Research Journal of Finance and Accounting
ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online)
Vol.6, No.17, 2015

Mean Reversion in Stock Prices: Evidence from Karachi Stock Exchange

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Abstract
This study provides a complete examination of the stock prices behavior in the Karachi stock exchange. It examines that whether Karachi stock exchange can be described as mean reversion or not. For this purpose daily, weekly and monthly index data from Karachi stock exchange ranging from period July1, 1997 to July 2, 2011 was taken. After employing the Multiple variance ratio and unit root tests it is concluded that stock market follow mean reversion behavior and hence have reverting trend which opens the door for the active invest management. Thus technical analysis may be help to identify the potential areas for value creation.
Keywords: Mean Reversion, Random Walk, Technical analysis, Karachi stock exchange.

1. INTRODUCTION

Fama (1965) stated that prices of shares should follow random walks because as prices reflect all available information. Lo and McKinley (1988) stated that prices always fully reflect the information available and no profit can be made from information based on trading strategies which leads to a random walk. The other concept which opposed the random walk is mean reversion. The concept mean reversion is the assumption that both stock's prices are short-term and that a stock's prices and returns will lean to the mean or average price over time. DeBondt and Thaler (1985) first time reported the evidence of mean reversion in U.S market by using U.S individual firm-level data. Fama and French (1988) also re- port mean reversion in U.S. equity market. So if we look at the behavior of stock prices index than it will be random walk or mean reversion. One key challenge to the efficient market hypothesis is mean reversion of returns. According to the mean reversion theory it is stated that the stock prices in long run ultimately shift reverse towards their average or mean and here average or mean can be considered as mean or average for returns, prices orany other proxy such as returns of an industry, economic growth. In mean reversion trend if the stock prices are less than the average or the mean value then the stock is measured as good-looking for the purchase purpose with the intention that the prices will rise in the future and if the stock prices are above than the average or mean than stock is not considered as a good-looking for the purchase and considered as an attractive for the purpose of sale with the intentions that in future the prices will regress towards the average mean it will fall. So here trading rules are very helpful for the investors to make investment in order to get the benefit of mispricing of stock.

The theme of this study is to explore the pattern of mean reversion in equity market of Pakistan. This study is important because in developing countries like Pakistan where environment is more volatile due to security threats, terrorism, inflation, energy crises which are changing the thinking pattern of investors related to the investment decisions. Such as Wagner (2006) stated that Global terrorism is indeed on the mind of some investors. Because of these problems making investment is becoming tougher, that make investors more serious about their investment decisions. So this study provides a tool to investors in their efficient allocation of recourses in form of active investment management. As Woo (2009) described that change in the terrorism activities demands a organized methodologies and intellectual approaches for the valuation and management of terrorism threats. As this paper contributes rare literature on mean reversion property of equity market in Pakistan thus, it should be useful for researchers as well.

As users of this research are investors because they have to make decision by analyzing the market trends i.e. mean reversion or random walk which is under observation in this study. This study provides guidelines to the investors in making investment decisions especially in economic forecasting. It assist in a way that if stock price index follow mean reversion trend then prices returns to their original trend paths over the time and investors can predict future prices on the basis of historical data (past behavior) by using technical analysis (trading strategies). Investors can earn expected returns by buying the undervalued securities after analyzing the financial performance of the companies through their performance indicators. In the same manner the investors will make investment and earn the expected returns through conducting the study of past stock prices in predicting future prices.

2. LITERATURE REVIEW

Numbers of research studies are also conducted on mean reversion in both developed and developing equity markets. This is justified that any shock to prices is not permanent and in long run prices returned back to their mean or average, hence prices should follow mean reverting trend. Now the brief overview of work of these

researchers is described.

