Testing the Weak-Form Efficiency of the Stock Market: Pakistan as an Emerging Economy

Sajeela Rabbani, Nida Kamal, Mahwash Salim

National Defence University Islamabad, Pakistan

ABSTRACT

In this study weak-form market efficiency hypothesis is tested on an emerging stock market Karachi stock exchange Pakistan. Secondary data has been taken for twelve years from January 1999 to December 2010 of KSE 100 Index. This time period is divided into four groups including three years each. Weak-form efficiency tests such as Augmented Dickey-fuller test, Auto-correlation function test, Phillip Perron test and Runs test are applied to analyze the data. All these tests rejected efficient market hypothesis(EMH) in its weak-form except Runs test , which suggested weak-form market efficiency for two groups of years 1999-2001 and 2005-2007.Overall KSE of Pakistan is weak-form inefficient and investors are compensated for taking augmented risk.
KEY WORDS: Market efficiency, EMH, Karachi stock exchange, weak-form efficiency Tests

INTRODUCTION

An efficient capital market is one in which the prices of the securities are adjusted according to the availability and infusion of new information and therefore current prices of the securities reflect all the information about the security. Also it can be termed as informationally efficient market. The new information is regarded as the one which was not known before and is unpredictable. Many interesting and academically important researches have been done to analyze the efficiency of Markets across the globe. An initial and important premise of the efficient market is a combination of assumptions such as that there are a number of profit maximizing investors that exist in the market and carry out the valuation and analysis if the securities exclusive of each other. Secondly, information is fairly unpredictable and occurs in a random order and finally, the investors adjust the stock prices quickly in response to the new information showing that one should expect random and independent price changes. Most of the historical work done on the efficient capital market was an empirical testing based on the Random Walk behaviour without much theory behind it. The random walk behaviour suggests that the changes in the stock prices occur randomly. Fama (1970) organized and presented the theory for the efficient market hypothesis, also called the Random Walk Theory. Eugene Fama is widely thought and accepted as the king of efficient market hypothesis, extremely vital concepts were proposed by Fama that have defined the debate on efficient markets. Three types of efficiency were proposed by Fama are Weak form, Semi-strong form and Strong form efficiency. These are explained in background of what information is factored in price. Each of the above mentioned type has different connotations for how do the markets undertake their assigned tasks.

Types of the Efficient Market Hypothesis

Since the EMH is detailed to have incorporated and reflecting all relevant and available information in the stock prices, the forms of the EMH have been distinguished from one another based on the extent to which the information is available and incorporated.

Weak Form Efficiency:

In the first type (weak form efficiency), the forecasting or prediction of the future prices is not possible from the past data. Investment strategies based on the past data of the share price cannot help to achieve surplus in the long run. Some forms of fundamental analysis can help to achieve surplus but not on a regular basis. Share prices do not show any serial dependencies, which means there is no pattern similar to the asset prices. This means that information which is not present in the price series determines the price movements of the future. Therefore, the prices will have to follow a random pattern.

Semi-Strong Form Efficiency:

The second type (semi strong form efficiency) it states that when ever new information is publically available the share prices adjust to them almost instantaneously and without any bias, in a way that no surplus can be earned with trading on the publically available information. The semi string efficiency states that both the fundamental analysis and technical analysis techniques will not be able to reliably produce the surplus. In order to test for the semi strong form efficiency, the adjustments must be of acceptable size and should be instantaneous to the news which was unknown before this. To test what is mentioned in the previous line, after the initial change consistent upward or downward adjustments should be searched for. If the upward or downward adjustments are found this implies that the investor had understood the information with a bias, therefore rendering it inefficient.

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*Corresponding Author: Sajeela Rabbani, National Defence University Islamabad, Pakistan

Strong Form Efficiency:

In the third type (strong form efficiency), all the information is given or obtained by the share prices, whether it is public or private and surplus cannot be earned by anybody. This type of efficiency is not possible if there are legal obstructions to the private information becoming public. To test for this type of efficiency, there should exist, a market where the people investing cannot regularly earn surplus longitudinally. EMH is widely thought to be the key element of the conjectures in finance but on the other hand it is argumentative and repeatedly disputed. It is argued by the followers that it is fruitless to anticipate trends in the stock market prices by financial analysis techniques.

