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Stock Market Efficiency of Karachi Stock Exchange

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Abstract*: This study examines the weak form of efficiency of Pakistani stock market .The study uses daily observation over the period from July 2015 to July 2020, comprising a total of 1258 observations. The market efficiency is examined using Auto correlation, Runs test, Unit root test (ADF &PPT) and the Variance ratio test. The Autocorrelation tests clearly reveal that the null hypothesis is accepted in the case of stock market returns of indices. This suggests that the Pakistani stock market does not follow the random walk and as such are inefficient in the weak form implying that stock prices remain predictable. Only the autocorrelation explodes the Pakistani stock market is efficient.*

Keywords: *Weak form efficiency, Auto correlation, Variance ratio test, Unit root test, Runs test, Random walk.*

1. Introduction:

The efficient-market hypothesis argues that stock markets are based on the informational efficient. The investor normally achieves returns in excess of average market returns on the basis of risk-adjustments, with the help of publicly available information at the time the investment is made. There are three hypothesis of market efficiency: "weak", "semi strong" and "strong". Weak form of efficiency declares that prices of the traded stocks already mirror all publicly available information from the past. Semi-strong form of efficient market hypothesis declares that prices of the stock reflect all publicly available information and that prices immediately change to reflect new public information. Strong form of efficiency additionally declares that prices instantly reflect even hidden or "insider" information.

Since the research done by Fama, there is a common observation of analysts, researchers and practitioners in financial economics that stock prices or returns explore a random walk behavior. The random walk behavior, which forms the theoretical basis of the weak-form efficient market hypothesis, assumes that future stock prices or stock returns are identically and independently distributed that historical stock prices have no predictive power to forecast future stock prices. The random walk hypothesis is an independence test which beliefs that stock prices are indicated by a white-noise process, a stable first-order autoregressive pattern, a unit root process, or a low correlation dimension. Because financial time series such as stock prices exhibit nonlinearity and time-varying volatility, studies that are more recent tend to employ Auto correlation, Runs test, Unit root test (ADF &PPT) and the Variance ratio test to examine the existence of long-term dependence in stock returns.

There are numerous empirical research in both developed and developing countries concerning the rationality of the random walk hypothesis or weak-form efficient market with respect to stock prices. The empirical research on the random walk hypothesis explored the mixed results. The previous research is supportive of the weak and semi-strong forms of the efficient market hypothesis in well-developed stock markets. The current research has reported that stock prices and stock market returns are foreseeable. The empirical result is also mixed for the developing countries and emerging capital markets can be divided into two groups depending on findings.

A researcher who finds the evidence to support the weak-form efficiency and others shows the evidence of predictability or rejection of the random walk hypothesis in stock returns. Considering the theoretical and practical significance, the testable implications and conflicting empirical evidence of the random walk hypothesis motivates us to have a fresh look at this issue of weak-form efficiency in the context of an emerging market, namely Karachi stock exchange.

2. Review of Literature:

There were numerous researches conducted in the efficient market hypothesis. Earlier studies mostly probed into the behavior of developed financial markets, mostly of European and US financial markets. Traditionally markets of developed economies are more efficient as compared to emergent markets (Gupta, 2006).

(Kendal, 1953) Investigated British industrial and US commodity share price indices. The study supported random walk on zero correlation rationale. Similar rationale was provided by Working (1934) with small sample.

