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Testing the Random Walk Hypothesis: A Case of Pakistan

Ume Habibah
[1] PhD Scholar, Sukkur IBA University Sukkur Sindh Pakistan
Email: umehabibah@iba-suk.edu.pk

Niaz Hussain Ghumro
[1]Assistant Professor, BA Deptt Sukkur IBA University Sukkur Sindh Pakistan
Email: niaz_ghumro@iba-suk.edu.pk

Manzoor Ali Mirani
[1] Assistant Professor, BA Deptt Sukkur IBA University Sukkur Sindh Pakistan
Email: manzoor@iba-suk.edu.pk

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Abstract
Random walk hypothesis is one of the models designed to empirically test the stock price behavior. Rejection of Random walk hypothesis (RWH hereafter) implies that stock prices or stock returns can be predicted by using their own previous values. The objective of this study is to test the RWH in Pakistani equity market which is an important emerging market and moreover, characterized by high turnover and high price volatility. This study incorporates the monthly data of 83 individual stocks categorized in 26 sector, covering the period from February 2009 to December 2015. In order to check the random walk hypothesis Augmented Dickey Fuller test, the Phillip-Perron Test and The Runs test are applied. Findings suggest that the KSE-100 stock returns are predictable on the basis of past information and the investors can earn the abnormal profit by following the systematic pattern. In other words, Pakistani stock market does not reflect the weak form efficiency.
Key words: Random Walk Hypothesis, Weak form Efficiency, Pakistani Stock market

1. Introduction

Stock price behavior has been a topic of great interest for a long time. Various theories and models are developed to test the stock price behavior empirically. Random walk hypothesis (RWH) is one of them. It states that the future stock prices could not be predicted using the available past information of stock prices behavior. For an investor, random walk hypothesis states that past information based investment strategies does not give higher return as compared to portfolio comprised of randomly selected stocks.

RWH model has been tested for many equity market since the work of Lo and MacKinley (1988, 1989). This model is proved as a valid model in developed equity markets depicting that

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Random walk hypothesis cannot be statistically rejected in developed capital market (Dryden, 1970; Fama, 1965; Granger and Morgenstern, 1963; Kendall and Hill, 1953; Solnik, 1973). Further Fama (1965) also find the strong evidence of Random walk hypothesis in behavior of daily stock returns in New York stock exchange.

On the other side, rejection of Random walk hypothesis (RWH hereafter) implies that stock prices or stock returns are predictable on the basis of their own previous values. In the stock market of Turkey, Kuwait and Saudi Arabia, RWH model is found to be statistically insignificant. So, a mutual consensus has not been reached at the conclusion regarding the behavior of stock returns around the globe. This shows the importance of RWH being tested in other countries to provide worthwhile insights regarding the validity of RWH.

The RWH model is related to another concept of finance literature that is market efficiency. This concept is initially introduced by Eugene Fama in early 60's. Mr. Eugene Fama is an American economist. He defined the Efficient Market as the market in which new information is incorporated in the stock prices very quickly. In general term, Efficient Market Hypothesis (EMH) states that current stock prices contains and reflect the all kind of relevant information. It also holds the assumption that the cost if zero of attaining suck prices of stock that reflect the full information (Grossman and Stiglitz, 1980).

Different studies have tested the random walk hypothesis in developed, as well as in developing economies with the conclusion that stock markets of developed countries follow the random walk and could not be predicted (Evans, 2006; Groenewold, 1997; Hawawini and Michel, 1984; Hudson, Dempsey, and Keasey, 1996; Sung and Johnson, 2006), while in developing countries, results are different and somehow mix outcomes. So, keeping in view the above arguments, it is worthwhile to study the random walk hypothesis in Pakistani stock market which is considered as an important emerging market and moreover, considered by high price volatility and high turnover too. According to the list updated by DowJones[1], Pakistan's economy is counted in the list four emerging markets. It is because of Karachi Stock Exchange (KSE) which is considered as the strong institute of Pakistan. Inclusion of Pakistan's economy in the four emerging list reflect the expected contribution of Pakistan's economy to the global growth. Although many studies have applied the RWH in Pakistan (see Chakraborty, 2006; Haque, Liu, and Nisa, 2011; Husain, 1997; Khilji and Nabi, 1993; Mehmood, Mehmood, and Mujtaba, 2012) but this study tests the RWH in detailed way incorporating all the firms listed in KSE. This study provide insights regarding predictability of Pakistani stock market.