Even though much support is provided by the academics in favour of EMH, there are people almost equal in number that do not accept it, an example of which is Warren Buffet who have regularly trodden over the market with longitudinal data, which according to the EMH is not possible. In the previous centuries the EMH concept has been widely accepted and acknowledged by the academic financial economists. Yet by the twenty first century the dominance of EMH intellect has reduced to a great extent across the globe. Many specialists started to believe that the stock prices have a slightest possibly to be forecasted whereas; the psychological and behavioural components of determining the stock-price are being emphasized by the economists today. They believe that the prices can be forecasted based on the historical price trends. Moreover these economists argue that the investors can take advantage of earning abnormal returns though such patterns. This paper aims at testing the efficient market hypothesis in Pakistani stock exchange. As the stock market acts as an intermediary between the saving sectors to the investors for the flow of financing, the market efficiency is a critical element in consideration if the funds are to be appropriately used. This only is achieved if the stock prices absorb all information to become efficient. Not only the firm's generate capital easily but also the efficient market perspective helps the market allocate the required resources to profitable investments. It is also to note that in such a case the Random Walk of the stock prices that is the display of unpredictable behavior is necessary for the testing of weak form efficiency. Pakistan as an emerging equity and capital market seems highly suitable for the testing of the Weak form efficiency hypothesis. The emerging markets are under consideration by all analysts as these markets have an outburst of investment opportunities as they follow the globalization trends. Increase in the policy reforms and increase in domestic and foreign capital investment demands the market to be efficient. In such a case of the emerging markets the economic and political conditions and stability of the country is crucial. Many studies have aimed at testing the weak form efficiency yet a gap exists in linking the effect of the economic conditions and policies on the availability and reflection of all relevant information in the stock prices. This paper targets to test the volatility of the stocks and the weak form efficiency of the Karachi Stock Exchange (KSE-100 INDEX) over a period of past 12 years. The data has been divided into four groups of time, each of 3 years to examine test the weak-form efficiency and relate its cause to the economic conditions. We initiated this task with an objective to clearly define the EMH for Pakistan an emerging market and the availability and flow of information.

LITERATURE REVIEW

Efficient market Hypothesis testing in its three forms have long been a part of stock market researches. Several studies proved each of the form of this EMH. Emerging markets most commonly concluded that their stock markets are inefficient whereas the developed markets also test the other two forms of EMH in their markets. Inefficiency of stock market suggests that the prices of the securities does not reflect the available relevant information, on the other hand Market efficiency says that the stock prices reflect all relevant available information. In other words stock market inefficiency implies that stock prices are dependent upon one another and investors cannot generate excessive returns. Poshakwale (1996) argues that the efficiency of the emerging markets is of much greater importance as being the developing markets the investments are increasing due to positive reforms and the removal of the barriers for equity. His study provides empirical evidence on weak form efficiency in Bombay Stock Exchange over a period of 1987-1994.The Serial Correlation Coefficients Test and Runs test have been applied to the selected data. The results concluded by Poshakwale show that despite the increasing investment, reforms and removal of barriers the market is not weak form efficient. The results of several researches indicate that most of the emerging markets are not weak-form efficient.

