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ARE KARACHI STOCK EXCHANGE FIRMS INVESTMENT PROMOTING? - EVIDENCE OF EFFICIENT MARKET HYPOTHESIS USING PANEL COINTEGRATION



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ABSTRACT

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This study investigates the evidence of efficient market hypothesis for the firms listed in Karachi Stock Exchange (KSE), which signifies the nature of the stock market. According to this hypothesis, the empirical information available is not enough to predict the present movement of share prices. After using the Panel cointegration approach between current share price and past share price in the light unknown structural break on the daily data of 75 selected firms over the period June 2004 to March 2014, comprising 2370 observations per firm. The study found that the firms listed in Karachi Stock Exchange are inefficient firms, therefore, for the case of KSE – 100 offer information which can be used to make economic profits. Hence Karachi Stock Exchange provide enough predictable information using past trends so that investor can gain economic profit from it, so it will take time for the market to become mature and the creation of competition.

Contribution/ Originality: This study is unique in estimating univariate ECM equation in a Panel cointegration setup to investigate efficient market hypothesis while controlling for relative movement of share prices, unknown shocks and time trends present in the daily share price data of KSE listed firms.

1. INTRODUCTION

When individuals are considering any form of investment, their first and foremost concern is to be able to visualize the expected returns from the investment. Investment ventures whose returns are unpredictable might discourage investors from investment, as there are no expected returns in this venture whereas with a venture no matter how volatile it is if it is growing then there are some expected returns.

For example, the investor who is investing in the stock market is more likely to invest if he can visualize the future stock prices on the basis of present information available to project a value to expected returns (Jensen, 1978). Conversely if on the basis of available information an investor cannot envisage expected returns then it will be hard for the investor to commit to the investment. Hence in terms of attracting investment, this predictable market will be efficient (Lee *et al.*, 2010).

The idea of market efficiency is well recognized and has been addressed by many research studies. According to economic theory, if the firms are pro-growth then definitely the share prices (value) will grow too (Truett and

Truett, 1998). So if share prices are growing then definitely present price is higher than the past price so they become predictable, attractable to investment and hence called inefficient market. Moreover; sage investors like Warren Buffet recommend that investors should set their minds for long term profits while investing in the stock market and should abandon the speculative mindset, as speculation only works in inefficient markets. The inefficient stock market offers arbitrary returns to the speculators, whereas, there is no charm for the speculators in an efficient stock market (Malkiel, 1973). Therefore, one could always plan for long-term investment to reap long-term gains while investing in an efficient stock market (Shafi, 2014).

This study investigates the efficient market hypothesis for the case of Pakistan using daily data from listed companies Karachi Stock Exchange. The study utilizes sophisticated statistical techniques (i.e. Panel Unit Root and Panel Cointegration) which are better able to comprehend the behaviour dynamics of change in share prices and the investor. It provides evidence on whether the Karachi Stock Exchange (KSE) of Pakistan is attractive to speculative investors or to long-term investors.

The second section reviews empirical studies which tested the efficient market hypothesis. The third section, introduces the data sources and estimation methods. The next section discusses the analysis and interpretation will be. The final section presents the study findings and arguments, concluding with some of the policy implications.

2. LITERATURE REVIEW

This section reviews prior research which has empirically tested the efficient market hypothesis for the equity markets of various countries in different time spans. The concept of the efficient market has been widely addressed in the economics and finance literature and basically holds that, where current knowledge is widely available to participants in the market, that the actual price of a security is a good estimate of its intrinsic value (Roberts, 1967; Fama, 1970). If the market is efficient then it is argued that investors cannot 'beat' the market. In other words, random investment choices should produce the same results as those of investment experts. This concept was popularised by Malkiel (1973) in his book '*A Random Walk Down Wall Street*.' Thus, testing for the presence of a random walk performance of a given exchange can be seen as a way to determine whether that stock market is efficient, or whether it is inefficient, in which case investors with better knowledge should be able to outperform those with less useful information. Many market studies have been done to examine this phenomenon and a representative set of such studies is reviewed below, concluding with the findings of several studies of the Karachi Stock Exchange (KSE).

Mobarek *et al.* (2008) attempted to test the random walk hypothesis by considering the daily price index of the Dhaka Stock Exchange (DSE). After applying both parametric tests (autoregressive regression model, autocorrelation test, ARIMA model) and non-parametric tests (Runs test and Kolmogorov-Smirnov normality test) on the sample period ranges from 1988 – 2000; the study concluded that random walk hypothesis does not exist in DSE, therefore, the efficient market hypothesis is not true for DSE. Besides Mobarek *et al.* (2008); Magnus (2008) tested the efficient market hypothesis for Ghana Stock Exchange (GSE). Using GARCH (1, 1) on the daily returns for the sample ranges from 1999 to 2004; his findings concluded in the end that GSE is an inefficient stock market that does not follow the efficient market hypothesis.