To achieve the research objective, this study uses monthly returns stocks individually. These returns are adjusted for gross dividends. While the time period taken under consideration to examine the RWH model is 2009-2015.

The paper is organized as follows. Section 2 overviews the Random walk Hypothesis. Section III provides the empirical evidences of RWH in emerging countries and in context of Pakistan. Section IV explains the description of data and methodology followed by results and discussion given in Section V. Further, the final section summarize the study.

[1] www.dowjones.com

2. Random walk hypothesis (RWH)

Two hypotheses are included in the Random Walk Hypothesis (RWH) given as;

1. In the series of an individual stock, successive values of returns are independent.
2. Some kind of probability distribution is involved in stock returns' series.

Hypothesis 1 deals with testing either stock return series possess the serial dependence or not. For any investor, this hypothesis has great implication as expected profits could be increased by taking the dependencies of stock returns into consideration. Another parametric test, named as the serial correlation test, can be used to test this first hypothesis. Serial correlation test measures the dependency between the current values of a random variable (at time *t*) with its lagged values up to the lags *k*. It can be explained as;

$$r_k = \frac{Cov\ (R_t, R_{t-k})}{Var\ (R_t)}$$

Here R_t is the stock returns while the standard error (SE) of $r_k$is estimated as;

$$SE(r_k) = \sqrt{\frac{1}{(n-k)}}$$

t-value is used to test the significance of coefficients and significant coefficient shows the existence of serial correlation. Further, the sign (+,-) are also of great importance if analysis is being done in capital markets. If the coefficient is negative in sign, this shows the negative serial correlation which may induce by the thin market with extensive fluctuations in prices about the intrinsic value. While the positive coefficient implies the slow diffusion of new or insider information to the stock prices.

Rather than testing the individual coefficients separately, a joint hypothesis test is applied to simultaneously test all the individual coefficients up to the lags k, putting them equal to zero. Ljung-Box *Q*(*k*) statistic is used here, which is estimated as;

$$Q(k) = n(n+2)\sum_{k=1}^{k}\frac{r^2 k}{n-1}$$

The Ljung-Box *Q*(*k*) statistic has *k* degree of freedom and follows the chi-square distribution.

Second hypothesis of RWH model is about the stock returns distribution. It has equal importance for both investors and researchers. Investors consider it important to determine the investment risk in stocks. Further, it is also important to know the probability of gain and losses by investors. From researchers' point of view, this hypothesis is of great importance to know the returns distribution for the purpose of development of theoretical models and their applications. It also provides the descriptive nature of information about the nature of process to generate the results.

Nonetheless, regarding the stock returns distribution form, there is still lack of mutual consensus among the researchers. Because of different opinion, many researchers limit their empirical analysis applying normal distribution to stock returns series while testing the random walk model. Earlier researchers assumed this as normal distribution, later empirical results suggest that normal distribution assumption is not valid (Fama, 1965; Mandelbrot, 1963). So

leptokurtic distribution with fatter tail and high peak and kurtosis with larger positive values are generally accepted.

3. Empirical evidences on random walk hypothesis

Reviewing the past studies tested the random walk hypothesis model in other emerging markets would be useful to make comparison between the results of current study and already established results. This section reviews few studies, previously conducted in other emerging countries.

Errunza and Losq (1985) explored the stock price behavior of ten emerging countries including Argentina, Chile, Jordan, Thailand, Brazil, Korea, Greece, Mexico, Zimbabwe, and India for the time period 1978-1981. Monthly data is used to test the RWH. The serial correlation test is applied to test the RWH model. Finally, the results of study support the Random walk hypothesis.

Araújo Lima and Tabak (2004) investigated the Random walk hypothesis model in the market of Singapore, Hong Kong and China by applying the variance ratio tests and bootstrap techniques. Findings suggest that Hong Kong equity returns cannot be predicted using the historical information while Singapore equity markets do not reflect the weak form efficiency. While in case of China, equity shares available to China nationals are weak form efficient and equity shares available to foreigners are don't follow the RWH.

Gozbasi, Kucukkaplan, and Nazlioglu (2014) examined the Turkish stock market efficiency applying the non-linear unit root tests. They incorporate the daily data Borsa Istanbul composite index and three different sector indexes (industry sector, service sector and financial sector) for the time period of July 2002 to July 2012. The findings support the weak form efficiency of Turkish stock market depicting that Turkish market affirm the efficient market hypothesis.

