Available online at www.elixirpublishers.com (Elixir International Journal)

Finance Management

Elixir Fin. Mgmt. 91 (2016) 38335-38341

ISSN: 2229-712X

Testing of random walks in Karachi stock exchange

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ARTICLE INFO

Article history:
Received: 17 October 2012;
Received in revised form:
10 February 2016;
Accepted: 16 February 2016;

Keywords
Random walk,
Weak form Efficiency,
Karachi Stock Exchange.

ABSTRACT
This study was conducted to check the random walk behavior in the Karachi Stock Exchange. Daily, weekly and monthly stock returns of KSE 100 index for the period from 1st Jan. 1998 to 29th Feb. 2012 was tested by using descriptive statistics, VAR test, RUN test, KS test and unit root tests (ADF test and PP). Results of all the tests indicate that the KSE don't follow random walk behavior and thus not weak form efficient, and there are chances of abnormal profit for the technical investors.

Introduction

The concept of "Market efficiency" is very important to understand the working of stock markets of the world. Fama and French (1970) introduce the concept of market efficiency. According to Fama and French (1970) the prices can't be predicted, stock market is efficient and there is no chance of getting benefit. The term market efficiency means that prices changes instantaneously as the information is released, stock prices reflect all relevant information available. The market where everybody knows everything and everybody has full information is called efficient market. All the assets in the market are appropriately priced no asset is undervalued or overvalued and market is offering optimal return to the investors on their level of risk. Market efficiency is categorized into three forms, weak-form market efficiency, semi-strong market efficiency and strong-form market efficiency. In weak-form market efficiency stock prices reflect all the historical price information. In weak-form efficiency the benefit of public information can be gain by the investor. In semi-strong form of market efficiency prices of stocks reflect instantaneously new publically available information. In semi-strong efficiency investor can gain the benefit of inside trading. Strong form efficiency is the form in which stock prices reflect all the information whether available publically or private. In strong-form efficiency no abnormal benefit can be gained by the investor.

The hypothesis of market efficiency is linked to the random walk behavior. The random walk states that the price of tomorrow is independent of today's price, prices can be determined on the base of daily economic condition; past prices can't be useful to forecast the future prices. If a market follows a random walk than its means that there are no patterns present in the market and any new information that is available is instantaneously reflected in the prices of stock and investor can't earn the abnormal profit by identifying trends or patterns.

Objective of Study

The objective of this study is to check the efficiency in its weak-form in Karachi Stock Exchange and check whether KSE follow random walk or not. The purpose behind the study is to identify that a technical investor that uses historical trends and events to forecast future prices can earn the benefit from KSE or not.

Literature Review

Moberik et al. (2008) conducted a study whether Dhaka stock exchange (DSE) follow random walk behavior or not. For this purpose daily price index of DSE over the period of 1988 to 2000 were used. Both parametric tests (auto-regression model, auto-correlation test, ARIMA model) and non-parametric (Run test and Kolmogorov-Smirnov normality test) were employed to test random walk model in DSE. The results of all parametric and non-parametric tests provide evidence that the security returns in DSE don't follow the random walk model and there is no presence of weak form of efficiency in DSE.

Hassan et al. (2007) investigates the market efficiency in weak-form in Karachi stock Exchange (KSE). The data examined consists of daily, weekly and monthly returns for the period Jan1st, 2000 to Dec 31st, 2005 to test Random Walk behavior. Jarque- Bera test, Kolmogorov-Smirnov test, auto correlation coefficient runs tests, Augmented Dickey-Fuller (ADF), Phillips- Perron (PP) and multiple variance ratio (MVR) tests were used. The outcome of tests shows that there is no random walk in KSE. That means KSE is not weak-form Efficient. Technical analysts can forecast the market and earn profits.

Gupta et al. (2007) check the weak form market efficiency in the support of random walk hypothesis for two major equity markets of India, National stock exchange (NSE) and Mumbai stock exchange (BSE). Values of daily indexes for the period 1991 to 2006 were used and unit root tests; Phillips-Perron (PP) test and Augmented Dickey-Fuller (ADF) were employed. The results suggest that BSE and NSE don't follow random walk and thus they are not efficient in weak form.

