

## MARKET EFFICIENCY IN ITS WEAK-FORM; EVIDENCE FROM KARACHI STOCK EXCHANGE OF PAKISTAN

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### Abstract

*Following study investigates the weak form efficiency for Karachi stock market by taking monthly index data for the period of July 1, 1997 to July 2, 2011. Jarque Bera test, Kolmogorov Smirnov test, Unit root tests, Autoregressive Model, Run test and Variance ratio test employed to test the evidence of weak form efficiency. The results show that for selected sample period the Karachi stock market is not weak form efficient and hence not found to be random walk, therefore the rational investors can use the utility of the technical analysis in predicting the behavior of Karachi stock market at least in short run.*

**Key Words:** Weak form efficiency, Monthly KSE 100 Index, Variance ratio, Autoregressive Model.

### INTRODUCTION

One of the foundations of modern financial markets is the proposition that markets are efficient. In modern finance the concept of market efficiency is best explained through the efficient market hypothesis. Different researchers explained the concept of EMH in relation to the stock prices after the core work of Fama (1965, 1970) on it. Fama (1965) stated that pattern of change in market prices are random and hence previous pattern has no predictability factor for future market prices. Today in financial economics it becomes a most important research area because it provides a relation between the EMH and predictive element of stock market return. The concept of market efficiency after the research on the developed market data is that actually the prices are the reflection of all available public information. This concept could be a sign that there is greater degree of market efficiency on which the stock markets operate (Gitman, Joehnk and Smart

2011, 324). The various supporter of the market efficiency accept the observation that there is no predictability of the assets and they are priced correctly (Samuelson, 1965; Fama, 1970). Many financial models in modern finance are based on this market efficiency concept such as "capital market efficiency" is the concept of the above findings from developed markets data. The debate is generated by this market efficiency concept in the form of January effect, day of the week effect etc in equity prices through the inclusion of different views on capital market regarding the strong economic concept. The relationship between information and market prices is related to informational efficiency. Fama (1970) also categorized the market efficiency into three type's i.e. weak form, Semi strong form and strong form market efficiency on the basis of their level of informational efficiency. The market efficiency plays an important role for the investors in analyzing and managing the investment portfolios. In financial markets there should be efficiency because it has plentiful impact on the rational decision making of the investors as they react very quickly to the information released. The operations of the stock market are frequently contrasted to the functions in gambling dens by the investors and they look for the right combination and appealing strategies through the implementation of numerous investment strategies (Ranganatham, Madhu, Mathi R, 2005). So actually the investigation of the weak form of efficiency is for the testing of technical analysis for profitability or for the prediction purpose.

Much of the research related to the market efficiency has been conducted in the developed markets but there are not too many studies on market efficiency in order to show the stock prices behavior in developing or emerging countries and especially in Pakistan stock market. Now trend is shifted toward emerging economies to analyze the weak form efficiency of their financial markets, largely with respect to the valuable contribution of efficient capital market towards the economic and financial growth as well as development. The objective of this study is to investigate the weak form

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efficiency of Karachi stock exchange by using monthly data. This study has great significant especially for Pakistan environment is more volatile such as security threats, terrorism, inflation, energy crises and many more other problems are prevailed changing the thinking pattern of investors related to the investment decisions. So this study will provide a tool to investors in order to make appropriate investment strategies by recognizing the stock prices behavior and predictability element in term of weak form efficiency. As this paper adds to the scarce literature on the weak form efficiency of capital markets, thus it should be useful for researchers as well. The section II of this study focuses on the previous literature. It not only mentions the research from the developed countries but also research done in developing countries as well. Section III focuses on the data description and methodology used for this study. Section IV of this study deals with the empirical results of the study. The results discussion, conclusion and practical implication of the study are discussed in section V.

## **THEORETICAL BACKGROUND**

Over the previous many years the market efficiency is tested in many studies. Some market efficiency related findings and review relating to emerging and developed economies are available in the following research works: Fama (1970); Solink (1973); Granger (1975); Ang and Pohlman (1978); Hawawini (1984); Urrutia (1995); Huang (1995); Dahel and Laabas (1999); Grieb and Reyes (1999); Ojah and Karemera (1999); Magnusson and Wydick (2000); Pagan and Soydemir (2000, 2001); Mings and Guru (2000); Yasir and Kashif (2005).