(Cootner, 1962) Picked 45 stocks from New York stock exchange and found similar results at low levels of correlation. (Lo & MacKinlay, 1988) Conducted a vital study on stock price of US for the period of 1962-1985, by first introducing variance ratio test. The study rejected the random walk hypothesis of weekly and monthly returns. (Fama & French, 1988) done a study on the stocks of New York Stock Exchange (NYSE) for the period of 1926-1985 and found result of large negative autocorrelations for long periods of time. (Poterba & Summers, 1988) applied variance ratio test on Standard and Poor's composite stock index for the period 1928-1984, for US stocks market as whole for the period 1871-1986, and for sixteen other countries for 1957-1985. They rejected the random walk and found the evidence of positive serial correlation over short periods and negative autocorrelation for longer periods. But the study of (Lee, 1992) found contradictory existence of random walk for the stock markets of US and other ten developed countries like United Kingdom, Netherlands, Switzerland, Italy, Japan France, West Germany, Australia, Belgium and Canada, for the period of 1967–1988. Uniformly, (Choudhry, 1994) appraised stock indices of United States, United Kingdom, Canada, France, Japan, Italy and Germany for the period 1953–1989, by employing unit root test and co-integration using monthly stock return and also established unit root and presence of random walk in all stocks. (Poon, 1996) studied about the stock markets of UK for random walk, serial correlation, and persistence of volatility and found presence of random walk.

(Chan, Gup, & Pan, 1997)examined on 18 international stock markets like France, Germany, India, Italy, Japan, Netherlands, Norway, Pakistan, Spain, Sweden, Switzerland, the United Kingdom, Australia, Belgium, Canada, Denmark, Finland, and the United States for the period of 1962-1992. Amongst them, sixteen countries have developed stock markets and two countries like India and Pakistan are emerging stock markets. The study was aimed at test about the weak-form efficiency of stock markets. The result of unit root test revealed that the weak-form efficiency in developed market.

(Groenewold, 1997)assessed the stock markets of Australia and New Zealand for the period of 1975-1992. The study examined the weak-form of efficiency and semi-strong form efficiency in those markets. And applied stationarity test and autocorrelation tests and found result of efficient market hypothesis. (Lee, Gleason, & Mathur, 2000) examined about the futures and options markets using unit root and variance ratio tests. The study rejects the random walk hypothesis in the stock markets.

(Worthington & Higgs, 2004) studied about the sixteen European stock markets for random walk hypothesis like France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom Austria, Belgium, Denmark and four emerging markets of Czech Republic, Hungary, Poland and Russia. The popular three statistical test like Augmented Dickey-Fuller, Phillips-Perron and multiple variance ratio were applied. The result was found that only Hungary, Germany, Ireland, Portugal, Sweden and the United Kingdom follow random walk criterion.

(Gan, Lee, Hwa, & Zhang, 2005)assessed the stock markets of Australia, US, New Zealand, and Japan for the period of 1990-2003, and coincide the findings of (Groenewold, 1997) except for the granger causality test between the stock market of Australian and New Zealand. The study used Augmented Dickey-Fuller, Phillips-Perron test for measuring stock market efficiency.(Nakamura & Small, 2007) studied about the random walk hypothesis in US market and in Japanese market, exchange rate and commodity markets. And found the existence of markets whose first differences are independently distributed random variables. (Torun & Kurt, 2008) made a study about to investigate the weak-form and semi-strong efficiency on European Union Countries stock price index, consumer price index and purchasing power of euro for the period of 2000-2007. The study used unit root test, co-integration and causality test and found result of weak-form efficiency.

(Borges, 2010) Studied about the random walk hypothesis of the stock markets of France, Germany, UK, Greece, Portugal and Spain, for the period of January 1993 to December 2007 by using serial correlation test, runs test, multiple variance ratio test proposed by (Lo & MacKinlay, 1988) and ADF test. The study found the random walk hypothesis in all six countries for monthly returns. But from for the daily returns hypothesis of random walk was rejected for Greece and Portugal. (Shaker, 2013) assessed the weak-form efficiency of Finnish and Swedish stock markets by using ADF, variance ratio test proposed by (Lo & MacKinlay, 1988). This study explored the result of rejection of the hypothesis of random walk in these markets. The above empirical literature explored the result of weak-form efficiency and random walk in most of the developed financial markets and some emerging markets.