Husain (1997) Considering the KSE 100 index, through four years that ended December 1993, concluded that the Random Walk model does not apply to the Pakistani stock market, although many other emerging economies show a trend vice versa. The results through the research reveal the existence of successive correlation between the stock prices and that the market on the whole absorbs the new information fully at a very slack pace. Also that in such regard, the theoretical models shall be applied with great consideration and the remedy to rectify the condition of investors gaining benefit must be critically resolved. Mobarek & keasey (2000) in their study of weak-form market efficiency testing on Dhaka Stock exchange taken daily price indices of all listed securities of DSE for period 1988 to 1997.Weak-form Efficient market hypothesis proved true, there they found correlation in the series by using Parametric tests such as Runs test and Smirnov normality test. The null hypothesis has also been rejected by the parametric tests such as Auto-correlation, Auto-regression, and ARIMA model. This study reveals that emerging markets such as Dhaka Stock Exchange are at least weak-form efficient and investors can generate excessive returns. According to them such weak-form efficiency analysis is important for investors and regulatory authorities to make such decisions which make these markets better. Hogan, Jarrow, Teo & Warachka (2003) introduced the concept of statistical arbitrage they discussed that it's an extensive prospect opportunity of trading through which risk free yield could be generated. The purpose of this model to design is to utilize importunate anomalies. The results show that Statistical arbitrage is not dependant on any equilibrium model and its subsistence is not attuned with market efficiency. The authors gave a methodology on which the statistical arbitrage could be tested and then further it's empirically investigated that either value trading and impetus strategies compose statistical arbitrage or not. No matter the transactions cost and the small rock influence is illicit, substantiation has been found that statistical arbitrage is generated by these strategies. Hence the decline rate line does not show the abundance. Khawja & Mian (2005) have analytically conceived that the stock prices are subject to manipulation showing market volatility by concurring stock brokers such that the increase in volatility also enlarge the participation costs of the current and the prospect equity investors. In such a case the individual

investor who is not a part of the collaborative brokering are intimidated. The study also identifies direct costs that are involved as the equity is transferred to the inside controllers. And is according to the study affects the depth of the market and the intermediation in the market and overall does not correctly indicate the applicability of the efficient market hypothesis in terms of the Pakistani equity market.

An empirical study of emerging Asian capital markets and some developed markets proved the similar results (Worthington & Higgs, 2006).This study used daily stock returns of China, Korea, Malaysia, Sri Lanka, Pakistan, Indonesia, India, Philippines, Thailand and Taiwan as being the emerging markets. The five developed countries used for analysis were Australia, Japan, Singapore, Hong Kong and New Zealand. By using Unit root test, Augmented Dickey fuller test, Phillips-Perron test, Runs test, multiple variance ratio tests and auto correlation function test results were drawn. Among these Runs test, multiple variance ratio tests and Auto-correlation function test illustrated that all the emerging markets and three of developed markets of Japan, New Zealand and Hong Kong are not weak-form efficient. On the other hand apart from Australia and Taiwan, unit root test represent these markets as weak-form efficient. In recent times, Chakraborty (2006) analyzed the weak-form efficiency of the Pakistani market incorporating closing prices on everyday basis using a time frame of data through January 1st 1996 to 31st December 2000. Applying the serial correlation and variance ration tests his study attempted to reject the random walk behaviour and considers the stock market inefficient. Many researchers and economists believe that the Pakistani stock market is volatile and its main reason lies in the manipulation that exists due to collaborative inside trading of the brokerage middlemen.

Dorina & Simina (2007) investigated a set of 8 emerging markets for weak-form efficiency. This study included developing countries of Poland, Slovenia, Hungary, Lithuania, Turkey, Romania, Slovakia, and Czech Republic. To test interdependencies between the stock prices this study employed Ljung-Box test, serial correlation LM test, Runs test and BDS tests(applied on residuals generated by ARMA models) for both linear and non-linear dependencies of the prices. These tests revealed that there are linear and non-linear dependencies in most of the series. This implied that set of these emerging markets are mostly weak-form inefficient and investors can generate abnormal returns.While testing the efficiency of the stock market Elango & Hussein (2008) used Gulf Co-operation council countries as the sample for analysis. According to this study GCC Countries have been trying to develop their capital markets by different innovative changes and regulations. By using daily indices Elago & Hussein found that the hypothesis of market weak-form efficiency rejected and the GCC market is inefficient in nature. They recommend that GCC stock market should be integrated to improve capital market efficiency. Another stock market efficiency test performed in an emerging market proved weak-form inefficiency of the Indian Stock market (Mishra, Das & Pradhan, 2009). This study used unit root tests on a given sample of daily stock index of BSE and found that stock prices are dependent on each other and doesn't show random manner. This empirical evidence of the Indian stock market examines the deteriorated suggestion about market inefficiency and proposes such suggestion as a false impression of the market. The study conducted by Hameed & Ashraf (2009) showed that the historical information helps in conjecturing the future expected prices and there is no proof that the investors gain benefit from high risk. Richard, Suchi & Ranghunandan (2010) checked the information efficiency of the stock prices using SEC regulation fair disclosure introduced in 2003.Having comparison of four quarters before and after the regulation, this study concluded that after this regulation informational efficiency of stock prices improved.

