TESTING THE EFFICIENCY OF PAKISTANI STOCK MARKET (PSX): A CASE OF KSE-100 INDEX

Mazhar Farid Chishti[1], Ali Farhan Chaudhry[2] & Ambreen Afzal[3]

[1]Senior Lecturer, Lahore Garrison University, Lahore, Pakistan
[2]Assistant Professor, Institute of Management Science, Lahore, Pakistan
[3]Lecturer, Lahore Garrison University, Lahore, Pakistan

ABSTRACT

This empirical study examines weak form efficiency of Pakistani stock market by employing Augmented Dickey and Fuller (1979), Phillip-Perron (1988) and Kwiatkowski, Phillips, Schmidt, and Shin (1992) unit root tests for random walk and Ljung-Box Q-Statistic of autocorrelation. Pakistan stock market is proxied by KSE-100 index daily closing prices for the period of January 3, 2000 to March 31, 2016. Empirical results of 4259 observations determine that KSE-100 index does not follow a random walk rather stocks follow a systematic patterns which translate into abnormal returns. All these are considered by various analysts as the most crucial factors in the context of weak efficiency of Pakistani stock market. The Pakistani stock market is informational weak form inefficiency due to one or another reasons. For this purpose, the current study is an attempt to investigate certain factors which are responsible to bring variations in this regard.

Keywords: *Karachi Stock Exchange, Random Walk Theory, Efficient Market Hypothesis*

INTRODUCTION

Timely information plays a very important role in the stock market while making an investment decision. Literature does exist on the efficiency of the stock markets. The most pioneer work on the market efficiency was undertaken by Bachelier (1900). Afterwards, a major contribution was done by Fama (1965) who introduced three forms of efficient market hypothesis (EMH). First, is the weak form efficient market hypothesis where, all historical information is already had been embedded in the current prices, secondly, in case of semi strong efficient market hypothesis new public information is immediately is reflected by current prices, and strong form efficiency represents current prices reflect historical, publically available and inside information. Then Fama (1970) extended his empirical work on weak form efficiency by employing serial correlation tests and found that market is weak form efficient. Extending empirical work further, Fama (1991) conducted another study to test the efficient market hypothesis for semi strong form of efficiency and concluded that historical prices already had been incorporated in the current prices and future returns can conventional by the past returns and at the same time was uncertain about his findings.

LITERATURE REVIEW

After the significant contribution by Fama (1970), a thorough empirical research works have been undertaken on the efficiency of markets by McQueen, Pinegar, and Thorley (1996), Hudson, Dempsey and Keasey (1996), Antoniou, Ergul and Holmes (1997), Suyin (2007), Cooray and Wickremasinghe (2007), Phatak and Tiwari (2007), Patel, Radadia and Dhawan (2012). In the context of Pakistan, few studies have been undertaken such as Khilji and Nabi (1993), Uppal (1993), Husain (1997), Hameed, Ashraf and Siddiqui (2006), Mustafa and Nishat (2007), Cooray

and Wickremasinghe (2007), Haque, Liu and Nisa (2011), Rehman, Masood, Arshed and Shah (2012). Some researchers estimated KSE-100 Index through model of Random Walk Hypothesis (RWH) on the monthly data of 85 stocks of 26 sectors. The returns were found predictable; due to systematic pattern an investor can earn abnormal profit. Fraz et al (2016) found the predictable behavior of KSE-100 Indec on daily, weekly and monthly basis. The pattern of stock show that the maket is weak form inefficient. In the current situation, the significance of this study is high-lightened when the KSE-100 index gained to new historical highs and it is very important to investigate weak form efficiency that in return will benefit market participants to have more clear insight about the capital markets.

Capital markets reforms, rebuilding international investors' confidence followed by steps taken to eliminate terrorism, facilitating more economic investments, and stabilizing the political situation in the country enhances the significance of the present study. The present article investigates weak form efficiency of Pakistan stock market approximated by KSE-100 index daily data for the period of January 3, 2000 to December 31, 2014 by employing unit root tests and Ljung-Box Q-Statistic of autocorrelation. Results indicate that unit root hypothesis is accepted and random walk hypothesis is rejected and Pakistan stock market is weak form inefficient. The objective of this study is to investigate the weak form efficiency of Pakistani stock market approximated by KSE-100 index by employing unit root tests for random walk hypothesis (RWH) and Ljung-Box Q-Statistic of autocorrelation and results indicate that market is weak form inefficient which implies the future prices can be predicted. Prediction of the future prices is the very reason why most of the times weak form efficiency of the stock market is tested. And this is true for both developed and developing countries because if a market is weak form inefficient then the historical data is helpful in the prediction of future prices. Further, the implication of this empirical study will be beneficiary for stock market traders, investors and fund seekers in emerging stock markets like Pakistan.