Kawakatsu and morey (1999) used stock prices of 31 emerging stock markets from the period 1987-1997 in order to test the mean reversion in that stock prices. The whole data was alienated into two separate subsets known as pre-liberalization period which was from 1987-1989 and post-liberalization period which was from 1989-1997. In order to test the mean reversion variance-ratio tests and univariate unit root tests were applied and concluded that there was no mean reversion in the stock prices of 31 emerging stock markets. Chaudhuri and Wu (2003) used monthly stock prices of 17 emerging countries for the period 1985 to 1997 in order to find the mean reversion in that stock prices. Test with structural breaks in the underlying series was applied while investigating the pattern of mean reversion or random walk in the stock prices index of seventeen emerging markets. They found that structural breaks are displayed in fourteen countries stock prices out of seventeen countries. Mean reversion trend was founded in 11 countries out of 17 countries. (Hassan, Haque, and Lawrence 2006) studied on the market efficiency in the 7 emerging market from European countries. Stock returns data was taken over the period December 1988 to august 2002 and concluded that results revealed that efficiency was founded in the emerging stock markets of 4 European countries i.e. “Czech Republic, Hungry, Poland, and Russia” which provided an evidence that these markets are random in nature whereas 3 countries i.e. “Greece, Slovakia, and Turkey” emerging stock markets have shown no efficiency and hence these markets are not random. (Liu, Song, and Romilly 1997) studied on the stock prices of china in order to find out that whether china’s stock prices reveal mean reversion movement or not. For this purpose daily stock prices data for Shenzhen stock exchange and Shanghai stock exchange ranging from period 21 May 1992 to 18 December 1995 was taken. Variance ratio tests were put into practice and concluded that Shenzhen and Shanghai stock prices have not shown evidence of mean reversion. Ming and Guru (2000) conducted the research on the Malaysia to test the random walk. For that purpose stock return data of Kuala-Lampur equity market was selected and found no evidence of random walk pattern in equity prices and followed mean reversion pattern. Narayan and Smyth (2007) worked on stock price indices of G7 stock markets. They used unit root test which allow for one and two structural breaks in the trend and found that random walk hypothesis exist in G7 stock price indices. They also found that Japan was the country with best evidence of mean reversion in price index. All others countries displayed evidence of random walk in their stock prices. They concluded the injurious effect on movement in stock prices when practice a second break in stock prices. Jorion and Sweeney (1996) worked on the exchange rates of USA in order to find out that whether these exchange rates follow mean reverting or random walk trend. For this purpose data was collected ranging from period 1997 to 1993 and concluded that exchange rates from the period 1997-1993 have strong confirmation of mean reversion hypothesis. Fama and French (1988) worked on the stock returns of US Stock market and for this purpose variance ratio test was used. Data was examined from the period 1962-1985 and it was concluded that mean reversion trend displayed in the US Stock markets. Poterba and summers (1988) used US Stock prices for the period 1926-1985. Variance-ratio tests were used that demonstrated negative correlation over long period of time and positive correlation over short period of time which provided the evidence of mean reversion in US Stock prices. Lo and McKinley (1988) worked on the US Stock prices in order to find the mean reversion trend in stock prices. For this purpose weekly data of stock prices was selected from the period September 6 (1962) to 26 December 1985. Variance ratio tests were applied on the selected data and found mean reversion in US stock prices at predictable significant level. Li and Chen (2010) selected the US and its major partners in trading i.e. China, Canada, Mexico and Japan for their study in order to investigate that whether stock prices of all these selected countries follow mean reversion trend or not. For that purpose stock prices data of these countries were taken from the period November 1998 to August 2010 and revealed that 3 major trading partner countries (Canada, Mexico and Japan) have shown a unit root (random walk) trend in their stock prices but one trading partner i.e. china have not shown any random walk (unit root) type movements in its stock prices. Urrutia (1995) studied on a group of 4 Latin American countries (Argentine, Brazil, Chile and Mexico) to find the evidence of mean reversion in stock prices and founded that there is mean reversion trend in the stock prices of a group of 4 Latin American countries. Chaudhuri (1997) worked on the stock prices of a group of 7 Latin American countries named as Argentina, Bolivia, Chile, Colombia, Mexico, Venezuela and United State of America in order to characterize that whether stock prices exhibit unit root (Random walk) pattern or Mean reversion. Monthly data of stock prices ranging from the period January 1989-December 1993 of these countries was taken for conducting this study. It was established that the monthly data of stock prices for these 7 countries were followed a unit root trend rather than mean reversion when implemented Unit root tests.

On the basis of above literature it can be stated that lot of researches have conducted to show the pattern of mean reversion in equity markets all over the world but directly no research has been conducted on mean reversion in Pakistani equity market. So in this context basically this study is a special contribution towards the field of research as well as for all those investors who are interested to invest in Pakistani stock market.

3. ECONOMETRIC METHODOLOGY

3.1. UNIT ROOT TESTS

In order to test the null hypothesis which is unit root two kinds of tests are used i.e. (i) Augmented Dickey-fuller test and (ii) Phillips- Perron test.

