RANDOM WALK BEHAVIOR IN PAKISTANI STOCK MARKET

By

Hafsa Matloob
PIDE2019FMSMS06

Supervisor

Dr. Ahmad Fraz

PIDE School of Social Sciences
Management Sciences Finance
Pakistan Institute of Development Economics, Islamabad

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Pakistan Institute of Development Economics, Islamabad

PIDE School of Social Sciences

CERTIFICATE

This is to certify that this thesis entitled: **"Random Walk Behavior in Pakistani Stock Market"** submitted by Hafsa Matloob is accepted in its present form by the PIDE School of Social Sciences, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Management Sciences.

Supervisor: Dr. Ahmed Fraz Signature:

External Examiner: Dr. Sumayya Fatima Signature:

Head,
PIDE School of Social Sciences: Dr. Hafsa Hina Signature:

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I HAFSA MATLOOB hereby state that my MS thesis titled RANDOM WALK BEHAVIOUR IN PAKISTANI STOCK MARKET is my own work and has not been submitted previously by me for taking any degree from Pakistan Institute of Development Economics or anywhere else in the country/world.

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Date: 20 September 2021

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Name of Student: HAFSA MATLOOB

Dedicated to My Family

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With the name of Allah Almighty who is the creator of whole universe and our Holy Prophet Muhammad (Peace Be Upon Him) who is the source of knowledge and enabled us to recognize our creator and guided us to differentiate between right and wrong. By the grace of Allah I am able to complete my thesis. I am very thankful to my Allah.

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ABSTRACT

The aim of this study is to check “weak form of efficiency” of All Pakistani indices in the pandemic. These indices are: KSE-100, KSE-30, KMI-30, and KMI All Share Islamic Index. Daily, weekly, and monthly closing prices for 8 years from 1 June 2013 to 30 June 2021 are used. Different parametric and non-parametric tests are employed with the help of E-view and SPSS i.e., for normality testing: Jarque-Bera (JB) and Kolmogrov-Smironv (KS) test are used, for correlation runs test and autocorrelation (AC) are used, for stationarity testing: Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Correlogram tests are used. For testing weak form of efficiency and random walk Multi variance ratio (MVR) tests are used in this study. MVR ratio test is used with both assumptions of heteroscesdicity as well as homoscesdicity. JB test observed values for KMIAS, KSE 30, KMI 30 and KSE 100 in daily, weekly , and monthly data for period of 8 years are higher than the critical values. P-value for monthly and weekly return series for KMIAS, KSE 30, KMI 30 and KSE 100 are greater than critical value, according to the KS test results show that weekly and monthly data is not normally distributed, but it is normally distributed at a 90% level of confidence. The findings of autocorrelation function and Q-Ljung box statistics shows the existence of autocorrelation in daily returns but in weekly and monthly returns there is no correlation in any lags. So it is concluded that daily returns do not follow random walk for 8 years. Results of Runs test suggests that there is autocorrelation in daily returns for KMIAS, KSE 30 and KMI 30, but no autocorrelation in both daily and weekly returns for KSE 100. Augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) tests are employed for unit root, results of tests showed that the monthly, weekly and daily returns are stationary at level but non-stationary at first difference for all the Pakistani indices. Results of MVR testing reveal that the series of all Pakistani indices do not follow a random walk. Results demonstrate that Pakistani market indices do not follow random walk and it is not weak form efficient, so all investors could profit from the Pakistani market's expected behavior. Investors can use technical analysis to forecast future prices and plan a good short-term investment strategy. When making decisions about new stock, managers can profit from market timing.