Asiri (2008) tested the random walk hypothesis for the case of Bahrain Stock Exchange (BSE). After applying Dickey-Fuller; exponential smoothing and ARIMA tests on the daily stock prices of all listed companies in BSE for the period of June 1st, 1990 to December 31st, 2000, the findings of the study supported the random walk hypothesis and hence concluded that BSE is an efficient stock market.

Awad and Daraghma (2009) examined the efficient market hypothesis for Palestine Security Exchange (PSE). Using various parametric and nonparametric tests such as serial correlation; Augmented Dickey - Fuller (ADF), Phillips - Perron (PP) and Runs tests on daily data of stocks for the period from January 1st, 1998 – October 31st, 2008. Their study found that Palestine Security Exchange does not support the efficient market hypothesis,

therefore, it was concluded that PSE was a weak inefficient stock market where investors could reap abnormal profits by speculation.

Hamid *et al.* (2010) investigated the weak form of market efficiency in the Asia-Pacific Region. They considered Korea, India, Pakistan, Indonesia, Hong Kong, Singapore, Malaysia, Japan, Philippine, Australia, and Thailand in the Asia-Pacific Region. Using different statistical methods in order to verify weak form of market efficiency, including Runs Test, Unit Root Test, Autocorrelation and Ljung-Box Q-Statistic and Variance Ratio tests on the monthly data series ranges from January 2004 – December 2009. Hamid *et al.* (2010) found that all of these 14 equity markets are inefficient and hence they concluded that in all the Asian Pacific Region investors are able to enjoy speculative returns. In 2011, the weak form of market efficiency for the KSE – 100 Index was examined by Haque *et al.* (2011). They used various econometric techniques such as Runs Test, Unit Root Test, and Autocorrelation Ljung - Box Q - Statistic tests on the weekly data from 2000 to 2010 in order to see whether the KSE – 100 Index is weak form efficient or not. The empirical results of their study concluded that KSE – 100 Index is an inefficient stock market where investors could earn abnormal returns in short run.

In 2012, Zahid *et al.* (2012) explored whether the KSE – 100 Index followed the random walk hypothesis. Using different econometric tests for the sample period from March 2000 to October 2011, they found that KSE – 100 Index does not follow the random walk hypothesis, therefore, it is not efficient. During the same year, Nisar and Hanif (2012) examined four stock exchanges in South Asia – BSE-SENSEX, KSE-100, DSE-GEN, and CSE-MPI, investigating the efficient market hypothesis. They applied various statistical techniques, such as serial correlation (Durbin-Watson test), Runs test, Variance Ratio test, and unit root on the various frequencies of data series like daily, weekly, and monthly which ranged from 1997 to 2011. Their empirical results showed that weekly and monthly return series do not fulfil the features of random walk series in all the four leading stock exchanges; therefore, they concluded that all these stock exchange markets are efficient, while the daily returns are not random. Besides the Nisar and Hanif (2012) study mentioned above, Omar *et al.* (2013) also examined the efficient market hypothesis for KSE – 100 Index. They considered closing stock returns on the daily, weekly, and monthly basis for the period from January 1st, 1998 to February 29th, 2012. They applied different tests such as VAR test, Runs test, KS test, and Unit Root tests in order to determine whether the KSE – 100 Index is an efficient market. The study concluded that the KSE – 100 Index is inefficient and therefore, it is not difficult for the investors to expect returns from this market. Also in 2013, Ogege and Mojekwu (2013) tested the random walk hypothesis for the Nigerian Stock Market Price Index. After applying various estimation techniques such as regression analysis, involving the Runs test, correlogram, correlation matrix and the least squares on the monthly data series ranges from 1985 to 2010, they concluded that the Nigerian Stock Exchange does not follow random walk hypothesis, therefore, it has found to be inefficient.

The efficient market hypothesis was further tested by Shafi (2014) considering the National Stock Exchange (NSE) of Indian Capital Market. He applied both ADF and Phillip Perron unit root tests on the 2747 observations for the period from 2003 to 2013 in order to find whether NSE is predictable or not? The empirical results of both unit root tests reveal that the data series is stationary, having mean of stock returns constant throughout history, therefore he concluded that the NSE of Indian Capital Market is not predictable, so it is weak efficient. Akber and Muhammad (2014) investigated the efficient market hypothesis for the daily closing values from January 1st, 1992 to April 30th, 2013 for the companies enlisted in the KSE – 100 Index. They applied various parametric and nonparametric tests and concluded that companies enlisted in the KSE – Index during overall sample period are inefficient. Moreover; when the sample period is subdivided into various ranges, from the period between 2001 and 2003, the samples showed the signs of weak market efficiency. Finally, they also found that the companies enlisted in KSE – 30 Index is more predictable than that of companies enlisted in KSE – 100 Index.