Ilyas, et al. (2011) investigates efficiency in weak-form in banking sector in Karachi stock Exchange by using the closing prices on daily basis for individual firm level. The data used was consists of daily prices from June, 1997 to April 15, 2009 as of eleven banks listed in KSE whose stocks are traded at high volume. The tests used include Phillips-Perron tests and

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Augmented Dickey Fuller in an order to check the stationarity of prices, whereas VAR tests and Co-integration are applied to check the weak-form efficiency in the banking sector. The results rejected the hypothesis of weak form efficiency in banking sector in KSE. In addition the prices show predictable patterns of banking sector in KSE means that random walk behavior is not present in KSE.

Srinivasan (2010) in his research investigates the market efficiency in weak-form for two major stock market indexes in India S&P CNX Nifty and SENSEX of National stock Exchange (NSE) and Bombay Stock Exchange (BSE). The data consist of daily closing prices for the period of 1stJuly 1997 to 31st August 2010. The random walk hypothesis is examined by using unit roots tests, Phillips-Perron test and Augmented Dickey-Fuller test. The results of ADF and PP unit root tests shows that these two Indian stock markets don't follow random walk behavior and so are not weak-form efficient and stock prices are predictable.

Awad et al (2009) examine the weak form market efficiency in Palestine Security Exchange (PSE). The daily stock indices time series data of the PSE for the period 1st January 1998 to 31st October 2008 were used for the purpose. Different tests include serial correlation tests, Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and RUN test were used for examining the efficiency in its weak form in PSE. The results of parametric and non parametric tests exposed that PSE daily returns are weak form inefficient. It provides evidence that there is a chance of getting abnormal return for the investors by using historical trends in stock prices.

Mohamad et al (1993) investigates the predictability efficiency in Kuala Lumpur stock Exchange (KLSE) by using the unit root analysis. The data used for the analysis consist of monthly and weekly closing prices of all the indices of KLSE for the period of Jan. 1977 to May 1989. The results show that the KLSE is efficient in weak form.

Dewotor et al (2011) investigates and compare the market efficiency in weak-form of 32 stock prices indices in Africa, includes 8 individual African national stock price indices and 24 African continents wide. The data used for this analysis was consisting of 2 sets. First set consists of African continent wide sectorial, capitalization and regional daily closing stock prices indices and second set consists of daily national closing stock prices indices. Non parametric variance tests were used to check the weak informational efficiency. The results of the study shows that24 continent wide stock indices are more efficient than the National stock prices indices.

Hamid et al. (2010) conducted a study to check the random walk behavior and weak form efficiency in Asia-pacific region which includes stock markets of Australia, China, Hong-Kong, India, Indonesia, Japan, Korea, Malaysia, Pakistan, Philippine, Sri Lanka, Singapore, Thailand and Taiwan. The data uses for the study consists of monthly prices beginning from Jan. 2004 and ends on Dec. 2009. Autocorrelation, run test, unit root test, Ljung- box Q-statistic test and variance ratio were used to test the random walk behavior. The results of the tests show that the monthly return of the Asia-Pacific region stock markets don't follow the random walk behavior and no market is weak-form efficient so investors can predict the prices and earn the benefit.

Al-Saleem et al. (2003) conducted a study to investigate the weak-form market efficiency in Kuwait Stock Market (KSE). The data of daily stock price for the time period of 1995 -2000 was collected. Tests used for checking the weak-form market efficiency includes serial correlation test and the linear model. The results show that the Kuwait Stock Exchange is not weak form efficient however the efficiency of the market is being improved in the sample period of time.

Hossain et al (2006) conduct a study to check that Dhaka stock Exchange (DSE) is weak form efficient or not. The data use for the purpose is ranging from 1994 to 2005. The data was consists of daily price indices from 1st Jan. 1994 to 30th May 2005.Both non-parametric and parametric tests were used to test the random walk behavior. Parametric tests include ARIMA (0, 1, 0) test and auto-correlation coefficient test. Non-parametric tests include Lillie-fores test, Kolmogorov-Smirnov tests, Q-Q probability plots and run test. The results of all the tests provide confirmation that Dhaka stock Exchange (DSE) is not efficient in weak form and there is no random walk in DSE and investors can earn abnormal return.