Keywords: Indices, KSE-30, KMI-30, Weak form efficiency

JEL Classification: G10, G12, G14, G17

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LIST OF ABBREVIATIONS

EMH	Efficient Market Hypothesis
KMIAS	Karachi Meezan All Islamic share Index
KMI 30	Karachi Meezan 30 Index
KSE 30	Karachi Stock Exchange 30 Index
KSE 100	Karachi Stock Exchange 100 Index
RWM	Random Walk Model
RWH	Random Walk Hypothesis
RWT	Random Walk Theory

CHAPTER 1

INTRODUCTION

1.1 Introduction

1.1.1 Efficient Market Hypothesis (EMH)

Efficient market states that a market which responds quickly to entrance of new information and this happens when security prices incorporates this information and fully reveals all information accessible, so efficiency here refers to the informationally efficient capital market (Shefrin, 2012). Efficiency means the relationship of information with stock prices. Jones (2007) said that the markets are efficient if there is rapid response. A security market is “efficient” if a) the security prices reveal all accessible information and b) these prices respond immediately and in a neutral technique to newfangled information (Dyckman and Morse, 1986). Fama (1965, and 1998) has done different researches on “market efficiency” and proposed different method for market efficiency. Aumeboonsuke & Dryver (2014) pinpoints that stock does not possess reliable information and there is a possibility that investor cannot take the information in a good way. From 1960’s to 70’s different studies suggested that change in price is associated with specific stock (Fama, 1965; Samuelson, 1965 and Sharpe, 1994). Fama (1970) has given the theoretical underpinning of EMH and it is considered as a milestone for modern traditional finance. EMH has underlying assumptions given by (Reilly & Brown, 2011). The first and leading assumption is “Most of the profit maximizing contributors examine each security specifically” the second assumption is “rationality of market participants that it receives and interprets all information correctly”. If some investors are not rational then the trades are random so it cannot affect the prices. So prices reveal intrinsic value of the assets and due to information symmetry all market participants have similar expectations and no one can earn unusual returns. So no one can beat the market. Taking higher risk will bring the higher returns. "Market efficiency" is described by Fama (1970) in three kinds; weak form, semi-strong form and strong form. Weak form is one in which the prices reveal the information from past data. Semi strong form is in which all prices reveal publically accessible information, like information received through financial reports, news, rate of exchange and interest rate, money supply, earnings and divided announcements, and so on. And the strong form of efficiency is in which expected prices reveal both private and public information.

Efficiency of stock market has been an important issue from the very beginning. Most essential proposition in current financial markets is that markets are "efficient". For investors, market efficiency is critical in identifying and managing investment portfolios. Stock market efficiency is most essential 'topic' of modern finance. Efficiency means the relationship of information with stock prices. Reilly & Brown (2011) examine that EMH is the variation of stock prices on a well-timed routine and it also builds on the fast absorption of related information so investors can't get the unusual profit from any investment. Jones (2007) said that the markets are efficient if there is rapid response. According to Fama (1965) previous pattern are not expected for future market prices because the pattern variations in market prices are random. The theoretical underpinning of EMH was laid by (Fama, 1970). The idea of efficient market hypothesis (EMH), also known as Random Walk Theory (RWT), was neglected until Cootner (1962) published the English version of Bachelor's PhD thesis, in which he gave the foundations and theoretical framework of EMH in 1900. Fama (1970) interrogates that if markets are efficient, they readily reveal all accessible information and exactly pricing all stocks so that is supportive for provision of resources. Most studies have reported clear evidence that stock prices reveal all accessible information and efficient markets are not successful in providing unusual profits (Fama & French, 1988). Fama (1970) has divided market efficiency into three kinds. These are weak form, semi-strong form and strong form of efficiency.