These studies are summarized in Table 1 below.

Table-1. Comparison of Studies.

Study	Years Studied	Market	Tools Used	Efficient Market
Mobarek <i>et al.</i> (2008)	1998-2000	Dhaka Stock Exchange (DSE)	Parametric tests (autoregressive regression model, autocorrelation test, ARIMA model) and non-parametric tests (Runs test and Kolmogorov-Smirnov normality test)	NO
Magnus (2008)	1999-2004	Ghana Stock Exchange (GSE).	GARCH (1, 1)	NO
Asiri (2008)	1990-2000	Bahrain Stock Exchange (BSE).	Dickey-Fuller; exponential smoothing and ARIMA tests on the daily stock prices	YES
Awad and Daraghma (2009)	1998-2008	Palestine Security Exchange (PSE).	Parametric and nonparametric tests such as serial correlation; Augmented Dickey - Fuller (ADF), Phillips - Perron (PP) and Runs tests	YES/NO?
Hamid <i>et al.</i> (2010)		Asia-Pacific Region: 14 markets	Runs Test, Unit Root Test, Autocorrelation and Ljung-Box Q-Statistic and Variance Ratio tests	NO (for all)
Ogege and Mojekwu (2013)	1985-2010	Nigerian Stock Market	Regression analysis, involving the Runs test, correlogram, correlation matrix and the least squares	NO
Shafi (2014)	2003-2013	National Stock Exchange (India)	ADF and Phillip Perron unit root tests	Weak YES
Nisar and Hanif (2012)	1997-2011	BSE-SENSEX, KSE-100, DSE-GEN, CSE-MPI	Serial correlation (Durbin-Watson test), Runs test, Variance Ratio test, and unit root	YES
Akber and Muhammad (2014)	1992-2013	KSE -100	Various parametric and nonparametric tests	Overall NO but weak YES in sub samples of recent years
Haque <i>et al.</i> (2011)	2000-2010	KSE -100	Runs Test, Unit Root Test, and Autocorrelation Ljung - Box Q - Statistic tests	NO
Omar <i>et al.</i> (2013)	1998-2012	KSE -100	VAR test, Runs test, KS test, and Unit Root tests	NO
Zahid <i>et al.</i> (2012)	2000-2011	KSE -100	Various parametric and nonparametric tests	NO

From the studies reviewed above we can conclude that the stock markets which are immature or are still in transition phase are mostly inefficient, and that the stock markets which have grown or matured are efficient stock markets and into such stock markets investors can enjoy profits based on market growth instead of market risk and volatility. However, as Table 1 shows, in the case of Pakistan, there is a split between market being efficient and inefficient. Besides this part of the study; now we will explore some economic and behavior implications which will become part of the estimation model, also we would like to discuss some of the possible data sources and the estimation methods and tools to find out empirical results for this study in the next part and it has presented as below.

3. DEVELOPING THE RESEARCH MODEL FOR THIS STUDY

Lee *et al.* (2010) summarized recent studies and applied panel unit root test with a structural break on the country's aggregate stock market index to determine whether the overall market is efficient or not. This study aims to bridge some gaps in Lee *et al.*'s study as follows:

- i. To accurately estimate the efficiency of the stock market then the stock prices data must have the highest frequency possible. Whereas, Lee *et al.* (2010) used monthly data this study uses daily data (Omar *et al.*, 2013; Akber and Muhammad, 2014).

- ii. Investors tend to invest in the individual firms, hence the firm's share price is under consideration as compared to the market index which is often absent in other studies. Hence this study will use most of the firms (75) form KSE 100 index, subject to data availability.
- iii. Similarly in order to stabilize returns and minimize losses investors tend to invest in a portfolio approach hence this study indicates the construction of panel instead of individual time series testing, and allows for cross-sectional heterogeneity, Lee *et al.* (2010) used panel KPSS test (2nd generation) and 1st generation panel unit root tests, whereas this study uses 2nd generation panel unit root test and 2nd generation panel cointegration.
- iv. Since the relative importance of each firm depends upon relative movement of share prices indicating the presence of cross-sectional dependence, Lee *et al.*, used KPSS with critical values allowing for cross-sectional dependence (country-wise) whereas this study uses Westerlund (2007) cointegration test, allowing for cross-sectional dependence (firm wise) this dynamic is assumed in all the previous studies.
- v. Lastly, Market information or shocks can affect the movement of its share prices hence the tests must incorporate structural break using Bai and Perron (1998) method, which is ignored in all previous studies done on KSE.