3.1.1. AUGMENTED DICKEY-FULLER TESTS

In order to notice the attendance of unit root, ADF test (1979) and (PP) Phillips-Perron (1988) test are employed (Schwert, 1989).

The ADF test is employed in order to check out that whether there is presence of unit root in the autoregressive model or not. A plain auto regressive model, AR (1) is

$$y_t = \beta y_{t-1} + u_1$$

In the above autoregressive equation the variable of interest is symbolized by y_t, for the time period index t is used, for coefficient β and for the error term u_1 is symbolized. So the auto-regression model can be presented as;

$$\Delta X_t = \alpha + \beta T + (\rho - 1)X_{t-1} + \sum \varphi_i {}_{i=1}^{\Delta X^n} {}_{t-1} + \varepsilon_t$$

In order to examine the null hypothesis that the series are non-stationary the ADF unit root is employed and this null hypothesis is either discarded or accepted after make assessment of the tabulated/critical values specified in Mackinnon (1991) with the values of the t-statistics of the lagged term $X_{t-1.}$ In case of the tabulated/critical value greater than the values of the t-statistics than the null hypothesis of unit root i.e. "the series is non-stationary" is acknowledged. So if such chance taken place than evaluation of the series at first difference is made and if in that case the value of the t-statistics is greater than the tabulated values than in this case the null hypothesis is disapproved, the series is consider as the stationary and the conjecture is that the series is incorporated of order one *I* (1).

3.1.2 PHILLIPS PERRON TEST

"Augmented Dickey-Fuller (ADF)" test is supported by the distribution theory supposes the statistical independence of errors and has a stable variance. But the data employed here has not to face this case. Providentially, a substitute test i.e. Phillip-Perron test permits the fault conflicts to be weakly reliant and heterogeneously disseminated. Phillips and Perron (1989) projected a substitute (non-parametric) technique of scheming for serial correlation though examining for a unit root (random walk). In order to authorize the reliance and "heterogeneity in error term a non-parametric adjustment to the Dickey-Fuller test statistics was used". The PP test process is founded on the subsequent regression with same critical values used for ADF:

$$\Delta X_t = \lambda_0 + \lambda_1 X_{t-1} + \lambda_2 T + \sum_{i=1}^{n} \psi_i \Delta X_{t-i} + \epsilon$$

Here the series is a non-stationary is the null hypothesis, $\lambda_1 = 1$, alongside the substitute proposition that the time series is stationary around the deterministic trend, $\lambda 1 < 1$. The Phillips

Perron test is applied in adding to the augmented Dickey Fuller test due to the subsequent causes:

First of all the supposition of the homoscedasticity error is not required by the Phillips Perron (Phillips, 1987). There is no failure of the valuable annotations as the series for the reason that the lagged conditions for the attention changeable are put equivalent to zero (Perron, 1988) which is advantageous through the constrained amount of data positions.

3.1.3. MULTIPLE VARIANCE RATIO TESTS

Chow and Denning (1993) projected a test that is known as "MVR (Multiple Variance Ratio)" test which is used to identify the "Heteroscedasticity and autocorrelation" in the series of returns. The test statistics of this test are exercised to investigate for unit root (random walk) under the changeable distributional theories. The variance ratio in that case is symbolized by;

$$\text{VR (q)} = \frac{\text{Var (pt} - \text{pt} - \text{q)/q}}{Var\ (pt - pt - 1)}$$

$$= \sigma^2 (q) / \sigma^2 (1)$$

Like as under the null hypothesis VR (q) =1

Two kinds of test statistics, Z(q) and Z^*(q) are projected under the null hypothesis of "Homoscedasticity increments random walk and Heteroskedastic increments random walk" Correspondingly by Lo and McKinley (1988). The connected test statistic has an asymptotic standard normal distribution in case if there is truthiness in the null hypothesis. The ordinary normal test statistic Z (q) under the "Homoscedasticity increments random walk" as null hypothesis and through sample range of $nq + 1$ observation ($\rho 0, \rho 1 \ldots \rho nq$) is;

$$\frac{Z(q) = \{VR(q) - 1\}}{\sigma\sigma\ (q)}$$

Whereas, $\sigma (q) = \{2(2q-1)\ (q-1)\ /3q\ (nq)\}^{1/2}$

Z^* (q) test statistic for "Heteroskedastic increments random walk" is;

$$Z*(q) = \frac{\{VR(q) - 1\}}{\sigma\sigma\ (q)}$$

Anywhere, σo (q) = {4∑ (1-k/q) 2δk} 1/2 for all k=1, 2 ….q-1, and σk = {∑ (pj-pj-1-û) 2 (pj-k-pj-k-1-1-û) 2}/ {∑ (pj-pj-1-û) 2}.