Tiwari and Kyophilavong (2014) used the monthly observation of BRIC (Brazil, Russia, India and Cgina) stock indices, for the time period 2000 to 2010 to test the Random Walk Hypothesis through applying the wavelet based unit root test. Results reject the null hypothesis of unit root in BRIC countries (except Russia federation) suggesting that stock prices can be predicted using the historical information. Further, Mobarek and Fiorante (2014) also examine the weak form efficiency in BRIC countries for the time period of September 1995 to March 2010. They use a bias free statistical techniques (Variance ratio and Runs test) to test the model. They find the significant positive autocorrelation in returns suggesting that BRIC markets are approaching a state of being weak-form efficient.

Further, Said and Harper (2015) examined the weak form efficiency of Russian stock market testing the Random walk hypothesis model. They follow the Box-Ljung test statistics, the autocorrelation, and the variance ratio test on the daily data of July 2003 to December 2012. Results suggest that Russian stock market is not weak form efficient.

Rahman, Simon, and Hossain (2016) investigated the daily stock returns behavior of Chittagong Stock Exchange (CSE) of Bangladesh applying the Variance Ratio Test, K-S Goodness of Fit Test and Wald-Wolfowitz Runs Test as parametric tests and Autocorrelation Function Test and

Augmented Dickey-Fuller test as non-parametric tests. Results suggest that stock returns of Chittagong Stock Exchange can be predicted using the historical information.

Ngene, Tah, and Darrat (2017) performed a comprehensive analysis on 18 emerging countries including Turkey, Thailand, South Africa, Russia, Poland, Philippines, Morocco, Mexico, Malaysia, Korea, Indonesia, India, Egypt, Colombia, China, Chile, Brazil, and Argentina. The purpose is to test the RWH model in these countries in the presence of structural breaks for the time period of December 1987 to April 2013. The RWH model is rejected in the presence of single break model but the findings are consistent with the RWH models in the presence of multiple structural breaks.

In summary, we can say the emerging countries stock markets prices behave different from each other and their behavior is also time varying. These studies motivates us to look into Pakistan stock market behavior. Next section summaries the studies of testing Random walk hypothesis in context of Pakistan.

4. Empirical evidences from Pakistan

This section review some studies that have tested the behavior of stock returns in the Pakistani stock exchange market, KSE-100.

Chakraborty (2006) investigated the efficiency of Pakistani stock market by applying the serial correlation and Runs test along with the Variance ratio test for the two different time periods; one from of five years, 1996 to 2000 and second time period is also five years' time period. 2001 to 2005. They find that future returns of KSE 100can be predicted by using the past information. Further they apply the Auto-regressive moving average (ARMA) modelling to predict the KSE-100 returns.

Haque et al. (2011) tested the random walk hypothesis model of Pakistani stock market. The time period selected for investigation is ten years starting from 2000 to 2010. They found the empirical evidence that KSE 100 returns do not follow the normally distribution. Further, the findings don't support the RWH by employing the ADF unit root test, KPSS unit root test, Q-statistitics (Ljung-Box) test, and PP unit root test.

Omar, Hussain, Bhatti, and Altaf (2013) investigated the RWH model in Pakistan taking the daily and weekly and monthly returns of KSE 100 index. They apply the descriptive statistics, Runs test, VAR test, ADF unit root test, PP unit root test and KS test on the data of period January 1998 to February 2012. Findings suggest that Pakistan equity market does not follow the weak form efficiency.

Asif, khwaja, and Wali (2015) investigated the market efficiency of KSE 100 using the monthly data of 10 year sample period of 2000 to 2010. They apply the ADF unit root test and Duns test to check the market efficiency. The findings suggest that investor can beat the market by using the past information. There is a clear evidence of weak form efficiency of Pakistani market.

On the other side, Jun and Uppal (1994) find the evidence of Pakistani market efficiency using the company level data. Results show that monthly prices reflect adjustment to new information.

So, it could be concluded as Pakistani equity markets have been tested so far in different time periods for market efficiency. However, current study provides a comprehensive test of random

walk hypothesis with comparison of different sectors including oil and gas exploration companies, automobile assembler, automobile parts and accessories, commercial banks, cement, cable and electrical goods, chemical, close-end mutual fund, engineering, fertilizer, food and personal care products, glass and ceramics, investment banks/ inv. Cos./ securities cos., insurance, modarabas, oil and gas marketing companies, power generation and distribution, paper and board, pharmaceuticals, refinery, sugar and allied industries, synthetic and Rayon, technology and communication, tobacco, transport and textile composite.