Borges, (2009) said that efficient market theory and random walk hypothesis have been two of the most popular topics in financial literature in past decades. Random walk does not indicate that insider traders are unable to beat the market; rather, it demonstrates that investors are unable to obtain anomalous returns using past data on stock prices or trading activity. Al-Khazali et al., (2007) said that investors and policymakers seek an efficient market to ensure that stock prices are quickly adapted to new information while making investment decisions. Weak form efficiency and the RWM hypothesis are tested for various time periods and for different markets as well. An essential concern is whether Pakistan's indices are effective at their current level of weakness or not. There are number of research studies which were previously conducted to test market efficiency and RWH. Large daily price fluctuations are followed by larger price shifts. Changes can be both positive and negative, and they occur at random, implying that price changes are unrelated to investment decisions and are associated with the idea of efficiency (Fama, 1965). The theoretical underpinning of EMH was laid down by (Fama, 1970). According to the research, all past, present and future discounted events are revealed by prices. Samuelson (1965) expands the work of (Bachelier, 1900) and opens a new way in modern economic literature. “If one could be certain that a price would rise, it would have already done so,” it says. It also establishes a connection between random variation behaviors and price changes. In developed countries, certain research (Robert, 1959; and Fama, 1970) reject the idea that equity price changes are not expected based on past pricing information.

1.2 Statement of the Problem

Most essential proposition in current "financial markets" is that markets are "efficient". For investors, market efficiency is critical in identifying and managing investment portfolios. Stock market efficiency is most essential 'topic' of modern finance. According to previous studies pattern are not expected for future market prices because the pattern changes in market prices are random. Pakistani market is an emerging market, and it has undergone an incredible growth during last few years. Given the existence of random walk phenomenon, it is logical to examine the stock market's efficiency using these indicators. It is time to revisit the price behavior of all Pakistani stock market indices due to Covid-19 because prices are affected in the pandemic. This research aims to determine whether Pakistani market indices are inefficient and follow a random path or not in the 8 years from 1 June 2013 to 30 June 2021 for daily, weekly and monthly prices.

1.3 Research Questions

1: Whether Pakistani market is weak form efficient?

2: Whether Pakistani indices follow random walk?

1.4 Research Objective

The objective of this study is to examine weak form of efficiency in all Pakistani indices and to test random walk.

1.5 Significance of the study

This study can provide the guideline for the investors to take advantage and avail benefits by predicting the behavior of stock market. It can also be beneficial for the market portfolio managers, policy makers, security analyst and for mutual fund companies to forecast the market return. This study may help in measuring market potential and to encourage the development of market makers and regulators. Previous researchers do not cover all indices of Pakistan so this research will also potentially be worthy to existing work of market efficiency in Pakistani stock market because it covers all the indices of Pakistan. This is the latest study because it covers recent pandemic (Covid-19) years, from 1 June 2013 to 3o June 2021. The study provides the evidence that Pakistani market indices are inefficient and follow a random path or not in these 8 years. The study also examined whether the stock prices of all Pakistani indices adjust quickly to all accessible information and investors have the opportunity to profit from the Pakistani market's expected behavior or not.

1.6 Organization of thesis

First chapter explains the introduction of this thesis. Second chapter gives an overview of experimental work done in different markets. Third chapter provides detail about methodology used in this thesis. It sheds light on the detail about statistical procedures used to examine the efficiency of the Pakistani market. Fourth chapter contains results and the discussion. And the last chapter consists of conclusions and future implications.

CHAPTER 2

LITERATURE REVIEW

Borges, (2009) said that efficient market theory and random walk hypothesis have been two of the most popular topics in financial literature in past decades. Random walk does not indicate that insider traders are unable to beat the market; rather, it demonstrates that investors are unable to obtain anomalous returns using past data on stock prices or trading activity. Al-Khazali et al., (2007) said that investors and policymakers seek an efficient market to ensure that stock prices are quickly adapted to new information while making investment decisions. Weak form efficiency and the RWM hypothesis are tested for various time periods and for different markets as well. An essential concern is whether Pakistan's indices are effective at their current level of weakness or not. There are number of research studies which were previously conducted to test market efficiency and RWH. Large daily price fluctuations are followed by larger price shifts. Changes can be both positive and negative, and they occur at random, implying that price changes are unrelated to investment decisions and are associated with the idea of efficiency (Fama, 1965). The theoretical underpinning of EMH was laid down by (Fama, 1970). According to the research, all past, present and future discounted events are revealed by prices. Samuelson (1965) expands the work of (Bachelier, 1900) and opens a new way in modern economic literature. "If one could be certain that a price would rise, it would have already done so," it says. It also establishes a connection between random variation behaviors and price changes. In developed countries, certain research (Robert, 1959; and Fama, 1970) reject the idea that equity price changes are not expected based on previously past pricing information. Fama (1970) has divided market efficiency into three kinds. These are weak form, semi-strong form and strong form of efficiency.