4. MATHEMATICAL MODEL

The econometrics literature provides a rich discussion and models which are used to check how much the series is predictable based on its past pattern and other available information. In time series econometric these models are called models for testing of presence of unit root and cointegration. This section demonstrates the construction of a basic model of a unit root. Consider Y_t are the present share prices which are changing it time (annually or monthly) hence the prediction model will be

$$y_t = \alpha + \alpha_1 y_{t-1} + \mu_t \quad (1)$$

Here in Equation 1, α is intercept term which tells what will be the value of y_t if $y_{t-1} = 0$ and α_1 tell how much y_t will increase if y_{t-1} increase by 1 unit (in this derivation we assume $\alpha_1 = 1$ for simplification) and μ_t describes the random change in the prices which may be due to good or bad news effect in the economy. So if we substitute values of y_{t-1} in Equation 1 we have

$$y_t = \alpha + (\alpha + y_{t-2} + \mu_{t-1}) + \mu_t \quad (2)$$

$$y_t = 2\alpha + y_{t-2} + \mu_{t-1} + \mu_t \quad (3)$$

So, if we continue this process until the last (first) value of y (y_0) we will have following equation

$$y_t = t\alpha + y_0 + \sum \mu_{t-1} \quad (4)$$

If we assume that all the good news ($\mu > 0$) and the bad news ($\mu < 0$) cancel out each other in the history of the data used then we can omit this aggregate error component and simply write Equation 5.

$$y_t = t\alpha + y_0 \quad (5)$$

Hence there are two ways to predict the present share price of the firm, first is by checking its trend (t) if the line graph of the series is showing increasing trend then definitely it can be predicted, and second is using its past value which is determining the present share price (Enders, 2008).

5. METHODOLOGY

In order to create a qualitative variable which will represent the effect of market information and market shocks on the share prices, this study uses the Bai and Perron (1998) breakpoint method.

5.1. Finding Structural Break Points

Consider a standard linear regression model having T time periods and possible m unknown breaks in the data such that forming $m+1$ structurally different subgroups.

$$Y_t = X_t' \beta + Z_t' \delta_j + \varepsilon_t \tag{6}$$

Here in Equation 6, j defines the subsets and Z is a variable which is defining the subgroup-specific coefficients and X are set of variables which are stable across subsets. Here Bai and Perron (1998) provided a procedure to identify multiple breakpoints in the data and construct the dummy variable Z . Upon identification of the break (Bai and Perron, 2003a) used following test to compare the presence of break with no breaks.

$$F(\hat{\delta}) = \frac{1}{T} \left(\frac{T - (l+1)q - p}{kq} \right) (R\hat{\delta})' (R\hat{V}(\hat{\delta})R')^{-1} R\hat{\delta} \tag{7}$$

Where $\hat{\delta}$ is an estimate to find l breaks, this method uses a variance-covariance approach using $\hat{V}(\hat{\delta})$ which is expected to be robust to the presence of autocorrelation and heteroskedasticity.

5.2. Heterogeneity Tests

Previous studies used the overall KSE index data to determine if the market is efficient or not, but in reality, the state and pattern of each firm in the KSE are bound to be different. Using equality of means, medians and variances across firms averaging time and across averaging firms. If heterogeneity in terms of mean, median and variance is determined then this will indicate that using a panel approach is more appropriate as compared to the analysis of market index.

5.3. Testing the Efficiency Hypothesis

According to this hypothesis, the share prices should be predictable in order to indicate that the market is efficient. Hence for this purpose, there will be some tests performs in this study in order to analyze their degree of predictability. These tests include; unit root tests, variance ratio tests, cointegration tests including trend and structural break.

5.4. Unit Root Tests:

Levin et al. (2002) used the Dickey-Fuller specification in panel specification with adjustments using the mean deviations in the variables.

$$\Delta \tilde{y}_{it} = \phi_i \tilde{y}_{i,t-1} + \varepsilon_{it} \tag{8}$$

$$\begin{matrix} H_0: & \phi_1 = \dots = \phi_N = 0 & & \phi_1 = \dots = \phi_N \equiv \phi \\ & nonstationary & & \\ & & H_1: & \phi < 0 \\ & & & stationary \end{matrix}$$

This LLC test is based on assumption that all the cross section have common adjustment process when it is non-stationary then $\phi_1 = \dots = \phi_N = 0$ and for the case of stationary it is $\phi_1 = \dots = \phi_N \equiv \phi$ and $\phi < 0$.