5. Data and Methodology

This study incorporates the monthly data of 83 individual stocks categorized in 26 sector, covering the period from February 2009 to December 2015. This study incorporates the time period after the financial crisis 2008. The 2009 year is taken as the base year. KSE 100 firms in 2009 are considered for analysis at initial stage. While the firms that are not listed in KSE 100 in time period of 2010 to 2015, are excluded from the sample. Further the remaining firms with missing data are also excluded from the sample. Finally, the sample of 83 firms after screening criteria are considered for analysis. These firms includes the 26 different sectors including oil and gas exploration companies, automobile assembler, automobile parts and accessories, commercial banks, cement, cable and electrical goods, chemical, close-end mutual fund, engineering, fertilizer, food and personal care products, glass and ceramics, investment banks/ inv. Cos./ securities cos., insurance, modarabas, oil and gas marketing companies, power generation and distribution, paper and board, pharmaceuticals, refinery, sugar and allied industries, synthetic and Rayon, technology and communication, tobacco, transport and textile composite.

In order to check the random walk hypothesis, different tests are applied including Augmented Dickey Fuller (1979) test, the Phillip-Perron (1988) Test and The Runs test. Following section 5.1 to 5.3 explains the models applied in this study.

5.1. Augmented Dickey and Fuller test

For testing the non-stationarity (unit root) in financial time series, initial work has been done by Dickey and Fuller (1979). The basic objective of the test is to examine the equation 1,

$$r_t = \delta r_{t-1} + u_t \qquad (1)$$

Here r_t and r_{t-1} are current and previous values of returns while u_t is the white noise process and I(0) and it may be heteroskedastic. δ is the coefficient. The ADF test check the value of coefficient either it is greater than or equal to 1, or not. If the value of coefficient is significantly greater or equal to 1, this implies that series contains the unit root. And if value of coefficient is significantly less than 1, this implies that series is stationary. So, here the null hypothesis is $\delta = 1$ against the one-sided alternative $\delta < 1$. Thus the hypotheses of interest are H0: series contains a unit root versus H1: series is stationary.

Dickey and Fuller (1979) used the t-statistic to test the null hypothesis. Here, t-statistics is given as;

$$t_\delta = {\hat{\delta}}/{(se(\hat{\delta}))} \qquad (2)$$

Here $(se(\hat{\delta}))$ is standard error of $\hat{\delta}$. In the particular objective of the study, the null and alternative hypotheses of the ADF test are designed as;

H_0: The return series does not follow the random walk hypothesis.

H_1: The return series does follow the random walk hypothesis.

5.2. The Phillip-Perron Test

Another more comprehensive and detailed theory of non-stationarity (unit-root) has been developed by Phillips and Perron (1988). The Phillips and Perron (PP) test is just similar to already explained ADF test. Both tests usually infer to same findings and same conclusion even suffer with same kind of limitations. But both differ in terms of degree of freedom (DF) procedure. For auto-correlated residuals, the PP test incorporate the automatic correction to the DF procedure.

The PP test allows the correction in heteroskedasticity and any serial correlation in the errors u_t non-parametrically by modifying the ADF test statistics. T-statistics for PP test is given as,

$$\tilde{t_\delta} = t_\delta \sqrt{\frac{\theta_0}{f_0}} - \frac{T\,(f_0 - \theta_0)(se(\hat{\delta}))}{2\sqrt{f_0}\,s} \qquad (3)$$

Here, t_δ is t-statistics as described in equation 2, θ_0 is estimator of random error term, f_0 is estimator of residual spectrum, $(se(\hat{\delta}))$ is standard error of $\hat{\delta}$, and s is standard error of test regression. The null and alternative hypotheses of the PP test are given as;

H_0: The return series does not follow the random walk hypothesis.

H_1: The return series does follow the random walk hypothesis.

5.3. The Runs Test

To test the randomness in any financial data series, “The Runs test” has been extensively used by many researchers in the field of empirical finance. The Runs test initially assumes the independence of series then it tests for either successive runs occurrences are dependent of each other or are independent of each other. Basically, a run can be explained as an order of successive negative/positive return points. While the length of a run is typically the counting of consecutive same signs. The t-statistic used in the run test counts both sign, either negative or positive.