2.1 Weak form of efficiency

Truong (2006) defined it as "the prices reveal information from the past." We cannot predict future prices based on past prices. So no one can earn the unusual profit.

2.2 Semi Strong form of efficiency

It is defined as "All prices reveal publically accessible information" (Fama, 1970). For instance information about rate of exchange and interest rate, money supply, earnings and divided announcements, and so on. Traders will not be able to achieve extraordinary profits by merely calculating annual reports of corporations. The market promptly adjusts prices when there is entrance of a good or a bad news (Truong, 2006).

2.3 Strong form of efficiency

It is described as "Stock reveals related information, comprising both public and private information". Because the cost of obtaining insider knowledge is zero, it is extremely difficult for any market player to generate unusual returns. Because this assumption does not hold true in reality, this level of efficiency should not be expected (Truong, 2006). Fama (1970) has given a simple statement about EMH that "Security prices completely represent all accessible information". After reviewing the contributions of the SLB Model (Sharpe, 1964; Lintner, 1965 and Black, 1972) and Arbitrage Pricing Theory (APT), Fama (1991) revisits all work of market efficiency from 1970 to 1990. Malkiel (2003) criticizes EMH's claim that stock prices are unpredictably volatile and propose that they are partially expected. Fama claims that "once new information emerges, it circulates quickly and adjusts in stock prices without delay." Malkiel argued that “Information of price is revealed by tomorrow news”. It denies that markets are totally efficient since collective judgments can be inaccurate at any time because some market players are less rational than others. Professionals are unable to find all data that can be promptly incorporated into stock prices (Grossman and Stiglitz, 1990).

Mostly the work related to testing market efficiency of largest countries stock markets like United States, Western Europe and japan is done by (Lo & MacKinlay, 1988; Fama & French, 1988; Poterba & Summers, 1988). Masood, Ashraf & Shahid (2006); Iqbal & Mallikarjunappa, (2008, 2010 and 2011) studied on ISM. Related to Pakistani stock market the work is mostly done by (Hassan et al., 2007; Haque et al., 2011); Naimat, 2016; Fraz & Hassan, 2016). Fama (1965) states that market efficiency is seen when price of a stock represents all accessible information in market. As a result of this, we have discovered that no single investor will take benefit from the information because everyone has same information, which is revealed in the market price. Fama (1970) state the stock market is weak form efficient when subsequent stock price changes and price movements are independent. Uncertainty of stock returns, which is the base of the Random Walk (RW) hypothesis, should be addressed while testing the weak form efficiency.

Fama (1970) mentions that Random Walk Model (RWM) shows that prices reveal all information in a weak from efficiency. If prices are not represented by a RW, a temporary factor controls the return-generating process, and future returns can be somewhat anticipated by previous order of returns. Market efficiency is a desirable characteristic since it enhances capital price and availability, as well as attracting foreign investment and increasing domestic savings. The RWH has investigated in the almost all stock markets separately from the US markets, but not a single study found indication against the RWH. Mostly economists state that markets are efficient because it has investors which can take risk to earn some profit. Markets are expected to grow more efficient as a result of technological advancements. Taking advantage of market abnormalities can be a path to gain certain profits; market efficiency allows equity investors to make informed decisions. Irregularities usually fade away with time since there is usually a window of opportunity to exploit them. The majority of economists believe that markets will never be totally efficient since investors will always be able to gain profit. According to Hurt (2010), economists Matthew Bishop and Michael Green argue that full acceptance of the theory contradicts Adam Smith and John Maynard Keynes' beliefs that irrational behavior had a substantial impact on the market.