Mobarek and Keavin (2000) worked on the Dhaka stock exchange in order to find evidence of weak form of efficiency. Monthly returns data from 1988 to 1997 were taken and after employing the run test, auto regression and autocorrelation test found the significant autocorrelation at different lags in the return series which indicates that return series are not weak-form efficient. Elango and Hussein (2008) tested the weak-form efficiency among the seven countries of Gulf Cooperation Council by using the daily indices data ranging from October 2001 to October 2006. The results of

Kolmogorov-Smirnov and Run tests reject the hypothesis of weak form efficiency and stated that all seven countries stock market are not weak form efficient. Magnus (2008) tested the Ghana Stock Exchange to draw the evidence on weak-form efficiency. Daily returns data from 1999 to 2004 was taken and after employing the Random walk and GARCH (1, 1) model concluded that Ghana stock exchange is inefficient as it rejected the hypothesis of weak-form efficiency. Ahmad (2012) examined the weak-form efficiency in the Damascus securities exchange by taking the daily returns data from 31-12-2009 to 30-11-2011 and stated that stock prices do not follow random walk and hence the Damascus securities exchange is not weak form efficient. Asiri (2008) considered the Bahrain stock exchange to measure the weak-form efficiency. The daily stock prices data as well as individual sector data over the period 1 June 1990 to 31 December 2000 was used and concluded after employing the econometric methodology that Bahrain stock exchange and individual sector both are weak form efficient. Lim, Habibullah and Hinich (2009) worked on the weak form efficiency for the Shanghai and Shenzhen stock market and they explored that both stock markets are efficient in weak form and follow random walk pattern. Worthington and Higgs (2006) worked to test the weak form efficiency in stock markets of Latin American countries i.e. "Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela". Daily returns data were taken and by using the unit root tests and multiple variance ratio tests concluded that stock markets of all countries are not weak-form efficient. Hassan, Abdullah and Shah (2007) checked the weak form efficiency of Karachi stock exchange by taking the daily, weekly and monthly data for period of 6 years. The results of the unit root and multiple variance ratio tests finalized that Karachi stock market is not weak-form efficient. Al-Jafari (2011) tested the weak form efficiency by taking the daily data from June 2001 to December 2010 for Kuwait stock market. The results of the unit root tests and Run test confirm the weak-form informational inefficiency for Kuwait equity market. Venkatesan (2010) used the returns data from national stock exchange of India from January 1, 2008 to December 31, 2009 and revealed that Indian stock market is weak-form

efficient for the undertaking period. Mishra (2011) tested the weak form efficiency by taking both emerging and developed countries “(India, China, Brazil, South Korea, Russia, Germany, US and UK)” for sample period of January 2007 to December 2010. After employing the unit root tests and GARCH (1, 1) model it is revealed that the stock markets of these countries are not market efficient in its weak form. Hamid, Suleman, Shah and Akash (2010) tested the weak form efficiency for Asia- Pacific markets returns from January 2004 to December 2009. After employing the unit root test, run test and variance ratio test it concluded that all these markets are not weak form efficient and hence do not follow random walk. Mustafa and Nishat (2007) tested the market efficiency of Karachi stock exchange and found that it is efficient for the period of December 1991 to December 2003. Haque, Liu and Nisa (2011) tested the weak form efficiency for the stock market of Pakistan for period 2001 to 2010 and concluded after employing the unit root test, autocorrelation and run test of randomness that Pakistan stock market is not weak form efficient and not characterized by random walk. Worthington and Higgs (2004) tested the weak form efficiency for the emerging markets from Europe and for developed countries as well. ADF, PP and multiple variance ratio tests were employed and reported that out of emerging market the hungry was the only one which fulfill the criteria of weak form efficiency and among developed markets the stock market of Sweden, Portugal, Germany, United Kingdom and Ireland fulfill the situation of weak form efficiency.

## DATA AND METHODOLOGY

### 3.1 The Data

Monthly closing prices from Karachi stock exchange are collected for the period July 2, 1997 to July 2, 2012. The returns for the monthly stock index are calculated by continuously compounded annual rate of return;

$$R_t = \ln (P_t / P_{t-1})$$

### 3.2 Econometric Methodology

#### 3.2.1 Jarque Bera Test

Carlos Jarque and Anil K. Bera proposed the Jarque Bera test for normality of data. The

Jarque Bera test is used in order to find out that whether the skewness and Kurtosis of the sample data are matching with the normal distribution. The test statistics are;

$$JB = \frac{n}{6} (S^2 + \frac{1}{4} (K - 3)^2)$$

“Where n is the number of observations (or degrees of freedom in general); S is the sample skewness, and K is the sample kurtosis”.

#### 3.2.2 Kolmogorove Smirnov Test

“Kolmogorov-Smirnov test (K-S test) is a nonparametric test that can be used to compare a sample with a reference probability distribution”. So similarity of the data set to the normal distribution drawn as null hypothesis, Thus if the p-value is an adequately small then this satisfactorily small p-value designated the non normality of data. The Kolmogorov-Smirnov statistic for a given cumulative distribution function F(x) is;

$$D_n = \sup_x | F_n(x) - F(x) |$$

#### 3.2.3 Unit root tests

Unit root tests are applied in order to test the unit root (non-stationarity) which is necessary condition for random walk and hence also for weak form efficiency. In case of the presence of unit root in financial time series it can be inferred that these series are non stationarity. The Parametric Augmented Dickey Fuller test (1984) is used in order to test stationarity of financial series;

$$\Delta R_t = \beta_1 + \beta_2 T + \delta R_{t-1} + \sum_{i=1}^k \rho_i \Delta R_{t-i} + \varepsilon_t$$

In order to further test the unit root the alternative non-parametric Phillips Perron test (1998) is also used as alternative test and it permit the error conflicts to be weakly reliant and heterogeneously disseminated.