(Kim & Shamsuddin, 2008)studied about the stock market of Hong Kong, Japanese, Korean, Taiwan, Indonesia, Malaysia, Philippines, Thailand and Singapore. Weekly and monthly data were used for testing market efficiency by using non-parametric tests. They used multiple variance ratio test based on wild bootstrap. The markets of Hong Kong, Japanese, Korean and Taiwan were weak-form efficient. The stock markets of Indonesia, Malaysia and Philippines were weak form of inefficient. However Singaporean and Thai markets became efficient after Asian financial crises of nineties. The result of Hong Kong and Singapore market efficiency were weak form of efficient(Lima & Tabak, 2004).

(Nikita & Soekarno, 2012) also disclosed the result of weak-form inefficiency in Indonesian stock market during the period 2008-2011.

Further study made by (Munir, Ching, Furouka, & Mansur, 2012)to judge efficiency of Asean security markets like Indonesia, Malaysia, Philippines, Singapore and Thailand. The data were used for the period of 1990-2009. The auto regressive (TAR) approach was used to study the non-linearity in stock returns. Malaysia and Thailand stock returns followed random walk, while Indonesia, Philippines and Singapore do not follow the random walk. (Phan & Zhou, 2014)assessed the stock market of Vietnam for the period of 2000-2013 by autocorrelation test, variance ratio test, and runs tests. Vietnamese stock market was not found efficient in the study periods.Furthermore, the study has been made in Pakistani stock market and explored the result of inefficiency(Khwaja & Mian, 2005).(Cooray & Wickramasighe, 2007)studied about the Pakistani stock market and three other South Asian markets resulted the weak-form efficiency in pakistani stock market. (Mustafa & Nishat, 2007) also explored the presence of weak-form efficiency in Pakistan stock market. However, serial correlation and inefficiency was found in the Pakistani stock market by using co-integration test, variance ratio test, runs tests and GARCH (Mishra, 2011).

The main objective of this study is to examine whether the Karachi stock is weak-form efficient over the period from July 2015 to July 2020. The purpose of this study is also to find out whether Pakistani stock returns follow the random walk hypothesis. This study applies a classical framework of testing market efficiency to determine whether or not the time series predictability in Pakistani stock returns follow the random walk model which maintains that past stock return changes cannot be used to predict future stock returns.

3. Description of Data sample:

In this study daily index values of Karachi Stock Exchange (KSE 100) are used. The data, obtained from data stream, are collected on daily basis between the periods June 2015 to June 2020.

4. Data Analysis with Hypotheses:

The data which was collected was used in order to find out if the Pakistani stock market followed a random walk pattern or weak form efficiency. Therefore in order to check the above stated, time series analysis was used to determine a result. The tests which were used in the time series analysis include the Auto Correlation Function**,** Runs test unit root test and Variance ratio test. The hypothesis of the study is:

H0: The Pakistani stock market is a weak-form efficient.

H1: The Pakistani stock market is a weak-form inefficient

5. Statistical Tests for Market Efficiency:

In this study, we use two statistical methods, namely an autocorrelation correlation test and a runs test. The data is subjected to an autocorrelation correlation test, a non-parametric runs test to determine the level of dependency among successive returns of Nepalese stock market. The non-parametric run test is one of the most well-known earlier tests of the market efficiency based on the assumptions of the random walk hypothesis, while the autocorrelation correlation tests are based on the test of the weakest version of the random walk. These statistical tests are discussed more closely in each following with the help of SPPSS & Eviews.

Auto Correlation

As noticed in the literature, an autocorrelation test is the most commonly use as the first tool for randomness. Autocorrelation test measures the correlation coefficient between a series of returns and lagged returns in the same series, whether the correlation coefficients are significantly different from zero.

Runs Test

A runs test is another common approach to test for statistical independencies.. The runs test is a non-parametric test that is designed to examine whether successive price changes are independent. The test is based on the premise that if a series of a data is random, the observed number of runs in the series should be close to the expected number of runs.

