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Abstract  
This study describes the behavior of the Karachi Stock Exchange (KSE) regarding the movement of share prices of the companies listed at KSE-100 Index as well as how the share price at KSE follows Random Walk. Moreover, this study pinpoints that the prices of the securities are co-integrated and cannot always be predicted. However, the historical data of KSE-100 Index from January 2, 2001 to November 15, 2011 was collected which contains 2672 observations of the closing share price index of the top 100 companies listed with KSE. Simple unit root – Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) – tests and Johansen Co-integration test was used which discusses the efficiency of the market. Empirical findings of this study suggest that KSE-100 Index follows the Random Walk Hypothesis (RWH) and Efficient Market Hypothesis (EMH). However, KSE is an efficient financial market that can adjust to any new information very quickly and efficiently and the prices of the securities listed for trading at KSE-100 Index cannot be predicted. Hence, KSE cannot be beaten to gain any abnormal return. This research will provide a better understanding about the behavior of KSE as it applies advance econometric techniques which tends to produce more reliable results.

**Keywords:** Random Walk Hypothesis (RWH), Efficiency Market Hypothesis (EMH), Unit Root Test, Co-integration Test, KSE, Pakistan.
1. Introduction
Karachi Stock Exchange (KSE) is the first share market of Pakistan where almost 70-80% of the trading is taking place. The KSE gained momentum in 1960s in listing the companies and market capitalization. However, it faced challenges regarding the economic and political ups and downs in the country and most of the times these fluctuations have had a direct effect on its trading activities over the past sixty years. The share prices of the stock market take direct effect of these changes and show both positive and negative impacts accordingly. Stock exchanges play its key role in economic development of a country (Oskooe, 2011). Some of the markets prove efficient and the others inefficient in responding and adjusting to the sudden and prediction free information coming from changing political and economic conditions. Markets which do not adjust to or absorb these kinds of information would lead to a financial crisis that could be harmful for the small investors as well as for the national economy (Mujtaba, 2006). The market efficiency and inefficiency is discussed by Fama (1970) on the topic of the Efficient Market Hypothesis (EMH). This hypothesis defines efficient market(s) as a market where there can be a large number of rational, profit-maximize activities with a motivation of competing with each other by predicting the future market values of securities. However, all participants have access to the current information. In an efficient market, there is competition among the professionals who have relevant expertise which leads to a situation where at any point in time, actual prices of individual securities reflect the effects of information based both on events that have already occurred and on events which the market expects to take place in the near future. In other words, an efficient market will be a good estimate of the intrinsic value of a security at any point in time. The efficiency of the market is very necessary because if a market is inefficient in adjusting to the new information then the profit-maximizers can outperform the market by knowing the undervalued or overvalued securities and can gain abnormal returns. However, the inefficiency of the stock market can cause harm to the small investors as well as to the entire economic system of a country. On the basis of the information adjustment and availability of this information to the participants in the trading activities of the stock market, the efficiency of the stock market can be classified into three levels.

1.1. Strong-Form of Efficient Market
In this form of efficient market all the relevant information both public and historical is reflected in the share prices being traded in such markets and no one can beat the market.

1.2. Semi-Strong Form of Efficient Market
In this form of efficient market all the relevant information to the public is reflected in the share prices being traded in markets. In such markets with some insider information an investor can gain abnormal returns by judging the undervalued or overvalued securities.

1.3. Weak-Form of Efficient Market
In this form of market all the historical data and prices of the shares and securities are reflected in the current prices and by analyzing the past prices future prices can be predicted if such markets are inefficient in the weak form.

From the definitions of three forms of efficient markets the most important form is weak form efficient market and it is the main consideration point of the researchers because by technical analysis in weak form inefficient markets future prices of the securities can be predicted on the basis of the past and historic prices of the securities. If the security prices in a market follow the random walk that no future price takes any influence from the past prices than we can say that market is efficient in the weak form. Bachelier (1900), in his theory of speculation, conclude that the mathematical expectation of the speculator is zero and this condition is described as a “Fair Game”. However, he also presented EMH theory – Random Walk Theory – which states that in financial markets the prices evolve randomly and are not connected. However, they are independent of each other and, therefore, by
identifying the patterns and trends of price changes in a market could not be used to predict the future value of financial instruments.