Many researches have done researches on the equity market of Pakistan to identify the validity of Random Walk theory, as in other equity markets when such has been investigated , it has been concluded that historic trends in the stock market prices do not aid in anticipating or analyzing the future stock price. Since the Random walk model frames that the variations in the prices are progressively unconnected and attune to little probability distribution. Hamid, Suleman, Shah & Akash(2010) tested the weak form efficiency hypothesis for the emerging markets in the Asia-Pacific region based on monthly data of the stock market for the period over January 2004 to December 2009 The EM tests such as Runs Test, Unit Root Test, Autocorrelation, and Ljung-Box Q-statistic Test, that are of our primary concern are applied. This study assumes that the market follows a random walk phenomenon relating to no correlation between the monthly data returns. Overall the study revealed that the market is weak form inefficient as the investors can generate excess or abnormal returns through beneficial loopholes that exist transversely in the markets of the region. During the testing of Efficient Market Hypothesis in Istanbul Stock Exchange, Kormaz and Akman in 2010 selected two indices. These two indices were ISE 100 index and ISE industrial index. By emphasizing on market efficiency, analyses were carried out by using unit root and co-integration test .The co-integration test implied that there is no co-integration among the selected indices. This research concluded that Istanbul stock exchange of Turkey is weak-form efficient. According to Bashir, Ilyas & Farrukh (2011) Pakistani stock market is highly receptive to the socio-political changes, the market expectations, speculation and the private and public information which makes it logical to evaluate the market for efficiency. The study reveals that the market was inefficient in the banking sector, based on ADF and PP tests for data being stationary and co integration and VAR tests were applied for EMH Eventually there exist the anticipated price patterns that the investor can take advantage from resulting in the inefficiency.

Insight to the Pakistani Stock Market

Stock market in Pakistan consists of three main exchanges namely the Karachi, Lahore and the Islamabad Stock Exchange. Our study specifically focuses on the Karachi Stock Exchange (KSE). KSE came into existence on 18th September, 1947, soon after the country's independence. The progress of this exchange can be seen by analyzing the historical trading statistics. Indicators such as the total, average turnover rate and market capitalization show a progressive rise in the market adding to its development. With the increase in global activity and the changes in the economic structure, becoming more deregulated and privatized in the19th century, the stock market experienced rejuvenation. Adding to the invigoration of the market were the capital market reforms such as the management of risk, governance and investor related matters that were introduced prior to the 19th century. The Capital market of Pakistan has expanded and intensified by the privatization approach of trading the shares of government owned institutions in the stock market through listing procedures. Observing the pace of the rising index in the previous years, KSE has formed into one of the actively performing emerging

stock markets of the world. To safeguard the interests of the investing parties from disproportionate volatility in stock-prices, Security Exchange Commission of Pakistan has developed and implemented reforms of bringing in the circuit beakers in late 2001, prearranged in a method that no colluding parties or brokers could generate benefit protecting the investor's interests. Overture of these circuit breakers and the effectiveness of this policy is a controversial point. Price ceilings and floorings may provide the investors with immunity from alarming conditions and help reduce the volatility of the market critically in ambiguous situations when there is affinity to react excessively to any new information release. Conversely, price limits may effect or halt the division of price changes for each stock and generate irregular data as symmetric prices are not accessible when price limit becomes obligatory. Also it can impede the price detection procedure by becoming a hindrance to market clearing instrument. Additionally, concerns relating to the liquidity may also arise since the buyers and sellers in the market are hesitant to enter the market in eagerness of price variations be it increase or decrease. Since Pakistan holds great significance in respect to foreign investments due to elimination of trade barriers and the globalized policies, many researchers find the KSE as a potential stock exchange with prospects of efficient functioning. Yet many also believe that due to the emerging trends and slow and ineffective means of information dispersion, the KSE can generate excessive abnormal returns for collusive brokers and those investors to have quick access to new and old information. Hence, it is important to study the trends in the KSE and note whether it follows the random walk behaviour complying with the Efficient Market Hypothesis or not.