Unit Root Test (ADF &PPT)

Unit root test is a statistical test aimed for measuring the stationary of the data. It becomes obligatory for the researcher to perform the stationary test in the time series data

Variance ratio test

The Lo and Mackinlay variance ratio test is powerful than the Dickey-Fuller unit root or the autocorrelation Q tests for testing the predictability in stock price series (Lo and Mackinlay, 1989). The assumption of variance ratio test, the random walk series is linear in the sample interval.

6. Discussion:

Appendix 1 illustrates the results of autocorrelation test. The16 lag periods are taken for the autocorrelation test. The autocorrelation explore that the stock price of the Pakistani stock market follow a random walk because the p value of 0.7080 is higher than Alfa ($P \geq 0.05$). The null hypothesis is accepted which states that stock returns on the Pakistani stock market is efficient. Appendix 2 explores the results of the run test. This study finds the Z value to be -6.713 and also, the P value is 0.000 and is significant at the 95% significance level ($P \leq 0.05$). The null hypothesis is not accepted, which indicates that the Pakistani stock market does not follow a random walk and the stock market can be classified as weak form inefficient.

Appendix 3 & 4 presents the result of unit root test of at the maximum lag length of 22.The probability value of Augmented Dickey-Fuller test statistic is 0.0000 which is less than 0.05. Thus the above test, results to rejection of research hypothesis i.e KSE index has unit root (Non stationary).So return of KSE is stationary (no unit root). Appendix 5 illustrates the Variance ratio of joint as well as individual test explore the same picture that the Pakistani stock market is weak form of inefficient. Both joint and individual test reject the null hypothesis because the probability is less than the 5% level of significance ($P \leq 0.05$) as well as Z value is higher than the critical value at 5% level of significance. Since the stock market is weak form inefficient, that investors have opportunity to earn excess profit by investing in the stock market. This implies that the stock market of Nepal is weak form inefficient signifying that there is a systematic way to exploit trading opportunities and able to acquire excess profits. In this situation the investor can get an opportunity for predicting the future prices and earning abnormal profits. Since the stock market is weak form efficient, investors are unable to earn abnormal profit from the stock market.

7. Conclusion:

Here in the study the tests of statistics explore conflicting results as ACF test indicates that the Pakistani stock market is weak form of efficient, Run test, ADF, PP test and variance ratio test results to rejection of null hypothesis i.e KSE 100 index indicates that the Pakistani stock market is weak form inefficient. Hence it can be concluded that the above tests prove that the investors have fruitful opportunity to earn profit by investing in the Pakistani stock market.

8. Implication:

The implication of acceptance of weak form efficiency for investors is that they cannot predict the stock price movements, in the Pakistani stock market. But the implication of rejection of weak form efficiency for investors is that they can better predict the stock price movements, by holding a well-diversified portfolio while investing in the Pakistani stock markets. Further research can be constructed to investigate whether the Pakistani stock market is weak-form efficient using weekly or monthly data. Alternatively, using the largest and liquid stocks might have more power to detect the weak-form efficiency of Pakistani stock market. Another fruitful area of research can be testing sectorial indices.

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Appendices

Appendix-1

Autocorrelations

Series:Rk

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.088	.028	9.722	1	.002
2	-.021	.028	10.257	2	.006
3	.006	.028	10.303	3	.016
4	-.001	.028	10.305	4	.036
5	.007	.028	10.370	5	.065

6	-.003	.028	10.381	6	.109
7	-.008	.028	10.452	7	.164
8	.001	.028	10.455	8	.235
9	-.004	.028	10.475	9	.313
10	-.004	.028	10.496	10	.398
11	.017	.028	10.884	11	.453
12	-.005	.028	10.917	12	.536
13	-.009	.028	11.020	13	.609
14	.026	.028	11.910	14	.613
15	-.019	.028	12.362	15	.651
16	-.011	.028	12.517	16	.708
a. The underlying process assumed is independence (white noise).					
b. Based on the asymptotic chi-square approximation.					