Asiri (2008) conduct a study to check the random walk behavior in the prices of Bahrain Stock Exchange (BSE) and to check whether BSE is efficient in weak-form or not. The data use in the study was consist of daily stock prices of all listed companies in BSE for the period of 1st June 1990 to 31st Dec. 2000. The dickey-fuller with drift and trend test, unit root test with drift, exponential smoothing test and ARIMA were used to check the random walk in BSE. The results of all the tests show that BSE follow the random walk behavior and BSE is also efficient in weak form.

Irfan et al. (2010) investigate the market efficiency in weak form in Karachi stock Exchange (KSE). The sample of the study includes daily and monthly closing prices for the period of 1stJanuary 1999 to 31st August 2009. Different parametric methods were used to test the weak form efficiency in KSE. These tests include autocorrelation tests, unit root test and ARIMA model. The results of all the tests show that KSE don't follow the random walks and KSE is not weak-form efficient.

Khan et al. (2011) tests the efficiency in its weak form in Indian capital market on the basis of indices of two major stock markets of India National Stock market (NSE) and Bombay stock market (BSE). Daily closing prices of NSE ant BSE over the period of 1st of April 2000 to 31st of March 2010 were used and run test was employed to check the random walk in NSE and BSE. The results of the run test shows the there are trends present in Indian capital market so NSE and BSE both do not follow random walks and thus are not weak-form efficient.

Moustafa (2004) conduct a study to examine the stock prices behavior in United Arab Emirates (UAE) stock market. 43 listed stocks daily prices were used to check the behavior of prices. The data consist of prices from 2nd October 2001 to 1st September 2003. Non Parametric run test was employed to test the randomness. The results of the tests provide evidence that UAE stock market efficient in weak-form.

Worthington, et al. (2006) investigates the market efficiency in weak-form in Asian-pacific stock markets. Daily returns of five developed markets (Hong-Kong, Japan, New-Zealand, Australia, and Singapore) and ten emerging (China, Indonesia, India, Korea, Malaysia, Philippines, Pakistan, Sri-Lanka, Thailand and Taiwan) were observed for random walks. The techniques used for the purpose were multiple variance ratio tests, serial correlation coefficient and runs tests, Phillips-Peron and Kwiatkowski, Augmented Dickey-Fuller, , Phillips, Schmidt and Shin unit root tests. The ending date for all data was 28th May 2003 with Australia commencing on 31st Dec.1986, Pakistan on 1st Nov. 1995, China, India and Sri-Lanka on 31st

Dec-1992 and the remaining all markets on 31st Dec. 1987. The runs tests and serial correlation show that all of the markets are not weak-form efficient. The unit root tests concluded that all markets are weak-form efficient except the markets of Australia and Taiwan. The results from the variance ratio tests show that not only a single emerging market follows the random walks and therefore are not efficient in weak-form, although the developed markets of Japan, Hong-Kong and New-Zealand follow the random walk criteria.

Hameed, et al. (2006) investigates stock returns volatility and test the efficiency of the stock market of Pakistan in weak-form, using GARCH Model. Data consists of daily closing stock prices from Dec. 1998 to Mar. 2006. Results of the study point out that returns of Pakistan stock market show trends and volatility clustering. Hypothesis of weak-form efficiency is rejected because the previous trends help in forecasting future prices and provide chances of abnormal returns.

Shamsavari, et al. (2010) investigates random walks in Iran stock market(ISM). For this purpose, the data used includes observations for the period 2nd Jan. 1999 to 31st Oct. 2009. Different tests including Phillips-Peron (PP) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) unit root tests, Augmented Dickey-Fuller (ADF), structural break a Perron unit root tests were used to test random walks in ISM. The results of the test employed show that the Iran stock market is efficient in the weak-form and prices can't be predicated from the past movements and investor can't earn abnormal returns.