This study is based on the random walk hypothesis using some statistical tests to find out if KSE is an efficient market in the weak form and whether securities traded in KSE follow the random walk or not. This study also highlights that rational investor by analyzing the past prices can predict the future prices accurately to beat the market. Hence, if KSE proves to be efficient there could be the following benefits to the economy of a country:

- Foreign investment can be increased
- National savings can be increased
- Capital availability and pricing can also be increased
- Capital can be efficiently allocated in the economy which will result into economic and national development.

This paper intends to investigate whether the stock prices movements follow the Random Walks and this will help to know that KSE is efficient or inefficient as a whole in the weak form. Moreover, this study also pin points whether the prices of the securities are co-integrated and if they can be predicted. Hence the analysis of daily closing stock prices of the KSE-100 Index is made by taking the sample period of January 2nd, 2001 to November, 15-2011 through Unit Root Test and Johansen Co-integration Trace Test. This study attempts to analyze the behavior of KSE and presents a review of literature, data description and research methodology, along with the results and discussions.

2. Literature Review
The Random Walk Hypothesis (RWH) is a financial theory which states that the prices prevailing in a stock market cannot be predicted because these prices follow a unique random patron that cannot be fully analyzed due to the availability of all the information to each and every individual with the stock market. The randomness in the prices restricts the investors to outperform the market to gain abnormal returns. The concept of the RWH can be traced to Regnault (1863) and then Bachelier (1900) as “The Theory of Speculation” included remarkable insights and commentary. Same ideas were later developed by Cootner (1964) in “The Random Character of Stock Market Prices”. The term was popularized by Malkiel (1973) through his research work namely “A Random Walk Down Wall Street” and was used earlier in Fama’s (1965) research entitled “Random Walks in Stock Market Prices”. The theory that stock prices move randomly was earlier proposed by Kendall (1953) in the research entitled “The Analytics of Economics Time Series”.

This information describes the basis for the random walk availability in the stock market prices which is tested and empirically analyzed by many researchers all over the world. However, some of them find that the stock prices proves inefficient in following the random walk, few of them confirm the random walk existence and a weak form market efficiency in developed, less developed and emerging stock markets of the developed and underdeveloped countries.

By applying different statistical techniques on the Kuwait stock market (KSM), Al-Loughani (1995) concluded that KSM does not follow the random walk as it shows stationarity in its results. Song and Weigen (1995) used average return of 29 stocks listed on Shanghai Stock Exchange (SSE). The findings of this study reveals that SSE is weaker than efficient over 1993-1994. Lo and Mackinaly (1988) tested the RWH for weekly stock market returns by comparing variance estimators derived from data sampled at different frequencies. However, this study rejects the random walk model for the entire sample period (1962-1985) and for all sub periods for a variety of aggregate returns indexes and size sorted portfolios. Wu (1996) evaluated the weak-form efficiency of Shanghai and Shenzhen stock market, and the findings of this study didn’t conclude weak form efficiency at bottom line.