Appendix-2

Runs Test	
	Rk
Test Value[a]	-.00030
Cases < Test Value	629
Cases >= Test Value	629
Total Cases	1258
Number of Runs	511
Z	-6.713
Asymp. Sig. (2-tailed)	.000
a. Median	
Runs Test 2	
	Rk
Test Value[a]	-8.230965 8E-4
Cases < Test Value	592
Cases >= Test Value	666
Total Cases	1258
Number of Runs	509
Z	-6.726
Asymp. Sig. (2-tailed)	.000
a. Mean	

Appendix-3

Null Hypothesis: D(RK) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=22)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.34542	0.0000
Test critical values:	1% level	-3.435352	
	5% level	-2.863637	
	10% level	-2.567936	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RK,2)
Method: Least Squares

Date: 11/02/20 Time: 13:36
Sample (adjusted): 5 1258
Included observations: 1254 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RK(-1))	-2.203547	0.165116	-13.34542	0.0000
D(RK(-1),2)	0.618047	0.121675	5.079479	0.0000
D(RK(-2),2)	0.206157	0.067468	3.055639	0.0023
C	-0.000783	0.000870	-0.900896	0.3678

R-squared	0.326497	Mean dependent var	-0.000785
Adjusted R-squared	0.324880	S.D. dependent var	0.037481
S.E. of regression	0.030796	Akaike info criterion	-4.119663
Sum squared resid	1.185511	Schwarz criterion	-4.103286
Log likelihood	2587.029	Hannan-Quinn criter.	-4.113507
F-statistic	201.9889	Durbin-Watson stat	1.179034
Prob(F-statistic)	0.000000		

Appendix-4

Null Hypothesis: D(RK) has a unit root
Exogenous: Constant
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-20.24484	0.0000
Test critical values:	1% level	-3.435344	
	5% level	-2.863633	
	10% level	-2.567934	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000968
HAC corrected variance (Bartlett kernel)	0.000841

Phillips-Perron Test Equation
Dependent Variable: D(RK,2)
Method: Least Squares
Date: 11/02/20 Time: 13:42
Sample (adjusted): 3 1258
Included observations: 1256 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RK(-1))	-1.395609	0.058879	-23.70308	0.0000
C	-0.000792	0.000879	-0.901016	0.3678

R-squared	0.309409	Mean dependent var	-0.000793
Adjusted R-squared	0.308858	S.D. dependent var	0.037452
S.E. of regression	0.031136	Akaike info criterion	-4.099343
Sum squared resid	1.215654	Schwarz criterion	-4.091165
Log likelihood	2576.387	Hannan-Quinn criter.	-4.096269
F-statistic	561.8358	Durbin-Watson stat	1.239141
Prob(F-statistic)	0.000000		

Appendix-5

Null Hypothesis: RK is a martingale
Date: 11/02/20 Time: 13:37
Sample: 1 1258
Included observations: 1257 (after adjustments)
Heteroskedasticity robust standard error estimates
User-specified lags: 2 4 8 16

Joint Tests	Value	df	Probability
Max |z| (at period 2)*	45.44149	1257	0.0000

Individual Tests

Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	0.524303	0.010468	-45.44149	0.0000
4	0.265677	0.020025	-36.67055	0.0000
8	0.136475	0.031788	-27.16519	0.0000
16	0.076861	0.048966	-18.85256	0.0000

*Probability approximation using studentized maximum modulus with parameter value 4 and infinite degrees of freedom

Test Details (Mean = -0.000786993316312)

Period	Variance	Var. Ratio	Obs.
1	0.00100	--	1257
2	0.00053	0.52430	1256
4	0.00027	0.26568	1254
8	0.00014	0.13647	1250
16	7.7E-05	0.07686	1242