Mangus (2008) conducted a study to check the efficient market hypothesis (EMH) in weak-form in the Ghana Stock Exchange (GSE). Databank Stock Index (DSI) daily returns for period of 1999-2004 were used for the purpose to test the weak form efficiency. GARCH (1, 1) and Random walks models were used to check the efficiency of GSE. The GSE DSI returns series show volatility in the returns of the stocks, which gives the sign of inefficiency in the GSE. The efficient market hypothesis of weak-form was rejected for the GSE that means that GSE is not efficient in weak form and prices are predictable.

		Daily	Weekly	Monthly
Kolmogorov-Smirnov(a)	Statistic	.164	.167	.167
	df	3458	731	170
	Sig	.000	.000	.000
Shapiro-Wilk	Statistic	.871	.870	.871
	df	3458	731	170
	Sig	.000	.000	.000

Data and Methodology

The data used in the study is obtained from Yahoo! Finance. The daily, weekly and monthly KSE index closing prices from the 1st January 1998 to 29 February 2012 was used to check the random walk and weak form efficiency in Karachi Stock Exchange. The daily data include 3458 observations of daily index. Weekly data includes 731 observations and monthly data includes 170 observations. LN of index was taken to calculate the return.

$R= LN (R_t/R_{t-1})$

Where Rt= market price at time t

Rt-1=market price at time t-1

Following tests have been used to check the efficiency of the KSE 100 index

VAR test

Unit root Test

K-S Test

Descriptive statistics

Run Test

Unit root tests are used to see that whether the financial time series is non-stationary which is necessary condition for a random walk.

Unit root tests include 2 tests (i) Augmented Dickey-Fuller (ADF) test and (ii) Phillips-Perron (PP) test.

The augmented dickey-fuller test use to check whether a unit root is present in the model the more negative it is the stronger is the rejection of the hypothesis that there is a unit root at a given level of confidence.

$X_t= c_0+cX_{t-1}+c_t(t-T/2)+u_t$

Phillip Perron test allows the error distribution to be weakly dependent and heterogeneously distributed.

Normality tests check that whether the data is normally distributed or not.

Run test is used to analyze that whether the stock prices are dependent or independent to each other.

Hypothesis:

H1: Stock prices in KSE are non random.

H0: Stock prices in KSE are random.

Data Analysis

VAR Test

VAR test is use to check the lag length. We select the lag length by checking the minimum value of SC.

The VAR estimated on the daily data has minimum value of lag 2 so 2 lag length is selected for daily data.

The VAR estimated on the weekly data has minimum value of SC on lag length 2.

The VAR estimated on the Monthly data of KSE has minimum value on Lag 1 so Lag length 1 is selected.

The result of descriptive statistics shows that the average daily return of KSE is 8.44% and Std. deviation is .9314 which means that there is high risk in the KSE. Weekly avg. return in KSE is 8.40% and the std. deviation on Weekly return is .9338 which indicates that there is high risk in KSE. Monthly avg. return on KSE is 8.40% and value of Std. Deviation is .9385 which is very high and so the return on this risk is also high.

Unit root test is used to check the stationarity of data. For this purpose ADF test and PP tests were used. Results indicated that data was non stationary at level but becomes stationary after first differencing. And it shows that there exists trend in the data and the technical analysits can get benefit from the historical information. So from the results of the ADF and PP tests rejects the null hypothesis and Accept the alternative hypothesis that is the stock prices of KSE are not random.

The value of KS is significent because its value is less than .05 so we accept alternative hypothesis that is the stock prices in KSE are non-random and reject null hypothesis that the stock prices in KSE are random.

Histrograms:

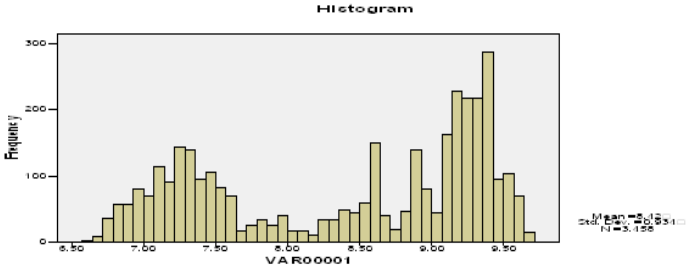

Figure 1: Histogram of Daily Data

Table 1: Daily

VAR Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4659.87	NA	0.872908	2.701953	2.703734	2.702589
1	9189.979	27683.64	0.000285	-5.32636	-5.3228	-5.32509
2	9207.282	34.5763	0.000282	-5.33582	-5.330471*	-5.33391
3	9210.759	6.946608	0.000282	-5.33725	-5.33013	-5.33471
4	9212.921	4.316382	0.000281*	-5.337925*	-5.32902	-5.334744*
5	9212.942	0.042292	0.000282	-5.33736	-5.32667	-5.33354
6	9213.819	1.751276	0.000282	-5.33729	-5.32482	-5.33283
7	9213.881	0.123048	0.000282	-5.33674	-5.32249	-5.33165
8	9216.023	4.272620*	0.000282	-5.3374	-5.32137	-5.33168
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Table 2: Weekly

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-984.7779	NA	0.881641	2.711906	2.718218	2.714342
1	1315.424	4587.748	0.001579	-3.613270	-3.600646	-3.608399
2	1326.604	22.26806*	0.001535	-3.641276	-3.622340*	-3.633969*
3	1327.909	2.596365	0.001534*	-3.642116*	-3.616868	-3.632374
4	1328.292	0.759110	0.001536	-3.640417	-3.608856	-3.628238
LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Table 3: Monthly

VAR Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-212.6000	NA	0.874521	2.703797	2.723181	2.711669
1	139.4166	695.1213*	0.010282*	-1.739450*	-1.700683*	-1.723707*
2	139.5682	0.297535	0.010393	-1.728712	-1.670561	-1.705096
3	139.5934	0.048987	0.010523	-1.716372	-1.638838	-1.684884
4	139.9714	0.732238	0.010606	-1.708499	-1.611582	-1.669140
5	139.9944	0.044152	0.010738	-1.696131	-1.579830	-1.648900
6	140.8701	1.673758	0.010755	-1.694558	-1.558873	-1.639455
7	140.9454	0.143017	0.010882	-1.682853	-1.527785	-1.619878
8	141.0087	0.119410	0.011012	-1.670996	-1.496545	-1.600149
9	142.2480	2.321786	0.010979	-1.674026	-1.480191	-1.595307
10	142.2501	0.003771	0.011120	-1.661393	-1.448174	-1.574802
11	142.2980	0.088634	0.011255	-1.649342	-1.416740	-1.554879
12	142.2980	2.04e-05	0.011399	-1.636684	-1.384698	-1.534349
LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Table 4: Descriptive Statistics

Descriptive								
			Daily		Weekly		Monthly	
VAR00001			Statistic	Std. Error	Statistic	Std. Error	Statistic	Std. Error
	Mean		8.4169	.01589	8.4084	.03473	8.4049	.07198
	95% Confidence Interval for Mean	Lower Bound	8.3858		8.3402		8.2628	
		Upper Bound	8.4481		8.4766		8.5470	
	5% Trimmed Mean		8.4405		8.4309		8.4271	
	Median		8.7068		8.6645		8.6649	
	Variance		.873		.881		.881	
	Std. Deviation		.93439		.93886		.93851	
	Minimum		6.64		6.66		6.74	
	Maximum		9.66		9.66		9.62	
	Range		3.02		3.00		2.89	
	Interquartile Range		1.86		1.87		1.88	
	Skewness		-.379	.042	-.360	.090	-.358	.186
	Kurtosis		-1.465	.083	-1.487	.181	-1.496	.370

Table 5: Unit Root Test

	Daily				Weekly				Monthly			
	ADF Level	ADF First Diff.	PP Level	PP First Diff.	ADF LEVEL	ADF 1ST DIFF.	PP LEVEL	PP 1ST DIFF.	ADF LEVEL	ADF 1ST DIFF.	PP LEVEL	PP 1ST DIFF.
KSE 100 Index	-0.6948	-30.594	-0.6676	-53.225	-0.7999	-13.439	-0.7445	-22.630	-0.6732	-8.804	-0.7224	-12.385
Critical Values												
1%	-3.4320	-3.4320	-3.4320	-3.4320	-3.4391	-3.4391	-3.4390	-3.4390	-3.4694	-3.4696	-3.4692	-3.4694
5%	-2.8621	-2.8621	-2.8621	-2.8621	-2.8652	-2.8653	-2.8652	-2.8652	-2.8786	-2.8787	-2.8785	-2.8786
10%	-2.5671	-2.5671	-2.5671	-2.5671	-2.5688	-2.5688	-2.5688	-2.5688	-2.5759	-2.5760	-2.5759	-2.5759