According to Lui & Chong (2013), traders' performance differs because they do not have the same market experience. They come to the conclusion that if the market is efficient, traders should have identical performance. Investors with more technical analysis experience may be able to outperform those with less experience. This contradicts the RWH and eliminates weak form efficiency. Fama & French (1988) found forty percent of volatility in long-term holding returns in the US market can be predicted using historical data. Poterba & Summers (1988) investigated the US stock market's weak form efficiency in comparison to 17 other stock markets. Positive serial correlation has seen in short term but negative correlation is seen in long term. Lo & MacKinlay (1988) used weekly returns and sub periods of 608 weeks of US stock returns for the period 1962 to 1985, and the study found the result that rejects the null hypothesis for sample period and sub periods. They devised a test statistic that is extremely powerful under both the homoscedastic and hetero-scedastic RWH. They also investigated the finite sample qualities and discovered that VR was more trustworthy than ADF and ACF in the context of financial prices under a heteroscedastic RWH. Lo & MacKinlay (1988) used Monte Carlo investigation to determine the magnitude in few samples. And discovered that the RWH is null and the VR test is more trustworthy than ADF and ACF. Hadi (2006) investigated the types of EMH. He tested weak, semi-strong, and strong form, and discovered that accounting-based research implies a semi-strong form of market efficiency because financial reports are considered public information once they are disseminated in the market. He also gives experimental evidence from the Jordanian market, claiming that the security market reacted to the release of profitability, liquidity, and solvency information with varied results. Pant & Bishnoi (2001) estimated ISM efficiency by using daily and weekly returns of 5 indices and indicated the result which shows that market is efficient. Deb (2003) examined same markets by taking save markets as Pant & Bishnoi (2001) used in their study and indicated the result which displays that market is efficient excepting for BSE100. Masood et al., (2006) examine the National stock exchange by using the daily returns and found that there is a negative autocorrelation in lag 2. Mishra et al., (2008) examined efficiency of Indian stock market (ISM) and Foreign exchange and result shows the presence of efficiency in its weak form. Iqbal & Mallikarjunappa (2011) investigated ISM and found it inefficient in weak and semi-strong form. Venkatesan (2010) worked on ISM by using returns from 1st January 2008 to 31th December 2009 and found the result that it is efficient in its weak form. Chander et al. (2008) has also examined the stock market of India by employing Parametric and non-parametric techniques and revealed that there is weak form efficiency. Jain et al. (2009); and Lazar et al. (2009) investigated Indian market. From ADF and PP test result revealed that it is efficient in its weak form. Pradhan et al. (2002) examined the behavior of Indian stock prices for 1990-2001 and found that these markets are efficient.

Several researches have been carried out to study India's market efficiency. Chaudhury (1991) investigated the ISM's efficiency with the possibilities of forecasting behavior. The RWH was rejected by this evidence-based study. The results showed that it was possible to foresee future prices, but he said against relying solely on a stock's past price sequence for future price projection. Barman & Madhusoodanan, (1993) used the VR test to study the ISM and discovered that it was mean reverting. Madhusoodanan (1998) examined Indian stock prices behavior by applying the VR test and found the result that the RWH was rejected in ISM. Ramasastri (2001 to 2002) also examined the ISM efficiency by using the VR test and runs test. He has sub divided these periods into three phases. First phase was the turbulence phase from (1991 to 1992), second one was the transition phase from (1993 to 1995) and the last but not the least phase was transformed phase from (1996 to 1999). Sharma et al., (2002) noticed that there is significant relation between market capitalization and market ratio, after the liberalization process by employing Lo & MacKinlay (1988) VR approach and Fama & French (1988)) test of autocorrelation during 1948 to 1949 and 1998 to 1999 and also for two sub periods i.e. 1948-1949 to 1984-1985 and 1998-1999. In this study it was observed that ISM is inefficient before the liberalization process, and following the liberalization process, the stock market experienced substantial progress, with greater market capitalization. On the basis of prior prices, it nevertheless demonstrated high predictability in returns. Barua et al. (1994) gives a complete overview from 1977-1992 on (ISM) and found the result in favor of weak form of efficiency. Belgaumi (1995) investigated weekly returns from April 1991 to March 1992 for 70 firms which belong to the group A on the BSE and founded the RWM was supported by serial correlation and runs test hence ISM shows weak form of efficiency. Fawson et al. (1996) examined efficiency of Taiwan share market and came up with findings that monthly prices were efficient in its weak form. Gurley and Shaw (1960) have stressed the role of transaction costs. For example, fixed costs of asset evaluation mean that intermediaries have an advantage over individuals because they allow such costs to be shared. Similarly, trading costs mean that intermediaries can more easily be diversified than individuals. Leland and Pyle (1977) suggest that an intermediary can signal its informed status by investing its wealth in assets about which it has special knowledge. Diamond (1984) has argued that intermediaries overcome asymmetric information problems by acting as "delegated monitors." Financial markets such as the stock and bond markets have grown in size using nearly any metric, such as the value of companies listed or any other conceivable measure of their importance. Current theories of intermediation focus on transaction costs and asymmetric information.

