchange indices

Variable (Index name)	ADF t-stat	Prob	Test Critical Values		
			1%	5%	10%
AlQuds	**-42.17**	**0.00000**	-3.43	-2.86	-2.56
General	**-35.21**	**0.00000**	-3.44	-2.86	-2.55
Banking	**-32.09**	**0.00000**	-3.34	-2.76	-2.52
Industry	**-37.94**	**0.00000**	-3.43	-2.86	-2.56
Service	**-26.14**	**0.00000**	-3.43	-2.86	-2.56
Investment	**-33.77**	**0.00000**	-3.43	-2.86	-2.56
Insurance	**-38.33**	**0.00000**	-3.43	-2.86	-2.56

In conducting the ADF test using E-views, our main goal is to find whether a unit root exist in the return series and to check whether the return time series are non-stationary. non-stationary in the return series is a necessary condition for the random walk to hold true. Table 4 above shows that the null hypothesis that return series in each index have unit roots as the ADF t-stat are more negative than critical values. This finding is inconsistent with the random walk theory and thus the stock market is inefficient at the weak form.

5. Conclusion

To recap, this empirical study examined the efficiency of the Palestinian equity market and found that the market is weak-form inefficient as supported by the results of parametric and non-parametric tests .The three tests used in this paper to check the presence of random walk theory are the serial correlation test (a parametric test), the Runs test (a non-parametric test) and the Augmented Dickey-Fuller unit root (parametric test). The sample of the study consists of daily time series closing values of the 7 indices in PEX. Autocorrelation test reveal that return series are serially correlated as the p-value of the test is less than 5%. Results of the runs test also show that future returns can be predicted from

previous returns for the main index and the general index only. Augmented Dickey fuller test (ADF) assumes that there exists a unit root in the returns series. On the contrary, Results of the ADF test implies that unit root doesn't not hold in the time series, which means that the indices are stationary and doesn't exhibit randomness.

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Appendix

Table 1 : Descriptive statistics

Descriptive Statistics

Index name	N	Minimum	Maximum	Mean	Std. Deviation
Alquds	3087	1.950463	2.079633	2.00014121	.006661237
general	2316	1.86000000	2.12000000	1.9997409326E0	.00726673416
banking	1671	1.9807155	2.0203310	2.000010532	.0049594052
industry	1671	1.9809063	2.0287402	1.999862930	.0043744768
service	1671	1.9090741	2.0932102	1.999817004	.0075643615
investment	1671	1.9778137	2.0211588	1.999584390	.0075791792
insurance	1671	1.9789666	2.0210030	1.999774893	.0050850017
Valid N (listwise)	1671				

Table 2 : Autocorrelation test results for each Index

1- Alquds Index

Autocorrelations			
Series:Alquds			
Lag	Autocorrelation	Std. Error[a]	Sig.[b]
1	.255	.018	.000
2	.051	.018	.000

2- General Index

Autocorrelations			
Series:general			
Lag	Autocorrelation	Std. Error[a]	Sig.[b]
1	.162	.021	.000
2	-.093-	.021	.000

3- Banking Index

Autocorrelations			
Series:banking			
Lag	Autocorrelation	Std. Error[a]	Sig.[b]
1	.213	.024	.000
2	.061	.024	.000

4- Industry Index

Autocorrelations			
Series:industry			
Lag	Autocorrelation	Std. Error[a]	Sig.[b]
1	.095	.024	.000
2	-.030-	.024	.000

5- Service Index

Autocorrelations			
Series:service			
Lag	Autocorrelation	Std. Error[a]	Sig.[b]
1	.138	.024	.000
2	-.019-	.024	.000

6- Investment Index

Autocorrelations			
Series:investment			
Lag	Autocorrelation	Std. Error[a]	Sig.[b]
1	.190	.024	.000
2	-.016-	.024	.000

7- Insurance Index

Autocorrelations			
Series:insurance			
Lag	Autocorrelation	Std. Error[a]	Sig.[b]
1	.048	.024	.049
2	-.017-	.024	.114

Table 3 : Runs test Results

Runs Test

	Alquds	general	banking	industry	service	investment	insurance
Test Value[a]	2.00014121	1.9997409326E0	2.000010532	1.999862930	1.999817004	1.999584390	1.999774893
Cases < Test Value	1703	313	816	834	837	852	722
Cases >= Test Value	1384	2003	855	837	834	819	949
Total Cases	3087	2316	1671	1671	1671	1671	1671
Number of Runs	1364	375	803	818	830	815	831
Z	-5.969-	-14.891-	-1.618-	-.905-	-.318-	-1.037-	.495
Asymp. Sig. (2-tailed)	.000	.000	.106	.365	.750	.300	.621

a. Mean