Chow and Denning's (1993) planned that MVR (Multiple variance ratios) test produces a method for various assessment by way of unity of variance ratio approximates. Sole variance ratio test, in the null hypothesis is, *VR (q)* = 1, therefore

Mr (q) = VR (q) – 1 = 0. Under the null hypothesis i.e. random walk suppose a situate of m variance ratio tests {Mr (q) I = 1, 2….m}, there are multiple hypothesis;

H_oi: Mr (qi) = 0 for i = 1, 2….m

H_oi: Mr (qi) = 0 for i ≠ 1, 2….m

The refusal of any one or more H_oi refuses the random walk null hypothesis, for situate of Z (q),

{Z (qi) I = 1, 2… m} test statistic, if any one of the predictable variance ratio is considerably dissimilar from one then there is rejection of null hypothesis i.e. random walk. Therefore in situate of test statistics only the highest worth is believed. The heart of the multiple variance ratios (MVR) projected by Chow and Denning's (1993) is stood on the result:

PR {max (1Z (q_1)1……. (1Z (q_m) 1) ≤ SMM (α; m; T)) ≥ 1-α}

Chow and Denning (1993) organize the size of "MVR" through the comparison of the "SMM" critical value with the calculated values of the standardized test statistic either Z (q) or Z^* (q). Prominently, under the homoscedasticity the refusal of the random walk is due to either the presence of autocorrelation in the series of stock prices and/or due to Heteroscedasticity. There ii confirmation of autocorrelation in the series of stock returns if there is refusal of "Heteroskedastic random walk".

4. OVERVIEW OF DATA

Stock index was taken for conducting this study and this data was collected from the most reliable sources of data in Pakistan i.e. business recorder and yahoo finance. The closing prices of the Daily, weekly and monthly KSE-100 index in support of the Karachi Stock Exchange are in used ranging from the period 2 July, 1997 to 1 July, 2011. The closing prices of daily, weekly and monthly KSE-100 index are used for computing the returns for a specific period the

"Continuously compounded annual rate of return" was used.

Rt = ln (pt/pt-1)

"Rt = Return on day t"

"Pt = Market price at time t"

"Pt-1 = Market Price at time t-1"

"Ln = natural log"

Data of closing prices (for daily, weekly and monthly) was taken from Karachi Stock Exchange over the period ranging from 2 July, 1997 to 1 July, 2011. The data of closing prices was also taken for the pre-structure and post-structure period.

5. RESULTS AND CONCLUSION

5.1. Descriptive Statistics

Table 1

Statistic	Monthly Returns	Weekly Returns	Daily Returns
Mean	0.010913	0.002792	0.0006
Median	0.017723	0.007059	0.00116
Standard Deviation	0.098618	0.039923	0.017228
Kurtosis	6.991883	6.231306	8.136245
Skewness	-1.117	-0.95181	-0.3663
Minimum	0.68991	0.328927	0.259755
Maximum	0.241114	-0.200976	0.127622

Descriptive statistics for the Karachi stock market returns are presented in the table 1. A watchful assessment of the descriptive statistics discloses that the Average daily returns are 0.06 % and the Average

standards deviation is 1.7228 %. While the Average weekly returns are 0.2792 % and the standards deviation is 3.9923 %. Similarly the average monthly returns are 1.0913 % and the standard deviation for the monthly returns is 9.8618 %. Descriptive statistics result also showed that all the three types of returns monthly, daily and weekly are skewed negatively for the period 1st July 1997 to 2 July 2011 which clearly specifies that "large negative returns (minimum extreme values) are dominant than higher positive returns (maximum extreme values)". The values of the kurtosis in the descriptive statistics for monthly, weekly and daily returns are greater than 3 which means that the "distributions of the returns are leptokurtic indicating higher peaks than the expected from normal distribution".

5.2. Unit Root Tests

In order to decide whether the presentation of the index of the stock market is stationary or not, the augmented Dickey Fuller and Phillips Perron tests are used. The performance of the stock market index is also scrutinized at level and 1st difference. Unit root tests is always conducted on the stock index series and not employed on the series of stock returns.