Dahel and Laabas (1999) examine the efficiency of Gulf Cooperation Council (GCC) equity markets. By taking the data from 1994-1998, this study concludes that the stock market of Kuwait follows the weak form of efficiency. However, the rest of the markets reject the weak form of the
EMH. Abraham et al., (2002) tested the RWH and market efficiency hypothesis for Saudi Arabia, Kuwait and Bahrain. The results of this study shows that Saudi and Bahraini markets follow the hypothesis of random walk but market of Kuwait is inefficient and hence couldn’t follow RWH. Malkiel (2003) states that in case of fully efficient markets, present period is not effected by the past information. However, the investors are not allowed by the efficient stock markets to earn more average returns without facing more average risks. Narayan and Smyth (2004) apply Zivot and Andrews (1992) and Lumsdaine and Papell’s (1997) one and two structural break unit root tests respectively to analyze the random walk hypothesis for stock prices in South Korea. The findings of this study narrate that stock prices in South Korea has unit root, hence are consistent with the RWH. Chakraborty (2006) evaluated the weak form efficiency of KSE-100 index. Findings of this study reject the random walk hypothesis which depicts that KSE is not an efficient stock market. Hassan and Abdullah (2007) examined the weak form market efficiency of KSE. The result shows that prices pattern didn’t follow random walks and are not weak form efficient. Marashdeh and Shrestha (2008) highlight the efficiency in emerging markets of United Arab Emirates (UAE) by applying Perron’s (1997) model to test for a unit root. Empirical results show that UAE securities markets follow the RWH and are efficient in the weak form. Liu (2010) examines the stock market development and market efficiency on China Stock Market (CSM). By applying EGRACH test, the findings of this study reveals that the CSM are not weak form efficient and do not follow the RWH. Zaubia and Nahleh (2010) tested the financial market efficiency in the Middle East and North African Countries (MENA). The results of this study show that MENA markets follow the RWH and are efficient weakly. Irfan, M. et al. (2010) determine the existence of weak from efficiency in the Karachi Stock Exchange (KSE), either it is efficient market or not. This study uses daily and monthly closing prices of KSE-100 indexes over the period of January 011999 to August 31, 2009. Results of this study show that the Karachi Stock Market of Pakistan is not efficient in weak from. Oskooe (2011) tested the RWH for Iran Stock Market (ISM). Findings of this study reveal that that ISM follows the RWH or in other words ISM is efficient in the weak form. Mishra (2011) conducted a study to find out the weak form market efficiency in the emerging and developed world capital markets. By applying unit root test and GARCH (1, 1), this study concludes that these markets are not weak form efficient and do not follow the RWH. Bashir et al., (2011) examined the weak form hypothesis in the stock prices of banks listed in KSE. The findings of this study concludes that KSE is inefficient and do not follow the RWH. However, the prices of banking sector for KSE are being predictable or its pattern can be judged based on its inefficiency at bottom line. Above given scenario depicts the mixed results about different stock exchanges behavior. However, this study fills the gap by examining the behavior of KSE by analyzing the random walk hypothesis.

3. Data Description and Methodology
3.1. Data Collection and Analysis
The study about the random walk nature of the share prices of the firms listed at KSE-100 Index consists upon the historical data of KSE-100 Index from January 2, 2001 to November 15, 2011 which contains 2672 observations of the closing share price index of the top 100 companies listed with KSE. For the first time share prices of the KSE as a whole are considered for the analysis of market efficiency or randomness in the share prices of the KSE and almost all the research conducted for this purpose are based on the sector wise analysis. However, all the data required for this study is gathered from official web site of the KSE and this data does not include the share prices of public holidays and sessions when the market is off.

3.2. Econometric Methodology
3.2.1. Unit Root Test
There is a need of stationarity checking before applying any econometric work. However, Granger and Newbold (1974) narrates that working with non-stationary variables often bring spurious results and
that may observe incorrect inferences in this regard. It is compulsory that the series should be stationary. This study applies two unit root tests namely, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for investigating the order of integration of the variables.

3.2.2. Johansen Cointegration Test
Cointegration is considered as a statistical property that depicts the long-run relationship of economic time series. Johansen (1988) proposed an approach to examine the long-run relationship among variables. However, this study uses Johansen and Juselius’s (1990) cointegration approach for estimating the co-integration among the stock prices of the firms listed at KSE-100 index. The hypothesis of efficient stock market in weak form narrates that price movements of stock are independent and hence successive stock price shows their independence in this scenario. However, for examining the efficiency of stock market in weak form, this study examines the randomness of stock prices by taking the RWH as base. Past precedence and trends of stock price did not help to predict the future stock price movements.

\[ P_t = \mu_t + P_{t-1} + \varepsilon_t \]  

(1)

Whereas, \( P_t \) is the stock price index at time \( t \), \( \mu \) is the expected price change, \( P_{t-1} \) depicts the stock price index at time \( t-1 \) and \( \varepsilon_t \) is error term.