DATA SOURCE AND METHODOLOGY

Data Sources

The present study uses daily closing prices of KSE-100 index of Karachi Stock Market that is used as the proxy for Pakistan stock market for the period of January 3, 2000 to March 31, 2016. The working hours of KSE-100 index are from 9:30 am to 3:30 pm from Monday to Thursday but on Friday there are two trading sessions, the first session is from 9:15 am to 12:00 pm and the second trading session is from 2:30 pm to 4:30 pm. However, weekends and holidays are excluded. Further, data consists of 4259 observations and is obtained from the official website of Karachi Stock Exchange. The weak form efficiency is estimated by applying econometric tests as discussed in methodology on continuous daily returns.

Methodology

This study investigates the weak form efficiency of KSE-100 Index by applying unit root tests that estimate if the stock prices are following a random walk. Unit root tests are ADF (1979), PP (1988) and the KPSS (1992). The existence of random walk is confirmed by the statistical results that indicate all available information is incorporated into stock prices.

Unit Root Tests

The criteria to check the weak form efficiency (WFE) of stock markets is investigated through random walk hypothesis (RWH). Where randomness estimates the independent movement of stock prices. In this case current price (P_t) is independent in its movement and is not dependent on past prices. Stocks following random walk and prices are fluctuating independently then are expressed by the following model.

$$P_t = \mu + P_{t-1} + \varepsilon_t$$

Where, P_t represents current prices, $P_{t-1,}$ are prices with one lag, μ is drift and ε_t is random error and "t" is time subscript. The presence of unit root indicates the time series data is non-stationary or time series is random walk or in other words time series is weak form efficient where all historical prices already had been incorporated in the current price.

Augmented Dickey-Fuller (1979) Test

This test was devised by Dickey and Fuller in 1979 and can process the lengthy data. An Augmented Dickey-Fuller (1979) test estimates the presence of unit root in time series data. Higher negative estimated ADF test statistic than critical negative value indicates the rejection of the presence of unit root in time series, in turn, confirms the rejection of the null hypothesis. In an AR (1) series where, $P_t = \mu + \rho P_{t-1} + \varepsilon_t$ and P_t are current prices of log, $P_{t-1,}$ are lagged values of log, μ is drift, ε_t is random error. In the testing of unit root if the value of coefficient ρ of $P_{t-1}$is greater than or equal to 1 the null hypothesis will be accepted. In other words, $Ho\ |\rho| \geq 1$ confirms the unit root and non-stationary of the data. It further indicates that the series has uncontainable variance and movement of price is independent and it indicates the presence of random walk.

$$P_t = \mu + \rho P_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

Phillips-Perron (1988)-Test

Phillips-Perron (1988) unit root test also estimate complex data and finds the presence of unit root in time series data.in the time series data this is a nonparametric approach for testing unit root.

$$\tilde{t}_\beta = t_\beta \sqrt{\frac{\gamma_o}{f_o}} - \frac{T\left(f_o - \gamma_o\right)\left(se\left(\hat{\beta}\right)\right)}{2\sqrt{f_o}.\, s} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

Where $\tilde{t}_\beta$ is test statistics given in above Model and $Se\ (\hat{\beta})$ and s are standard error of $\hat{\beta}$ and test regression. Also, γ_o is estimator of random error and f_o is estimator of residual spectrum.

Kwiatkowski-Phillip-Schmidt-Shin (1992)-Test

This test was devised by Kwiatkowski, Phillip, Schmidt and Shin in 1992 and diverges from both ADF (1979) and PP (1988) tests. For a return P_t of the form is given for stationarity;

$$P_t = r_t + \beta_t\ \varepsilon_t$$

The P_t series is developed into random walk component r_t, a deterministic trend component β_t along with an error term ε_t. The LM statistics of KPSS are generated by as given below whereas the critical values of test statistics are produced by KPSS (1992).

$$KPSS = N^{-2}\sum_{t=1}^{N} S_t^{\,2} / \sigma^2(p) \text{ ……..}$$

Ljung-Box Q-Statistic of autocorrelations

This test was devised by Box and Pierce (1970). This is an autocorrelation test where stocks values are independent in their movement and predictions of future prices of stocks are not possible and thus confirms the presence of randomness in stocks. The Q-Statistics is estimated by the following model.

$$Q_k = n\sum_{k=1}^{m} \rho^2{}_k \text{.....(10)}$$

Under the null hypothesis all values of ρ_k=0, Q_k is asymptotically Chi-Squared distribution with "m" lag length and "n" sample size.

EMPIRICAL RESULTS

The weak form efficiency of KSE-100 index was tested by employing three unit root tests and Ljung-Box Q-Statistic of autocorrelation devised by Box and Pierce (1970) on daily closing data and estimated results are given below.