5.2.1. Augmented Dickey Fuller test

Table 2

USING INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
ADF test Statistics			
Level	-0.4920	-0.5447	-0.4647
Critical-value a 1%	-3.4695	-3.4391	-3.4320
Critical- value at 5%	-2.8786	-3.4391	-2.8621
Critical- value at 10%	-2.5760	-3.4391	-2.5671

Table 3

USING TREND AND INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
ADF test Statistics			
Level	-1.9670	-1.9453	-1.8076
Critical-value at 1%	-4.0136	-3.9707	-3.9607
Critical- value at 5%	-3.4367	-3.4160	-3.4111
Critical value at 10%	-3.1425	-3.1303	-3.1273

Above Table 2 and 3 display the results of Augmented Dickey Fuller test at level by using intercept in equation as well as trend and intercept both in equation for monthly, weekly and daily index. In monthly index the value of ADF test statistics (= -0.4920) at level is less than the critical or tabulated value (= -2.8786) which clearly concludes that the series of monthly index is non-stationary at level. In weekly index the value of ADF test statistics (= -0.54474) at level does not exceeds than the critical or tabulated value (= -3.43917) which clearly concludes that the series of monthly index is non-stationary at level. Similarly in daily index the value of ADF test

Statistics (= -0.4679) at level is less than the critical or tabulated value (= -2.86219) which clearly concludes that the series of monthly index is non-stationary at level. Similarly the results also revealed non-stationary at level for monthly, daily and weekly index when both trend and intercept used in equation.

The postulation is made by the distribution theory sustaining the ADF (Augmented Dickey Fuller) test that data is independently and individually distributed. But the data used here may not fulfilled condition. Providentially, Phillips Perron test which is an alternative test is used that permit the error conflicts to be weakly reliant and heterogeneously disseminated.

Table 4

USING INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
ADF test Statistics			
1st.Difference	-11.4885	-24.082	-51.1142
Critical-value at 1%	-3.4697	-3.4391	-3.4320
Critical- value at 5%	-2.8787	-3.4391	-2.8621
Critical- value at 10%	-2.5760	-3.4391	-2.5671

Table 5

USING TREND AND INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
ADF test Statistics			
1st.Difference	-11.4669	-24.0735	-51.110
Critical-value a 1%	-4.0139	-3.9707	-3.9607
Critical- value at 5%	-3.4369	-3.4160	-3.4111
Critical- value at 10%	-3.1426	-3.1303	-3.1273

The below given Table 2.3 and 2.4 display the results of Augmented Dickey Fuller test at 1st difference by using intercept in equation as well as trend and intercept both in equation for monthly, weekly and daily index. In monthly index the value of ADF test statistics (= -11.4885) at level is greater than the critical or tabulated value (= -2.8787) which clearly concludes that the series of monthly index is stationary at 1st difference. In weekly index the value of ADF test statistics (= -24.082) at level is greater than the critical or tabulated value (= -3.43917) which clearly concludes that the series of monthly index is stationary at 1st difference. Similarly in daily index the value of ADF test statistics (= -51.1142) at level is greater than the critical or tabulated value (= -2.86219) which clearly concludes that the series of monthly index is stationary (Mean reversion) at 1st difference. Similarly the results also revealed stationary at 1st difference for monthly, daily and weekly index when both trend and intercept used in equation.

5.2.2. PHILLIPS PERRON TEST

The postulation is made by the distribution theory sustaining the ADF (Augmented Dickey Fuller) test that data is independently and individually distributed. But the data used here may not fulfilled condition. Providentially, Phillips Perron test which is an alternative test is used that permit the error conflicts to be weakly reliant and heterogeneously disseminated.