4. Empirical Results and Discussion
By using the Eviews-7, the descriptive statistical summary is obtained to view the data as a whole with the help of Histogram and statistical results about the KSE-100 Index share prices.

Figure 1: KSE-100 Index Share Prices

4.1. Descriptive Statistical Analysis

Table 1: Series: Closing KSE-100 Index

<table>
<thead>
<tr>
<th>Obs.</th>
<th>Mean</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Jarque-Bera</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2672</td>
<td>7693.209</td>
<td>8470.810</td>
<td>15676.34</td>
<td>1075.160</td>
<td>4093.154</td>
<td>-0.152</td>
<td>1.803</td>
<td>169.735</td>
<td>0.000</td>
</tr>
</tbody>
</table>
The descriptive statistical values of the KSE-100 Index shows that there is variation in the share prices of the 100 companies listed with the KSE and the data sample is negatively skewed. Table 1 depicts the stochastic properties of the KSE prices index. The sample mean for stock return series is 7693.209. Standard deviation is 4093.154. However, the Kurtosis in KSE-100 index is 1.803 which is smaller than the normal value of 3. The Jarque-Bera statistics also reject the null hypothesis that KSE stock prices series is normally distributed.

4.2. Augmented Dickey-Fuller (ADF) Unit Root Test
Share prices always have a trend which means there could be a major observation that can affect the results which we normally want to obtain. Before applying the desired econometric test, data should be made stationary or its trend should be reduced to minimize the effect of such major observations which are normally caused by the market crises as faced by market in 2008 and recently in October, 2011. The KSE-100 index during the outgoing week (October, 2011) shed almost 463 points or 3.9% to close at 11,525.25 index points as compared to 11,988.09 index points of the previous week. Such sudden changes affect the desired result and to minimize the effect of such unwanted ups and downs, this study uses ADF unit root test for this purpose and it is depicted in table-2.

Table 2: Augmented Dickey-Fuller Unit Root Test Results for KSE-100 Index

<table>
<thead>
<tr>
<th>Unit Root</th>
<th>t-statistics</th>
<th>Critical Value at 5%</th>
<th>Critical Value at 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>-1.459</td>
<td>-3.411</td>
<td>-3.961</td>
</tr>
<tr>
<td>1st Difference</td>
<td>-25.427</td>
<td>-3.411</td>
<td>-3.961</td>
</tr>
</tbody>
</table>

Hypothesis
KSE-100 Index Series is Non-Stationary

As can be seen from table 2, at level the results of the ADF test of null hypothesis is true but at the 1st difference of ADF unit root test, null hypothesis is rejected as the t-statistic value of the ADF is greater than their critical values both at 5% and 1% level of significance which means the KSE-100 Index series data becomes stationary. However, KSE-100 Index share prices move along time within a stochastic process which means that there exists a sense of randomness among the share prices of the KSE-100 Index. In other words, KSE-100 Index follows the random walk and is an efficient market.

4.3. Phillips-Perron (PP) Unit Root Test
Phillips-Perron (PP) test is another test which is mostly used by the analysts to de-trend the series data to minimize the effects of the major variations in the data same as the ADF unit root test as applied and interpreted thus far. Table-3 shows the results of the PP unit root test.