Table 1: Unit Root Tests for KSE-100 Index Daily Returns: Jan 03, 2000 to March 31, 2016

	ADF (1979)		**PP (1988)**		**KPSS (1992)**	
Series	Test Statistics with Intercept	Test Statistics with Intercept and Trend	Test Statistics with Intercept	Test Statistics with Intercept and Trend	Test Statistics with Intercept	Test Statistics with Intercept and Trend
R_t	-23.75686	-23.74875	-495.1464	-495.5186	0.087514	0.082385
p-value	0.0000	0.0000	0.0001	0.0001	0.739000	0.216000

Statistical results given in Table 1 indicate that ADF (1979) test statistics -23.75686 and -23.74875 for KSE-100 index returns with intercept and with intercept and trend, respectively, are highly significant with associated p-values of 0.0000 and smaller than critical values of tau (τ) -3.440387 at 1% significance level. Also, indicate that null hypothesis of a unit root in KSE-100 index return series cannot be accepted. Therefore, it can be concluded that that KSE-100 index return series with intercept and with intercept and trend are stationary at levels and do not follow the random walk, hence, are weak form inefficient.

Similarly, results given in Table 1 indicate that PP(1988) test statistics -495.1464 and -495.5186 for KSE-100 index returns with intercept, and with intercept and trend, respectively, are highly significant with associated p-values of 0.0001 and smaller than critical values of tau (τ) -3.440387 at 1% significance level. Also, indicate that null hypothesis of a unit root in KSE-100 index return series cannot be accepted. Therefore, it can be concluded that that KSE-100 index

return series with intercept and with intercept and trend are stationary at levels and do not follow the random walk, hence, are weak form inefficient.

Further, results are given in Table 1 also indicate that KPSS (1992) test statistics 0.087514 and 0.082385 for KSE-100 index returns with intercept, and with intercept and trend, respectively, are highly insignificant with associated p-values of 0.73900 and 0.216000, respectively. Results also indicate that null hypothesis of stationary in KSE-100 index return series cannot be rejected. Therefore, it can be concluded that that KSE-100 index return series with intercept, and with intercept and trend are stationary at levels and do not follow the random walk, hence, are weak form inefficient.

Table 2 Ljung-Box Q-Statistic of Autocorrelations **(Model Statistics)**

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Closing-Model_1	0	.015	40.439	15	0.000	0

Statistics results given in Table 2 indicate that Ljung-Box Q-Statistic of autocorrelations test statistic (=40.439) is significant at 5% significant level means $\rho - value < \alpha(= 0.05)$. Further, these statistical results indicate that the significant autocorrelation Q-Statistics (=40.439) rejects the random walk hypothesis (RWH) which also indicates to reject the efficient market hypothesis (EMH) in case of KSE-100 index. This indicates that successive values are correlated to each other and the series is not independent and the stock prices are weak form inefficient.

DISCUSSION AND CONCLUSION

This efficiency of Pakistani stock market was approximated by employing unit root tests for random walks namely; ADF (1979), PP (1988) and KPSS (1992) and Ljung-Box Q-Statistic of autocorrelation devised by Box and Pierce (1970) by using closing prices for the period of January 3, 2000 to March 31, 2016. Historical information of stock is not reflected in the current prices of shares. Informational inefficiency is there which shows that investors are unaware while making their investment. Companies either do not share key information timely so investors remain unaware and make wrong decisions which further translate into huge losses Abnormal returns are found due to systematic patterns of stocks, the predictions of stocks is possible. Informational deficiency deter the due process of prudent investment. Empirical results of unit root tests reject null of random walks in daily KSE-100 index returns that conclude Pakistani stock market is weak form inefficient. Serial correlation test results also lead to conclude weak form inefficiency in stock market returns of Pakistan.

These findings are align with Husain (1997), Mustafa and Nishat (2002), Hameed and Ashraf (2006), Hassan and Abdullah (2007), Cooray and Wickremasinghe (2007), Haque, Liu and Nisa (2011), Nisar and Hanif (2012), Rehman, Masood, Arshed and Shah (2012), Eddien and Ananzeh (2014), Kumar and Kumar (2012), and differ from Abass (2004). The implication of these findings suggest that regulatory authorities and policy makers can further formulate policies and regulations to support transition from weak form inefficient market to weak form efficient market and then semi strong and strong form efficient stock markets with ultimate goal to discourage

abnormal profits and minimize arbitrage profits in emerging markets of developing countries like Pakistan. The limitation in the measurement of stationarity in finite samples unit root tests has arbitrarily low power so stationarity and the process of unit root result are arbitrarily close with finite samples of the data.

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