The runs test does not involve a particular type of probability distribution as it is a non-parametric test. Keeping in view the random walk hypothesis, expected number of runs and actual number of runs are same in any financial series who follows the RWH.

Say for example, there is a return series named as R_t. The count of number of positive and number of negative runs are N_+ and N_- consecutively. By adding the positive and negative runs count, we get the total count of runs which is $N = N_+ + N_-$. The successive runs are independent of each other under the null hypothesisH_0. When the sample size is large, which is the case of present study, then t-statistic of runs test follows the normal distribution and is given by:

$$Z = \frac{r - \mu_r}{\sigma_r} \sim N\ (0,1) \qquad (4)$$

Here μ_r is mean and σ_r is standard deviation, calculated as;

$$\mu_r = \frac{2\,(N_+)(N_-)}{N} + 1$$

$$\sigma_r = \sqrt{\frac{2\,(N_+)(N_-)(2\,(N_+)(N_-)-N)}{N^2(N-1)}}$$

The null and alternative hypotheses of the runs test are given as;

H_0: The return series is random

H_1: The return series is non-random

6. Results and Discussion

Table 1 describes the results of Augmented Dickey Fuller test, Phillips Pearson test and The Runs Test. Results of Augmented Dikkey Fuller test shows the ADF-statistics with the p-values less than 0.01 depicting the rejection of null hypothesis. As discussed above ADF test is designed to test the null hypothesis of there is unit root with the meaning that data series does not have trend in it. In other words, if the null hypothesis fails to reject then it implies that data series follows the random walk hypothesis implying that investors cannot beat the market using the past information and historical data. In the current study, significant ADF-statistics clearly reject the Random walk hypothesis in the case of KSE -100 stock return series which implies that the KSE -100 stock returns does not reflect the weak form efficiency. The results reported in table 1 show that investors can predict the stock returns and they can earn the abnormal profits by following the systematic pattern. These findings are consistent in all sectors of KSE-100.

Table 1: Results of ADF, PP and the Runs test

	ADF test		**Phillips–Perron test**		**The Runs Test**	
company name	ADF stat.	p-value	Statistics	P-value	Z-stat.	p-value
Oil and gas exploration companies						
OGDC	-7.6436***	0.000	-61.3346***	0.000	-0.99277	0.320821
PPL	-9.63825***	0.000	-97.9461***	0.000	-0.10913	0.913103
POL	-8.51797***	0.000	-74.1388***	0.000	1.216347	0.223853
MARI	-9.31858***	0.000	-85.3239***	0.000	0.553611	0.579845
Automobile assembler						
PSMC	-10.2197***	0.000	-94.4458***	0.000	1.437258	0.150645
INDU	-10.7101***	0.000	-102.294***	0.000	2.320906**	0.020292
ATLH	-10.1085***	0.000	-76.9614***	0.000	0.995435	0.319525
AGTL	-9.1883***	0.000	-81.8072***	0.000	0.111787	0.910993
Automobile parts and accessories						
THALL	-10.1584***	0.000	-89.4615***	0.000	-0.10913	0.913103
AGIL	-7.95916***	0.000	-70.0493***	0.000	-0.10913	0.913103
Commercial banks						
SCBPL	-8.65855***	0.000	-66.3233***	0.000	-0.10913	0.913103