Im et al. (1997) built on the LLC test using ADF specification and relaxing the assumption of common adjustment to allow cross section heterogeneous adjustments. This IPS test is applied when a number of time periods are more than the number of cross sections. Based on the IPS W statistic below this test can determine if the pattern of the series in predictable by itself or not.

$$y_{it} = \rho_i y_{i,t-1} + \sum_{j=1}^n \phi_{it} \Delta y_{i,t-j} + z_{it}' \gamma + \varepsilon_{it} \tag{9}$$

$$H_0: \rho_i = 1 \text{ for all } i \quad H_1: \rho_i < 1 \text{ for at least one } i$$

The average t statistic for the heterogeneous ρ_i is following

$$\bar{t} = \frac{1}{N} \sum_{i=1}^N t_{\rho_i}$$

Using the asymptotic properties of $N \rightarrow \infty$ and $T \rightarrow \infty$ the IPS W statistic will be calculated as following

$$W_{IPS} = \frac{\sqrt{N}(\bar{t} - \frac{1}{N} \sum_{i=1}^N E[t_{iT} | \rho_i = 1])}{\sqrt{(\frac{1}{N} \sum_{i=1}^N Var[t_{iT} | \rho_i = 1])}} \rightarrow N(0,1)$$

Hence the hypothesis becomes

$$H_0: \text{Unit roots in all cross sections} \quad H_1: \text{At least on cross section is Stationary}$$

The benefit of IPS is that is used more robust approach by incorporating seasonal variations $\Delta y_{i,t-j}$ and also it allowed the adjustment process to be heterogeneous which is more realistic.

Another class of panel unit root tests were introduced by Maddala and Wu (1999); Choi (2001) based on the idea of simulation based statistics by Fisher (1932). Specification of Fisher type ADF and PP tests are following.

$$\begin{aligned} y_{it} &= \rho_i y_{i,t-1} + z'_{it} \gamma + \mu_{it} \\ i &= 1 \dots N \\ t &= 1 \dots T \end{aligned} \tag{10}$$

$$P = -2 \sum_{i=1}^N \ln \rho_i \rightarrow \chi^2 \text{ with } 2N \text{ d.f}$$

Hence the hypothesis based on the test statistic becomes

$$H_0: \text{Unit roots in all cross sections} \quad H_1: \text{At least on cross section is Stationary}$$

Hadri (2000) built the langrage multiplier unit root with a special focus that some characteristics have to be statistically significant in order to make series non-stationary hence the hypothesis of this test are opposite to previous tests. In this test, any variable y_{it} is a function of trend and some characteristic which is a random walk.

$$\begin{aligned} y_{it} &= r_{it} + \beta_i t + \varepsilon_{it} \\ r_{it} &= r_{it-1} + \mu_{it} \\ y_{it} &= r_{i0} + \beta_i t + \sum_{t=1}^t \mu_{it} + \varepsilon_{it} \end{aligned}$$

Here a statistic will be generated to test the non-stationarity of the series. In this test, the null hypothesis states that the characteristic r_{it} is not random walk hence series is stationary.

$$H_0: \lambda = \frac{\delta_\mu^2}{\delta_\varepsilon^2} = 0 \quad H_1: \lambda = \frac{\delta_\mu^2}{\delta_\varepsilon^2} > 0$$

Breitung (2000;2002) has a different approach as compared to Levin et al. (2002) by constructing a proxy for the variable which has the autoregressive component such as.

$$\Delta \tilde{y}_{it} = \left(\Delta y_{it} - \sum_{j=1}^{p_i} \hat{\beta}_{ij} \Delta y_{it-j} \right) / s_i$$

$$\tilde{y}_{it-1} = \left(y_{it-1} - \sum_{j=1}^{p_i} \hat{\beta}_{ij} \Delta y_{it-j} \right) / s_i$$

This proxy will be used to create the variable which is also detrended. The final test will have a null hypothesis of series have common unit root for non-stationarity.

$$\begin{aligned} \Lambda y_{it}^* &= \sqrt{\frac{T-t}{T-t+1}} \left(\Delta \tilde{y}_{it} - \Delta \tilde{y}_{it+1} + \dots + \Delta \tilde{y}_{iT} / T-t \right) \\ y_{it}^* &= \tilde{y}_{it} - \tilde{y}_{i1} - t-1 / T-1 (\tilde{y}_{iT} - \tilde{y}_{i1}) \\ \Delta y_{it}^* &= \alpha y_{it-1}^* + v_{it} \end{aligned} \tag{11}$$

H₀: ρ_i = 1 for all i H₁: ρ_i < 1 for all i

5.5. Variance Ratio Tests

Since the stationarity of the series requires the series to have a constant mean and constant variance (Enders, 2008) so the unit root tests above are not specifically testing the variance to be equal. For this purpose variance ratio tests are applied which check the variance of the series to be a random walk or not. Following is the specification of the variance ratio test proposed by Lo and MacKinlay (1988).