#### 3.2.4 Autoregressive Model

Autoregressive model is used to test the auto regression among the financial time series. This model is used to find out that whether stock returns have any relation with the lagged returns. The financial time series are found to be follow random walk if no significant relation is found among the stock returns and their lagged returns and hence gives evidence of weak form efficiency. The autoregressive model can be depicted as;

$$R_{i,t} = \alpha_i + \rho_j R_{i,t-k} + \varepsilon_{i,t}$$

The above regression equation showed that Pj coefficient calculates the regression among the series of stock "i" by means of lag of "k" periods.

### 3.2.5 Run Test

Run test is a non-parametric test that is used to test the randomness of financial time series. If the financial series are random then these are found to be weak form efficient and in case of non-randomness of series these are not considered as weak form efficient. The sequence of price change of same sign is known as run in run test (Gujarati 2003). Here two types of approaches are followed that are upward runs (+++) that is showing increase in price while downward runs (---) showing decrease in price. The comparisons among the actual and expected runs are made considering the price changed independence. Financial series are found to be non-random in case of excess or less runs.

$$z = \frac{(U - U_{\mu})}{\sigma_{\pi}}$$

Here if the record of runs lies inside the  $[U_{\mu} \pm 1.96 \sigma_U]$  then the null hypothesis of randomness cannot be rejected at 95% confidence level.

### 3.2.6 Variance Ratio Test

The multiple variance ratio tests by Lo and MacKinlay is used to test the Heteroscedasticity and autocorrelation of the return series. According to Lo and MacKinlay the variance ratio test is more powerful tool for the testing of predictability element in the return series than the unit root tests and autocorrelation Q statistics. The basic assumption of this test is the linearity of the variance of increments in random walk series in the sample interval. The random walk in the return series by using this test can be calculated as;

$$\begin{aligned} VR(q) &= \frac{\text{Var}(pt - pt - q)/q}{\text{Var}(pt - pt - 1)} \\ &= \sigma^2(q) / \sigma^2(1) \end{aligned}$$

The null hypothesis of random walk is accepted or rejected by the variance ratio calculated here. If the variance ratio is found to be significant than the random walk hypothesis of random walk is reject which shows that there is either presence of autocorrelation or due to Heteroscedasticity.

## FINDINGS

### 4.1 Descriptive Statistics

The table 1 reports the information for monthly returns. The average monthly returns are 0.010913 and standard deviation is 0.098618. The value of skewness is negative showing that monthly returns of Karachi stock exchange are more flat toward left implying that negative returns are greater than positive returns and investors have extreme losses and small gains. The value of Kurtosis is also greater than 3 showing that returns are more peaked and therefore chances of extreme results.

### 4.1 Jarque Bera Test and Kolmogorov Smirnov Test

On the basis of Skewness and Kurtosis results the Jarque Bera test is employed for the testing of normal distribution of monthly returns. The results in the above table reports that statistics of JB is highly significant and the observed value is greater than its critical value that strongly reject the hypothesis that monthly returns are normally distributed. The results of the KS test is ALSO reported in table 2 which shows that Z statistics for Kolmogorov Smirnov test is significant at 5% significance level which rejects the hypothesis that monthly returns are normally distributed.

### 4.2 Unit Root Test

Table 3 reports that at level the ADF calculated value is less than critical value at 1, 10 and 5 percent significance level showing that monthly index are non-stationary. At First difference monthly index are non-stationary as ADF calculated value is greater than its critical value at 1, 10 and 5 percent significance level showing that monthly index are stationary.

Table 4 reports that at level the PP calculated value is less than critical value at 1, 10 and 5 percent significance level showing that monthly index are non-stationary. At First difference monthly index are non-stationary as PP calculated value is greater than its critical value at 1, 10 and 5 percent significance level showing that monthly index are stationary.

### 4.3 Autoregressive Model

Table 5 reports the auto regression among monthly returns. Auto regression is run in monthly stock returns with their lagged return.

At lag 1 the F significance is insignificant at 5% significance level showing that model is overall valued. The P value is 0.6321 which is greater than its critical value at 5% level of significance showing that that relationship is insignificant between stock returns and their lagged return at lag 1. The value of t-statistics is also less than 1.96 which is consistence with the results of insignificant relationship. Hence there is no element of prediction in the monthly returns showing that there is some sort of weak form efficiency in monthly returns.