Table 6: KS test (Tests of Normality)

		Daily	Weekly	Monthly
Kolmogorov-Smirnov(a)	Statistic	.164	.167	.167
	df	3458	731	170
	Sig	.000	.000	.000
Shapiro-Wilk	Statistic	.871	.870	.871
	df	3458	731	170
	Sig	.000	.000	.000

a Lilliefors Significance Correction

Table 7: Run Test

	Mean			Median		
	Daily	Weekly	Monthly	Daily	Weekly	Monthly
	VAR00001	VAR00002	VAR00003	VAR00001	VAR00002	VAR00003
Test Value(a)	8.4169	8.4084	8.4049	8.71	8.66	8.66
Cases < Test Value	1436	308	71	1729	365	85
Cases >= Test Value	2022	423	99	1729	366	85
Total Cases	3458	731	170	3458	731	170
Number of Runs	6	4	2	8	6	4
Z	-58.639	-26.829	-12.921	-58.575	-26.685	-12.616
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000

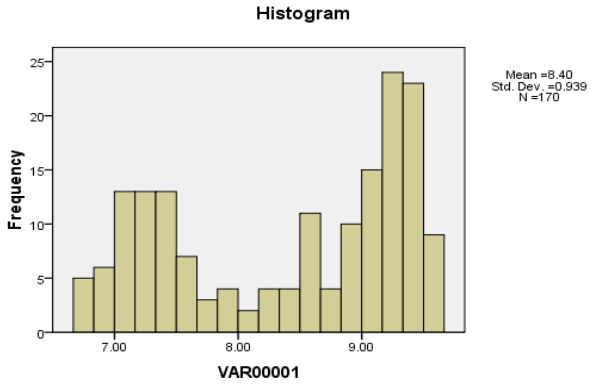

Figure 2: Histogram of Weekly Data

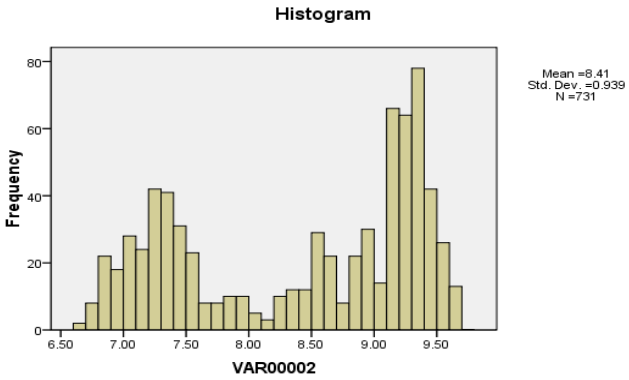

Figure 3: Histogram of Monthly Data

The histogram graphs shows that the data of daily, weekly and monthly prices of KSE are non random and there exists trend in the data and the technical analysts can get benefit from these trends and earn abnormal profits from KSE.

The value P 2 tailed for daily, weekly and monthly returns are .000 that is less than .05 so the KSE is non weak form efficient and the trends and patterns exist in KSE which means that the technical analysts can earn the abnormal profit.

Conclusion

This empirical study is conducted to investigate the market efficiency in the weak form in Karachi Stock Exchange. The data used is this study is consisting of daily, weekly and monthly closing prices for the period of 1st Jan. 1998 to 29th Feb 2012. Different tests have been employed to check the random walks in the KSE. This test includes descriptive statistics, unit root test (Augmented Dickey Fuller test and Phillip Perron Test), Run test and KS test. All the tests give the same result that KSE does not follow random walk so KSE is not efficient in the weak form. So there are chances for the technical investors that they can earn the abnormal profit by identifying the trends or patterns in KSE.

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