Table 3: Phillips-Perron Unit Root Test Results for KSE-100 Index

<table>
<thead>
<tr>
<th>Unit Root</th>
<th>Adj. t-statistics</th>
<th>Critical Value at 5%</th>
<th>Critical Value at 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>-1.509</td>
<td>-3.411</td>
<td>-3.961</td>
</tr>
<tr>
<td>1st Difference</td>
<td>-25.504</td>
<td>-3.411</td>
<td>-3.961</td>
</tr>
</tbody>
</table>

Hypothesis
KSE-100 Index Series is Non-Stationary

The results of the PP test fails to reject the null hypothesis as the value of the PP Adj. t-statistic remain less than the critical values but the at 1st difference the null hypothesis is rejected as the value of PP test becomes greater than the critical values at 5% and at 1% level of significance which means KSE-100 Index has no trend and series is now stationary. The results of PP test also confirms the outcome of ADF test which shows that series data of the KSE-100 index follows the random walk and KSE is an efficient market. Figures 2 and 3 also show two different lines of the KSE-100 index sample
data series. Figure-2 shows the raw data which is not stationary and has a trend in its movement but figure-3 shows the stationary data line which has no trend movement. However, Figure-2 shows that KSE-100 index share prices are at normal and Figure-3 depicts it at 1\textsuperscript{st} difference stationary.

**Figure 2:** KSE-100 Index Share Price Data

![KSE-100 Index Share Price Data](image)

**Figure 3:** KSE-100 Index Share Price Data

![KSE-100 Index Share Price Data](image)

4.4. **Johansen Cointegration Test**

Cointegration is a property of the times series data which normally shows the correlated accelerations or a stochastic drift among the observations of the data. It means the cointegration shows that each previous value puts some of its influence on the next observation which helps in predicting the future values. This study of share prices at KSE follows a random walk or KSE is an efficient market. However, our main objective is to know if any chance exists that KSE-100 share prices can be predicted on the basis of the previous market prices or KSE can be outperformed. To judge this characteristic of the KSE-100 index Johansen Cointegration Test is also used and the results obtained from this test are given in table-4.
Table 4: Johansen Cointegration Test of the KSE-100 Index

<table>
<thead>
<tr>
<th>Trace Statistics</th>
<th>Critical Value at 5%</th>
<th>Critical Value at 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.580</td>
<td>3.76</td>
<td>6.65</td>
</tr>
</tbody>
</table>

*Trace test indicates no cointegration at both 5% and 1% levels

From the values shown in table-4, the trace statistic value is less than the critical values of 5% and 1% significance, which means there exists no cointegration among the observations of the KSE-100 Index share prices. It means that no future value is influenced by the previous value of the market share price so future prices at the KSE cannot be predicted on the basis of the previous share market prices. However, KSE cannot be outperformed to gain an abnormal return from the share prices at KSE-100 Index.

5. Concluding Remarks
Each investor is profit-oriented and wants to gain the highest possible returns and different researches are conducted about beating the market for earning some abnormal return. However, most of the time markets prove efficient against the strategies of the investment gurus and the prices of the market cannot be predicted accurately. For the accomplishment of the purpose of this study, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Unit Root Test was applied to check the stationarity of the data. Hence the data included in this study is 1st difference stationary for both ADF and PP unit root test and that become the cause of applying Johansen Cointegration Test. From our analysis of the KSE-100 Index – prices of the sample period – we conclude that KSE is an efficient financial market that can adjust any new information very quickly and efficiently and the prices of the securities listed for trading at KSE-100 Index cannot be predicted as KSE cannot be beaten to gain any abnormal return.KSE-100 Index follows the Random Walk Hypothesis (RWH) and Efficient Market Hypothesis (EMH) according to the results of the tests used. Securities and Exchange Commission of Pakistan (SECP) can enhance the efficiency of KSE by improving infrastructure and through proper policy making that result in attracting foreign investments, which become the cause of soundness and uplifting the economy of Pakistan. However, security conditions and economic solidarity of Pakistan has major concerns in this regard and it needs much attention from government, policy makers and of all other stakeholders who hold offices regarding the administration. The results of this study may exhibit a lack of generalizability in case of other stock exchanges working in Pakistan. Further study is recommended in case of comparative analysis for getting ground breaking results about rest of the stock exchanges behavior working in Pakistan.

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