Table 6

USING INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
PP test Statistics			
Level	-0.5989	-0.5299	-0.5236
Critical-value a 1%	--3.4694	-3.4391	-3.4320
Critical- value at 5%	-3.4694	-3.4391	-2.8621
Critical- value at 10%	-3.4694	-3.4391	-2.8621

Table 7

USING TREND AND INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
ADF test Statistics			
Level	-2.1329	-1.7645	-1.8770
Critical-value at 1%	-4.0136	-3.9707	-3.9607
Critical- value at 5%	-3.4368	-3.4160	-3.4111
Critical value at 10%	-3.1425	-3.1303	-3.1273

The above Table 6 & 7 display the results of Phillips-Perron test at level by using intercept in equation as well as trend and intercept both in equation for monthly, weekly and daily index. In monthly index the value of Phillips-Perron test statistics (= -0.5989) at level is less than the critical or tabulated value (= -3.46945) which clearly concludes that the series of monthly index is non-stationary at level. In weekly index the value of Phillips-Perron test statistics (= -0.52993) at level does not exceeds than the critical or tabulated value (= -3.43916) which clearly concludes that the series of monthly index is non-stationary at level. Similarly in daily index the value of PP test statistics (= -0.52368) at level is less than the critical or tabulated value (= -2.86219 which clearly concludes that the series of monthly index is non-stationary at level. Similarly the results also revealed non-stationary at level for monthly, daily and weekly index when both trend and intercept used in equation.

Table 8

USING INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
ADF test Statistics			
1st.Difference	-11.4678	-24.319	-51.2714
Critical-value at 1%	-3.4696	-3.4391	-3.4320
Critical- value at 5%	-3.4696	-3.4391	-2.8621
Critical- value at 10%	-3.4696	-3.4391	-2.5671

Table 9

USING TREND AND INTERCEPT IN EQUATION			
	MONTHLY INDEX	WEEKLY INDEX	DAILY INDEX
ADF test Statistics			
1st.Difference	-11.4455	-24.308	-51.267
Critical-value at 1%	-4.0139	-3.9707	-3.9607
Critical- value at 5%	-3.4369	-3.4160	-3.4111
Critical- value at 10%	-3.1426	-3.1303	-3.1273

The above Table 8 & 9 display the results of Phillips Perron test at 1st difference by using intercept in equation as well as trend and intercept both in equation for monthly, weekly and daily index. In monthly index the value of PP test statistics (= -11.4678) at level is greater than the critical or tabulated value (= -3.34969) which clearly concludes that the series of monthly index is stationary at 1st difference. In weekly index the value of PP test statistics (= -24.319) at level is greater than the critical or tabulated value (= -3.43917) which clearly concludes that the series of monthly index is stationary at 1st difference. Similarly in daily index the value of PP test statistics (= -51.2714) at level is greater than the critical or tabulated value (= -2.86219) which clearly concludes that the series of monthly index is stationary (Mean reversion) at 1st difference. Similarly the results also revealed stationary at 1st difference for monthly, daily and weekly index when both trend and intercept used in equation.

5.2.3. MULTIPLE VARIANCE RATIO TESTS

For the further testing of mean reversion versus random walk in equity returns the strong multiple variance ratio tests is employed. Here the multiple variance ratio tests are employed with the assumption of Heteroscedasticity

as well as with the assumption of Homoscedasticity. Null and alternative hypothesis are constructed in both assumptions.

5.2.3(a).MULTIPLE VARIANCE RATIO TEST UNDER THE ASSUMPTION OF HETEROSCEDASTICITY

The below table 10 reports the results of multiple variance ratio test for daily weekly and monthly returns under the assumption of Heteroscedasticity.

Table 10

Period q	MVR tests	Monthly returns	Weekly returns	Daily returns
2	VR (J) Z^* (q)	0.5130 -3.8361	0.5561 -7.7488	0.5219 -14.0739
4	VR (J) Z^* (q)	0.2593 -3.5259	0.2999 -6.8482	0.2732 -12.3535
6	VR (J) Z^* (q)	0.1761 -3.2264	0.2141 -5.9646	0.1819 -11.1196
8	VR (J) Z^* (q)	0.1284 -2.9767	0.1549 -5.4741	0.1355 -10.2392
10	VR (J) Z^* (q)	0.1098 -2.7187	0.1197 -5.0861	0.1093 -9.5490
12	VR (J) Z^* (q)	0.0944 -2.5265	0.1087 -4.7105	0.0896 -9.0088
16	VR (J) Z^* (q)	0.0654 -2.2842	0.0754 -4.2827	0.0676 -8.1465

The 0.05 critical value for Z(q) is 2.49.*

In the above table 10 the standardized VR (Variance ratio) test statistics for Z* (q) is calculated for all three types of returns i.e. monthly, weekly and daily returns under the assumption of Heteroscedasticity. It is clearly shown that for daily returns the maximum absolute value of Z* (q) is greater than its critical value (2.49 rejects the null hypothesis that daily equity returns follow random walk and accept that equity returns follow mean reversion. In case of multiple variance ratio test with Heteroscedasticity for weekly equity returns It is clearly shown that maximum absolute value of Z* (q) is greater than its critical value (2.49) at which rejects the null hypothesis that weekly equity returns follow random walk reports in favor of Mean reversion. MVR with Heteroscedasticity for monthly stock returns. Most of the periods show higher Z*(q) than its critical value which reject the null hypothesis that monthly equity returns follow random walk reports in favor of Mean reversion.