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MCB	-9.38624***	0.000	-71.6168***	0.000	0.553611	0.579845
BAHL	-11.575***	0.000	-101.264***	0.000	0.774523	0.438622
SNBL	-9.72424***	0.000	-84.0203***	0.000	0.553611	0.579845
HMB	-9.63143***	0.000	-79.9041***	0.000	0.995435	0.319525
MEBL	-10.3681***	0.000	-94.5878***	0.000	0.553611	0.579845
NIB	-10.9786***	0.000	-91.4232***	0.000	0.111787	0.910993
SILK	-9.95884***	0.000	-81.8507***	0.000	2.320906**	0.020292
SMBL	-8.18928***	0.000	-68.7941***	0.000	-0.99277	0.320821
SBL PA Equity	-9.61650***	0.000	-84.2467***	0.000	2.320906**	0.020292
JSBL	-7.27436***	0.000	-62.2441***	0.000	0.774523	0.438622
NBP	-11.4006***	0.000	-88.7193***	0.000	0.332699	0.739362
BAFL	-10.1182***	0.000	-88.4112***	0.000	0.332699	0.739362
BOP	-8.39781***	0.000	-74.463***	0.000	0.553611	0.579845
HBL	-8.96665***	0.000	-53.2695***	0.000	-1.4346	0.151402
FABL	-10.3343***	0.000	-93.9336***	0.000	-0.10913	0.913103
AKBL	-8.40968***	0.000	-72.6653***	0.000	0.332699	0.739362
UBL	-9.08103***	0.000	-68.9578***	0.000	0.774523	0.438622
ABL	-8.25923***	0.000	-59.1324***	0.000	-0.99277	0.320821
Cement						
FCCL	-8.53913***	0.000	-74.4481***	0.000	0.332699	0.739362
DGKC	-8.33375***	0.000	-74.0997***	0.000	-0.77186	0.440197
LUCK	-8.14469***	0.000	-63.4204***	0.000	-0.55095	0.581669
PIOC	-7.91315***	0.000	-75.102***	0.000	-0.10913	0.913103
JVDC	-10.5646***	0.000	-86.4141***	0.000	1.562089	0.118267
PAKCEM	-7.93348***	0.000	-65.577***	0.000	-0.77186	0.440197
Cable and electrical goods						
SIEM	-11.2236***	0.000	-93.3322***	0.000	1.65817	0.097283
Chemical						
ICI	-7.42731***	0.000	-63.6284***	0.000	0.332699	0.739362
LOTCHEM	-8.0893***	0.000	-79.1927***	0.000	-1.4346	0.151402
Close-end mutual fund						
PGF	-8.6478***	0.000	-79.9584***	0.000	-0.33004	0.741372
Engineering						
INIL	-10.0777***	0.000	-84.1994***	0.000	0.553611	0.579845
Fertilizer						
FFC	-8.73218***	0.000	-77.6449***	0.000	-0.10913	0.913103
FFBL	-8.40678***	0.000	-75.0864***	0.000	-0.55095	0.581669
ENGRO	-11.6177***	0.000	-103.892***	0.000	1.437258	0.150645
DAWH	-9.88006***	0.000	-85.3008***	0.000	-0.99277	0.320821
Food and personal care products						

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NESTLE	-12.5442***	0.000	-107.956***	0.000	0.111787	0.910993
RMPL	-8.9771***	0.000	-80.0271***	0.000	-0.55095	0.581669
Glass and ceramics						
GHGL	-10.067***	0.000	-91.6454***	0.000	-0.33004	0.741372
Inv.banks/ inv. Cos./ securities cos.						
JSCL	-8.68875***	0.000	-78.5405***	0.000	0.995435	0.319525
FCSC	-9.87923***	0.000	-76.7763***	0.000	2.320906**	0.020292
JSGCL	-10.1338***	0.000	-92.6936***	0.000	1.65817	0.097283
JSIL	-10.4462***	0.000	-96.2414***	0.000	0.332699	0.739362
Insurance						
EFUL	-11.0501***	0.000	-90.8807***	0.000	0.111787	0.910993
PAKRI	-8.62427***	0.000	-69.5421***	0.000	0.995435	0.319525
AICL	-9.34644***	0.000	-87.8541***	0.000	-0.55095	0.581669
EFUG	-9.51985***	0.000	-88.0234***	0.000	0.111787	0.910993
JGICL	-7.85584***	0.000	-66.7158***	0.000	-0.55095	0.581669
IGIIL	-9.53495***	0.000	-79.2074***	0.000	0.332699	0.739362
Modarabas						
FHAM	-10.718***	0.000	-83.3981***	0.000	1.879082	0.060233
Oil and gas marketing companies						
SSGC	-8.73262***	0.000	-70.4755***	0.000	0.111787	0.910993
SNGP	-9.82069***	0.000	-87.1978***	0.000	0.111787	0.910993
PSO	-8.51644***	0.000	-72.4193***	0.000	-0.77186	0.440197
SHEL	-9.16335***	0.000	-83.0171***	0.000	0.553611	0.579845
APL	-7.94717***	0.000	-58.312***	0.000	0.553611	0.579845
Power generation and distribution						
KEL	-7.99897***	0.000	-69.7471***	0.000	-0.10913	0.913103
HUBC	-7.56866***	0.000	-63.6703***	0.000	0.332699	0.739362
KAPCO	-9.24962***	0.000	-83.8525***	0.000	-0.33004	0.741372
KOHE	-7.42687***	0.000	-64.1888***	0.000	-1.87642	0.060598
Paper and board						
PKGS	-9.84028***	0.000	-91.3883***	0.000	1.216347	0.223853
Pharmaceuticals						
GLAXO	-9.37369***	0.000	-81.73***	0.000	-0.10913	0.913103
ABOT	-9.34197***	0.000	-84.5646***	0.000	0.553611	0.579845
Refinery						
ATRL	-8.97687***	0.000	-76.6992***	0.000	1.879082	0.060233
NRL	-8.32842***	0.000	-80.325***	0.000	2.320906**	0.020292
PRL	-8.83047***	0.000	-79.1736***	0.000	0.553611	0.579845
Sugar and allied industries						
IMSL	-9.20275***	0.000	-85.9139***	0.000	-0.10913	0.913103