$$\begin{aligned} \hat{\mu} &= 1/T \sum_{t=1}^T (Y_t - Y_{t-1}) \\ \hat{\sigma}^2(q) &= 1/Tq \sum_{t=1}^T (Y_t - Y_{t-q} - q\hat{\mu})^2 \end{aligned}$$

So the variance ratio test has the following form

$$VR(q) = \hat{\sigma}^2(q) / \hat{\sigma}^2(1)$$

H₀: Series is martingale (non-stationary) H₁: Series is not martingale (stationary)

5.6. Panel Cointegration Test

5.6.1. Kao Test

Kao (1999) provided pioneer tests to cointegration test for panel data. This test uses same residual stationarity based test, its specification is illustrated below.

$$y_{it} = \alpha_i + x'_{it} \beta + \mu_{it} \tag{12}$$

Consider all the included variables are I(1) in nature, then for the presence of cointegration must require residuals μ_{it} to be I(0). Kao (1999) constructed Kao ADF test from the residual equation having a null hypothesis of no cointegration.

$$\Delta \hat{\mu}_{it} = \rho \hat{\mu}_{it-1} + \sum_{j=1}^p \varphi_j \Delta \hat{\mu}_{it-j} + v_{itp} \quad (13)$$

$$t_{ADF} = \frac{(\hat{\rho} - 1) \left[\sum_{i=1}^N (\mu_i' Q_i \mu_i) \right]^{1/2}}{\sqrt{\left(\frac{1}{NT} \right) \sum_{i=1}^N \sum_{t=1}^T \hat{v}_{itp}^2}}$$

H₀: No cointegration

H₁: Cointegration

5.6.2. Pedroni Engle Granger Based Cointegration Test

Pedroni (1999;2004) used same Engle-Granger based Cointegration Test with several specifications based on heterogeneous intercepts and trends which were ignored and assumed to be homogeneous in Kao (1999) test. Following is the primary and auxiliary regression

$$y_{it} = \alpha_i + \delta_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \dots + \beta_{Mi} x_{Mi,t} + e_{it} \quad (14)$$

$$\hat{e}_{it} = \rho_i \hat{e}_{it-1} + \sum_{j=1}^p \psi_{ij} \Delta \hat{e}_{it-j} + v_{it} \quad (15)$$

The basic illustration of Pedroni test statistics are following

$$Z_{\rho NT-1} = \left(\sum_{i=1}^N \sum_{t=2}^T (\Delta \bar{e}_{it} \bar{e}_{it-1} - \hat{\lambda}_i) \right) \left(\sum_{i=1}^N \sum_{t=1}^T \bar{e}_{it-1}^2 \right)^{-1}$$

$$\bar{Z}_{\rho NT-1} = \sum_{i=1}^N \left(\left(\sum_{t=2}^T (\Delta \bar{e}_{it} \bar{e}_{it-1} - \hat{\lambda}_i) \right) \left(\sum_{i=1}^N \sum_{t=1}^T \bar{e}_{it-1}^2 \right)^{-1} \right)$$

This test has two major type of specification one assumes that the cointegration is common for the cross sections and the second specification assumes that the cointegration is not common among the cross sections.

H₀: No Cointegration

H₁: Cointegration

5.6.3. Westerlund Error Correction Based Cointegration Test

Westerlund (2007) and Persyn and Westerlund (2008) developed a new generation of cointegration tests which are valid even if the cross-sectional correlation of the variables are not zero. Considering cross-sectional correlation is deemed to be present in the data describing the stock market behavior. Hence Westerlund (2007) test is considered to be more efficient and applicable. Following is the ECM specification of Westerlund (2007) test

$$\Delta y_{it} = \delta_i' d_t + \alpha_i y_{it-1} + \lambda_i' x_{it-1} + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{it-j} + \sum_{j=q_i}^{p_i} \gamma_{ij} \Delta x_{it-j} + e_{it} \quad (16)$$

$$\lambda_i' = -\alpha_i \beta_i'$$

The group statistics are calculated using following way

$$G_T = \frac{1}{N} \sum_{i=1}^N \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)}, \quad G_\alpha = \frac{1}{N} \sum_{i=1}^N \frac{T \hat{\alpha}_i}{\hat{\alpha}_i(1)}$$

And the panel statistics are calculated using the following way

$$P_T = \frac{\hat{\alpha}}{SE(\hat{\alpha})}, \quad P_\alpha = T \hat{\alpha}$$

For this ECM based cointegration test, the null hypothesis is no cointegration and the alternative hypothesis is the presence of cointegration.