5.2.3(B). MULTIPLE VARIANCE RATIO TESTS UNDER THE ASSUMPTION OF HOMOSCEDASTICITY

The below table 11 reports the results of multiple variance ratio test for daily weekly and monthly returns under the assumption of Homoscedasticity.

Table 11

Period q	MVR tests	Monthly returns	Weekly returns	Daily returns
2	VR (J) Z^* (q)	0.5130 -6.2930	0.5561 -11.935	0.5219 -27.9064
4	VR (J) Z^* (q)	0.2593 -5.1159	0.2999 -10.061	0.2732 -22.674
6	VR (J) Z^* (q)	0.1761 -4.3069	0.2141 -8.5480	0.1819 -19.3151
8	VR (J) Z^* (q)	0.1284 -3.8075	0.1549 -7.6819	0.1355 -17.0573
10	VR (J) Z^* (q)	0.1098 -3.4086	0.1197 -7.0102	0.1093 -15.3979
12	VR (J) Z^* (q)	0.0944 -3.1212	0.1087 -6.3917	0.0896 -14.1739
16	VR (J) Z^* (q)	0.0654 -2.7438	0.0754 -5.6480	0.0676 -12.3638

The 0.05 critical value for Z(q) is 2.49*

In the above table 11 the standardized VR (Variance ratio) test statistics for Z (q) is calculated for monthly, weekly and daily returns under the assumption of Homoscedasticity. It is clearly shown that for daily returns the maximum absolute value of Z (q) is greater than its critical value (2.49) which rejects the null hypothesis that daily equity returns follow random walk reports in favor of Mean reversion. In case of MVR test

with homoscedasticity for weekly equity returns It is clearly shown that maximum absolute value of Z* (q) is greater than its critical value (2.49) which rejects the null hypothesis that weekly equity returns follow random walk reports in favor of Mean reversion. In case of MVR with homoscedasticity for monthly stock returns It is clearly shown that maximum absolute value of Z (q) is greater than its critical value (2.49) which rejects the null hypothesis that monthly equity returns follow random walk and reports in favor of Mean reversion.

6. RESULTS DISCUSSION, IMPLICATION AND FUTURE DIRECTION

The current study was carried out to test the mean reversion vs. random walk of Karachi stock market in order to observe the usefulness of technical analysis and to notice the compass of diversification, portfolio management and investment management. The results of ADF test exposed that index for daily, weekly and monthly financial time series established as non-stationary while return series established as stationary. The distribution theory sustaining the Dickey Filler test supposes the statistical freedom and stable variance of the errors. This assumption of constant variance and independence of the errors are not for the data used here so in order to verify the results Phillips Perron test was employed as it permits "error disturbances to be weakly dependent and heterogeneously distributed". The results of the Phillips Perron test were again same as the results of the ADF.

In order to find out the evidence of mean reversion under the assumption of homoscedasticity and Heteroscedasticity the MVR test was employed. The results of variance ratio test showed that none of the return series either daily, weekly or monthly returns do not chase random walk and reports in favor of Mean reversion. The comprehensive discussion concerning to the mean reversion it can be concluded that prices of Karachi stock exchange follow mean reversion and hence equity market of Pakistan has mean reverting pattern. So this reverting trend proposes the predictable element in the equity market. This proposition through disciplined, planed and active investment management unlocks the door for the "long term investment returns".

As results concluded that equity market of Pakistan do not follow random walk pattern and hence it has mean reverting trend. This mean reversion trend shows that there is a tendency for the price level to return to its trend path over time and investors can predict future prices on the basis of historical data (past behavior) by using technical analysis (trading strategies). This study provides a base for further testing of random walk versus mean reversion model in a panel form by employing the more powerful panel statistical tool such as panel unit root test to justify the results with the results of this study. Further this study can also conducted in any specific sector of Pakistan such as agriculture sector, oil and gas sector etc. in order to investigate the behavior of these sectors returns.

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