Synthetic and Rayon						
IBFL	-10.1081***	0.000	-96.7499***	0.000	0.553611	0.579845
Technology and communication						
PTC	-10.3104***	0.000	-90.0563***	0.000	-0.10913	0.913103
WTL	-8.4831***	0.000	-74.1778***	0.000	-0.55095	0.581669
Tobacco						
PAKT	-7.497***	0.000	-77.2232***	0.000	-1.65551	0.097821
Transport						
PICT	-7.69189***	0.000	-70.0072***	0.000	0.774523	0.438622
PNSC	-7.07963***	0.000	-62.6034***	0.000	-2.09733**	0.035964
PIAA	-10.1873***	0.000	-98.0381***	0.000	-0.55095	0.581669
Textile composite						
NML	-9.28878***	0.000	-89.423***	0.000	0.111787	0.910993
ANL	-8.22829***	0.000	-68.4864***	0.000	1.216347	0.223853

Note: **, *** shows the significance at 5% and 1% respectively.

Further the results of ADF- statistics are given support by the Phillips-Perron test. Results also show the significant statistics depicting the rejection of null hypothesis. As discussed above in methodology section, PP test is designed to test the null hypothesis of there is unit root with the meaning that data series does not have trend in it. In other words, if the null hypothesis fails to reject then it implies that data series follows the random walk hypothesis implying that investors cannot beat the market using the past information and historical data. In the current study, significant ADF-statistics clearly reject the Random walk hypothesis in the case of KSE -100 stock return series which implies that the stock returns are not week form efficient. The ADF t-statistics reported in table 1 suggest that stock returns of all sectors of KSE-100 are predictable. Investors of KSE-100 stocks can easily earn the abnormal profits by following the systematic pattern

Further, the Runs test is also applied. Runs test is used to test the non-randomness. As stated above, null hypothesis of this test is, return series follows the random manner. If the z-statistics is statistically insignificant then one could concludes that return series follows the random walk and no one can beat the market using the past information and historical data. And if the z-statistics is statistically significant that means that null hypothesis of runs test is being rejected. One could concludes that return series does not follow the random walk. In other words, there is trend in the return series.

The results of current study reveals that null hypothesis could not be rejected in 77 stocks out of 83 stock. While in other 6 stock including one stock from automobile assembler sector, two stocks from commercial banks sector, one from investment banks sector, one from refinery sector, and one from transport sector, null hypothesis of randomness is rejected at 5% significance level. The Runs test is designed as the null hypothesis is return series is random with the alternative hypothesis of return series is not random. The findings of runs test are also in accordance with the previous ADF and PP test.so it could be concluded as KSE-100 stock

returns are not weak form efficient. In other words, abnormal profits could be earned by the investors by using the past information.

7. Conclusion

Many studies have done testing the weak form efficiency of Pakistani stock market by applying the random walk theory on the KSE index data points. The current study do a comprehensive analysis of Pakistani stock market by taking the 83 individual firms from KSE-100. The sample period is February 2009 to December 2015. To test the random walk hypothesis, three different tests are applied. One is parametric test, Augmented Dikkey Fuller (ADF) test, other two are non-parameters named as Phillips-Perron (PP) test and the Runs test.

Results of ADF and PP tests re-confirm the weak form inefficiency of Pakistan stock market as previous studies (Asif et al., 2015; Chakraborty, 2006; Haque et al., 2011; Omar et al., 2013). The results implies that the stock prices do not fully reflect the past information and investor can beat the market by using the past information and can earn the abnormal profits. Results also imply that past prices of Pakistani stocks effect the future prices of stocks that shows the non-random behavior of stocks. In nut shell, Pakistani stocks do not follow the random walk hypothesis.

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