DATA

The data used to test the weak-form efficiency of KSE 100 index has been taken from the daily market closing prices of KSE 100 Index. To check autocorrelation and random walk behaviour in the stock prices we divided the data into four groups, each having three years with data ranging from 1st January 1999 to 31st December 2010. The groups are divided to comprise of Groups as 11)1999-2001, 2) 2002-2004, 3) 2005-2007, 4) 2008-2010.The purpose of the division into groups is intended to evaluate the link of certain economic conditions that vary over time and whether there was opportunity for excess returns or not based on the absorption of information by the stock prices and making efficiency or inefficiency of the market of the market.

METHODOLOGY

This study used four weak-form market efficiency tests to analyze the data. These tests include Runs Test, Auto-correlation Function test, augmented dickey fuller test and Philip parren tests. Runs test is a statistical test to check the random behaviour of the data in a given distribution.

1. Runs Test

Runs test finds out the events same like other events and those which are different. For this purpose Runs test use Mean of expected returns and variance of the series data as follows:

$$E(R) = \text{mean } \mu = \frac{2\ N_+\ N_-}{N} + 1$$

$$\text{variance } \sigma^2 = \frac{2\ N_+\ N_-\ (2\ N_+\ N_- - N)}{N^2\ (N-1)}$$

Whereas E(R) is the average expected return, N+ are the increase in prices, N- is the decrease in prices and N is total of N+ and N-.

2. Auto-correlation function Test

Auto-correlation function (ACF) test is also used as a measure of weak-form efficiency. It depicts the relationship of each value of the series with itself at different times t, t+1, t+2, t+3 so on and so forth. ACF is articulated as the function of time-groups

$$R(\tau) = \frac{E[(X_t - \mu)(X_{t+\tau} - \mu)]}{\sigma^2}$$

Where "E" is the expected value, Xt is the value at t; μ is the mean of series and Xt+$^\tau$ is value at t+1.

3. Augmented Dickey Fuller Test

Another statistical technique used to test the weak form efficiency of the stock market is the Augmented Dickey Fuller test (ADF), it tests if data is stationary. It is applied for analyzing the unit root in time series data. Data that has a unit root means it is non-stationary and it behaves according to the Random Walk theory. This method is mainly used for long term and complex time frames. To assess the market efficiency based on the ADF we apply the following formula:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t,$$

Further the hypothesis can be classified as:
H0: δ=0 and H0: ρ=1

4. Phillips-Perron Test

The Phillips-Perron test is another widely used unit root test for financial data in times series. The PP test is based on the same null hypothesis formation as the ADF such as: H0: δ=0

While the ADF test uses a parametric auto-regression to estimate the construction of the errors in the test regression, the Phillips-Perron unit root testing on the other hand tends to overlook any form of serial correlation that exists in the test regression. The regression equation for this unit root test is:

$$\Delta y_t = \beta' \mathbf{D}_t + \pi y_{t-1} + u_t$$

TESTING AND ANALYSIS

Augmented Dickey-Fuller Test (ADF)
Null Hypothesis: KSE 100index has a unit root

a) Group 1: 1st January 1999 to 31st December 2001

ADF Test Statistic	-1.954656	1% Critical Value*	-3.4420
		5% Critical Value	-2.8659
		10% Critical Value	-2.5691

b) Group 2: 1st January 2002 to 31st December 2004

ADF Test Statistic	0.179743	1% Critical Value*	-3.4418
		5% Critical Value	-2.8658
		10% Critical Value	-2.5691

c) Group 3: 1st January 2005 to 31st December 2007

ADF Test Statistic	-1.340952	1% Critical Value*	-3.4419
		5% Critical Value	-2.8659
		10% Critical Value	-2.5691

D) Group 4: 1st January 2008 to 31st December 2010

ADF Test Statistic	-1.723208	1% Critical Value*	-3.4418
		5% Critical Value	-2.8658
		10% Critical Value	-2.5691

Result:
Augmented Dickey fuller test showed that in all four groups of time series, the prices has unit root. This in turns suggest that the market is weak-form inefficient and there is opportunity to generate excess returns by the investors.