6. ESTIMATION RESULTS

The following analysis is based on an analysis of the daily stock market data for 75 selected firms, over the period from June 2004 to March 2014, a total of 2,370 observations per firm.

A comparison of means, medians and variances of firms across time or across firms is provided in Table 2 below, a wide array of tests for the purpose that these firms are generically different hence their share prices do not match with each other in terms of market average through time or the firm average across the market. There is not any sort of homogenization between firms which can become a support that investor can analyze the market KSE 100 index and decide he should invest, where each firm has its own base share price and own variability which is prominent and observable for the investor to consider each firm separately.

Table-2. Heterogeneity Statistics.

Heterogeneity between firms in KSE		
Method	Comparison across firms Value (Prob.)	Comparison across time Value (Prob.)
Equality of Firm Share Prices means		
Anova F test	1896.4 (0.00)	4.23 (0.00)
Welch (1951)	12749.6 (0.00)	5.70 (0.00)
Equality of Firm Share Prices medians		
Med. Chi-square	99312.8 (0.00)	12332.1 (0.00)
Adj. Med. Chi-square	99198.5 (0.00)	11145.3 (0.00)
Kruskal-Wallis	117875.8 (0.00)	18781 (0.00)
Kruskal-Wallis (tie-adj.)	117875.8 (0.00)	18781 (0.00)
Van der Waerden	11693.1 (0.00)	19208.9 (0.00)
Equality of Firm Share prices variances		
Bartlett	329197.4 (0.00)	64358.2 (0.00)
Levene (1960)	370.18 (0.00)	4.16 (0.00)
Brown and Forsythe (1974)	263.7 (0.00)	2.11 (0.00)

Source: Results from Eviews.

Table 3 provides two different types of unit root tests, first set LLC, Breitung and Hadri LM test assumes that the nature of persistence ($\delta P_t / \delta P_{t-1}$) is same for all the firms indicating that the condition in the market is distributing the investors towards individual firms in such a way that all firms are facing same marginal change in its share prices, whereas second set IPS, Fisher (ADF & PP) test assumes that the persistence ($\delta P_t / \delta P_{t-1}$)_i is firm-specific which means there is no common source of influencing firm's historical pattern.

The first set of tests show that the share prices are non-stationary such that there is a prominent change from yesterday's share price to today's share price and the market is jointly inefficient whereas the second set of tests show that there are some (at least one) firms which are stationary concluding that the given set of firms are efficient based on some firms in the set whose share prices are not changing prominently, but the assumption used be the second set is a bit strong.

Table 4 below utilizes a different approach to determine share price efficiency – these tests check stationarity in terms of its panel variance, the null hypothesis of this test is that share price is a martingale which means that the first difference of share prices is only changing randomly and the level variable is changing in a predictable way. Two specifications of variance ratio test suggesting that the share prices are variance non-stationary means that for investors the variances of the share prices are changing in an observable way and it will assist in deciding to invest in share market for speculators.

Table-3. Panel Unit Roots Analysis.

Panel Unit root test (Share Price)						
	LLC	IPS	Fisher-ADF	Fisher PP	Breitung	Hadri LM ¹
Null Hypothesis	Common unit root	Individual unit root	Individual unit root	Individual unit root	Common unit root	No common unit root
Intercept	-0.86 (0.19)	-8.86 (0.00)	111.1 (0.00)	106.1 (0.00)	-	165.98 (0.00)
Intercept and trend	2.92 (0.99)	-	-	-	3.85 (0.99)	141.97 (0.00)

Source: Results from Eviews.

Table-4. Variance Constancy Tests.

Variance Ratio Tests (Share Price) (Lo and MacKinlay, 1988)	
Joint Test	Probability
Null Hypothesis: Share price is martingale	
Max z	0.781
Null Hypothesis: Share price is exponential martingale	
Max z	0.745

Source: Results from Eviews.

Since all the unit root tests are univariate, they are unable to capture the dynamic effect of market information other than the information from past prices, hence this study has utilized the cointegration tests among share prices using lag of share prices, trend and structural break. If there is a hint of cointegration then this would suggest that the current prices are influenced by past prices and structural break in them, which will indicate the predictability of prices (Baillie and Bollerslev, 1989). Table 5 shows the Pedroni (2004) cointegration test in two forms and Kao (1999) test, the first form is assuming that the convergence of firms toward its equilibrium is firm-specific whereas the second form assumes that this convergence is homogenous or market specific ². The idea behind using group-specific is that all these firms reported in the market have the same source of investment hence investor is evaluating the relative performance of the firm. Suppose one firm is growing faster than what its equilibrium suggests then it would attract more investors to slow the share price change and maintain convergence speed. Here all the Pedroni (2004) cointegration statistics across the board and Kao (1999) suggest presence of cointegration between share prices and past share prices. Using this result it can be stated that firms form a cointegration in terms of their present past prices, qualitative break and trend, this information can be exploited by the investors so that they can form expectations to earn returns, thus making KSE inefficient.