#### **4.4 Run Test**

Table 6 reports the results of run test for monthly returns. It shows that Z-statistics for run test is insignificant at 5% significance level and its value also lies inside the studied interval ( $\pm 1.96$ ) which does not reject the hypothesis of randomness for monthly returns.

#### **4.5 Variance Ratio Test**

Table 7 reports the variance ratio test results under the both assumptions of Heteroscedasticity as well as homoscedasticity. The result shows that value of variance ratio is significant for all period under both assumptions. This insignificance of variance ratio rejects the hypothesis of random walk by implying that some of autocorrelation or Heteroscedasticity is presence in monthly returns and this presence of autocorrelation or Heteroscedasticity also rejects the presence weak form efficiency.

## **DISCUSSION AND CONCLUSION**

This study was taken in order to test the weak form efficiency for Karachi stock exchange in order to make for investors by using the utility of technical analysis. Monthly data was taken for this study and normal distribution is checked out by using Jarque Bera and Kolmogorov Smirnov test and showed that normal distribution is not confirmed. For further examination ADF and PP tests are employed which shows that monthly index is not stationary at level and found to be stationary at first difference. For further testing the predictability element the Autoregressive model is applied which shows insignificant relationship of stock returns with lagged returns

and hence support the weak form efficiency. The run test is also applied and it reports that monthly return series are random and hence weak form efficient. Finally variance ratio test is employed which reports that monthly return series are not random and hence does not support the weak form efficiency. Here some contradictory results come out as results of run test and autoregressive model tests are contradicting with the results of variance ratio test so in this case the nature and power of the tool is checked out. According to Lo and MacKinlay (1988) stated that Variance ratio test is more powerful than run test, autocorrelation test so here the result of variance ratio test is accepted which goes against the weak form efficiency of Karachi stock exchange. The results of this study are consistent with the study of Hassan et al. (2007), Haque et al. (2011), and Hamid et al. (2010).

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Annexures

Table 1

Mean	Median	Std.	Kurtosis	Skewness	Minimum
0.010913	0.017723	0.098618	6.991883	-1.117	0.68991

Table 2

<i>Jarque Bera Test</i>	<i>Monthly</i>		<i>KS test</i>	<i>Monthly</i>
JB (Observed Value)	146.4813		Kolmogorov-Smirnov Z	1.435
JB (Critical Value)	5.991		p-value	.033
p-value	0			

Table-3

<i>Monthly Stock Market Data</i>	<i>Lag 1</i>
<i>Prob (F-Statistic)</i>	0.632077
<i>P-Value</i>	0.6321
<i>t-Statistics</i>	0.479698
<i>Coefficient</i>	0.037119

Table-5

<i>Mean</i>	<i>Cases&lt;K</i>	<i>Cases&gt;=K</i>	<i>Total Cases</i>	<i>No. of Runs</i>	<i>Z</i>	<i>P-value</i>
.010913	79	89	168	79	-0.886	0.376

**Table-4**

	<i>Monthly Index</i>		<i>Monthly Index</i>
ADF test statistic		ADF test statistic	
<b>Level</b>	-0.4920	<b>1st difference</b>	-11.4885
Critical value at 1%	-3.4695	Critical value at 1%	-3.4697
Critical value at 5%	-2.8786	Critical value at 5%	-2.8787
Critical value at 10%	-2.5760	Critical value at 10%	-2.5760

**Table-6**

	<i>Monthly Index</i>		<i>Monthly Index</i>
PP test statistic		PP test statistic	
<b>Level</b>	-0.5989	<b>1st difference</b>	-11.4678
Critical value at 1%	-3.46945	Critical value at 1%	-3.46969
Critical value at 5%	-3.46945	Critical value at 5%	-3.46969
Critical value at 10%	-3.46945	Critical value at 10%	-3.46969

**Table-7**

Period = J	MVR tests	Monthly returns		Period = J	MVR tests	Monthly returns
2	VR (J)	0.513026		2	VR (J)	0.513026
	Z*(j)	-3.83619			Z(j)	-6.29309
	Probability	0.0001			Probability	0
4	VR (J)	0.259371		4	VR (J)	0.259371
	Z*(j)	-3.52292			Z(j)	-5.11593
	Probability	0.0004			Probability	0
8	VR (J)	0.128454		8	VR (J)	0.128454
	Z*(j)	-2.97676			Z(j)	-3.80754
	Probability	0.0029			Probability	0.0001
12	VR (J)	0.09448		12	VR (J)	0.09448
	Z*(j)	-2.52651			Z(j)	-3.12128
	Probability	0.0115			Probability	0.0018
16	VR (J)	0.065422		16	VR (J)	0.065422
	Z*(j)	-2.28425			Z(j)	-2.7438
	Probability	0.0224			Probability	0.0061