Autocorrelation-function Test (ACF)
Null Hypothesis: There is no autocorrelation among the stock prices of KSE100 index.

Groups	1999-2001	2002-2004	2005-2007	2008-2010
Probability	0.00	0.00	0.00	0.00
Results	Weak-form inefficient	Weak-form inefficient	Weak-form inefficient	Weak-form inefficient

Result:
By applying auto correlation function test we found that there is zero probability of no auto correlation and market is weak-form inefficient in all four groups of years.

Phillips-Perron Test (PP)

a) Group 1: 1st January 1999 to 31st December 2001

PP Test Statistic	-1.884679	1% Critical Value*	-3.4420
		5% Critical Value	-2.8659
		10% Critical Value	-2.5691

b) Group 2: 1st January 2002 to 31st December 2004

PP Test Statistic	0.130599	1% Critical Value*	-3.4417
		5% Critical Value	-2.8658
		10% Critical Value	-2.5690

c) Group 3: 1st January 2005 to 31st December 2007

PP Test Statistic	-1.276852	1% Critical Value*	-3.4418
		5% Critical Value	-2.8658
		10% Critical Value	-2.5691

d) Group 4: 1st January 2008 to 31st December 2010

PP Test Statistic	-1.324286	1% Critical Value*	-3.4417
		5% Critical Value	-2.8658
		10% Critical Value	-2.5690

Result:

In all these results the value of t-statistic is less than the critical value which depicts that there is unit root among the prices of KSE index and hence this stock market is weak-form inefficient through all the years from 1999-2010.

Runs Test

Ho: There is no autocorrelation

H$_1$: There is autocorrelation

Result:

	1999-2001	2002-2004	2005-2007	2008-2010
N1(Increase)	367	446	438	361
N2(Decrease)	354	295	297	380
N= N1+N2	721	741	735	741
RUNS	344	329	350	328
E(R)	361.4	356.11	355	371
$\square_R$	13.41	13.03	13.04	13.6
Accepted hypothesis	Ho	H$_1$	Ho	H$_1$
Efficiency/ Inefficiency	Weak form Efficient	Weak form Inefficient	Weak form Efficient	Weak form Inefficient

The results from the Runs Test reveal that the market is working efficiently in some years and is inefficient in others. While making a sound conclusion from the above we must consider the overall market performance and that mainly shows that the market is inefficient.

Conclusion

Efficient Stock market is an essential Condition for valuable investment preferences .In efficient markets share prices are on their fundamental values where investors can estimate real discounted cash flows from their investments. By these economic values of securities companies can also forecast the future price at which investors would be willing to buy the securities and their risk tolerance.

In our study we have tried to test weak-form efficient market hypothesis on Pakistani stock market. We found that this hypothesis is rejected in this market as the securities prices can be forecasted on the basis of historical data about the market. Only runs test among all four tests we applied in this study, suggested weak-form efficiency of market in group 1 and group 3 of time period. We can conclude that overall market is weak-form inefficient with some exceptions of time period and tests applied. As a result investors of such market can produce abnormal returns. Being an emerging and weak-form inefficient market Pakistani stock exchange offers opportunities for individual and institutional investors. The volatility in securities prices must be due to certain factors prevailing in the overall economy of the country which include the slow communication and information dissipation, the working of the colluding brokerages, monopolistic trends and most significantly insiders' leakage of information to selected groups. Future studies are suggested to indicate factors that are causing such inefficiency of the market and effects of non-intrinsic value of stocks on company's value.

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