Considering share price decision is based on relative movement of share prices in the portfolio hence the cross-firm share price correlation is also a crucial indicator, Table 6 includes a second-generation panel cointegration by Persyn and Westerlund (2008). Like previous tests, there are two forms, first in which (Gt and Ga) are based on firm based convergence and second in which (Pt and Pa) are based on homogenous convergence. Surprisingly when the cross-sectional correlation is allowed for firm based statistics (4 out of 6) are indicating the presence of cointegration, while homogeneity based statistics (1 out of 6) is indicating the presence of cointegration. With the addition to a new dynamic in this cointegration test, still, there is a hint of cointegration. So if the individual considers day to day prices of individual firms as compared to market index, looking for the trend in the pattern, observing any qualitative change in structure as well as incorporating the relative movement of shares of firms in the portfolio he can find relevant information which can help in forming decision to purchase or sale of shares.

¹ Hadri LM test is robust for cross sectional heterogeneities.

² Presence of cointegration itself does not insure that the share prices are changing as it can show cointegration among share price and its lag value. Hence the evidence from the unit root & variance ratio test and the presence of trend & structural break component in cointegration relationship reveal that the share prices are not constant.

Table-5. First Generation Panel Cointegration tests.

Panel Cointegration Pedroni (2004) & Kao (1999)								
Null hypothesis: no cointegration								
	Alternative hypothesis: cross sectional convergence				Alternative hypothesis: group common convergence			Alt. Hyp.: Cointegration
	Panel V	Panel rho	Panel PP	Panel ADF	Group rho	Group PP	Group ADF	ADF t Stat
Intercept	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
trend	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	-

Source: Probability value in brackets. Results from Eviews.

Table-6. Second Generation Cointegration Test.

Panel Cointegration (Persyn and Westerlund, 2008)				
Null hypothesis: no cointegration				
Cross sections: 75 firms				
Gt and Ga assumes convergence can be different for each cross section				
Pt and Pa assumes convergence is same for all cross sections				
	Gt	Ga	Pt	Pa
Intercept and trend	(0.00)	(1.00)	(1.00)	(1.00)
Intercept	(0.00)	(0.00)	(1.00)	(1.00)
None	(0.00)	(1.00)	(1.00)	(0.00)

Source: Results from STATA.

7. CONCLUSION

The difference between developing and underdeveloped stock markets is that, for the case of underdeveloped stock markets, the investors lack conviction in their decision to invest as there is not any favorable information available which can influence the individual to commit their investment in the share market. Hence this study first introduced criteria and list of all the sources which can be used as information for the individual while deciding for investment. Using this set of information then this study evaluated the nature of stock markets in Pakistan, in particular the Karachi Stock Exchange (KSE).

This study proposed some characteristics of behavior which are considered while he is deciding to invest, which were examined as individual observations of the share price of individual firm instead of the KSE index as a whole, which was used in previous studies. Individuals build a portfolio which indicated the construction of panel data. There are other sources of information too other than the past prices which are the trend and the break in their pattern and last but not the least that previous models did not account for the relative movement of the share prices (i.e. cross-sectional correlation). This study has used a second generation cointegration test on the share prices, the lag of share prices, trend and structural break which is an efficient econometric model which incorporates complex behavior.

This study has used the differences in mean, median and variances in terms of time and cross sections to identify firms are different in terms of their behavior and also share prices are not constant in time which led to the utilization of panel data model instead of separate models. Using the panel mean variability (unit root) and the variance variability (variance ratio) test revealed that there are some of the firms whose share prices are varying in time and lead to attracting investors.

For the case of Pakistan, the unit root test and variance ratio test shows that the share prices are non-stationary hence market is considered to be inefficient, also by incorporating structural break in Pedroni cointegration and Westerlund cointegration tests we find evidence of cointegration hence the firms in the KSE 100 market are inefficient and can be considered as developing share market. It was only for the use of the assumption that whole market follows a uniform autoregressive pattern, then the market becomes efficient. This assumption is very strong after knowing that mean, median and variances are not equal Table 1.

This concludes to the policy that like most developing economies Pakistani stock exchange market (KSE) is currently immature, where there is still scope for investment gains done for the purpose of speculation. With the

increase in the financial literacy and economic growth, the competition among sellers and buyers of equity will increase and thus drive the market toward efficiency.

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