Some studies like Gupta & Basu (2007) and Mishra et al. (2009) investigated ISM and found that there is inefficiency. Hussain et al. (1996) investigated Pakistani stock market while Poshakwale (1996) investigated ISM. Mishra (2011) also investigated weak form of efficiency of India, China, Brazil, South Korea, Russia, Germany, US and UK by taking data of January, 2007 to December, 2010 by using unit root test and found that these countries are inefficient in its weak form. Budd et al. (2012) found time series data between 19 June, 2007 and 12 September, 2011 for Tadawul exchange by using parametric and non-parametric methods. He found results from Runs test, VR test and serial correlation and rejected RWH. Zulqarnain & Shah (2013) used data from July, 2006-June, 2011 from KSE 100 index. They used different test to examine the hypothesis like Runs test, (ADF, PP) tests, and AC test found the result that KSE do not follow the RWH. (Jarret and Kyper (2006) took monthly prices from NYSE and NASDAQ exchanges for 62 firms from April, 1992 to September 2002. And finding was that prices of stock follow RWH are uncertain. Chakraborty (2006) used daily data from 1996 to 2005 to study the efficiency of KSE using variance ratio tests, run tests, and serial correlation tests, with the result rejecting the VR hypothesis for overall period but accepting it for the second sub-period, and found that KSE is inefficient. Autocorrelation and hetero scedasticty was present in the data. Mustafa & Nishat (2007) uses KSE for December 1991 to December 2003 to check the market efficiency by taking daily, weekly and monthly stock returns and found the result that it is efficient for the certain period. Abdullah et al. (2007) studied weak form of efficiency of KSE by taking the monthly, weekly and daily data for 6 years and result found from unit root and MVR tests that it is inefficient. Hamid et al. (2017) worked on the Asia-Pacific market to test the weak form efficiency by using returns from January 2004-December 2009 and used unit root test, run test and VR test in their study and found the result that all these markets do not follow random walk. Haque et al. (2011) studied weak form of efficiency of KSE 100 index from 2000 to 2010 by using weekly data and found a result from unit root test, AC and run test that it is not weak form efficient. Zahid et al. (2012) examined weak form of efficiency of KSE by employing parametric and non-parametric test of RWM from March 2000 to October 2011 by taking their bid and offer rates and found that KSE do not follow RWM. Khan & Khan (2016) investigated weak form of efficiency of KSE by using daily, weekly and monthly data from 1991-2015 and found the result that stock market do not follow RWH. (Fraz & Hassan, 2016) studied weak form of efficiency of KSE by employing monthly, weekly, and daily data for June 2002 to June 2012 and found the same result that it is not weak form efficient.

Results of Ojah & Karemera (1999) study demonstrate that they follow random walk and investors cannot get advantage from past data. Mobarek & Keasey (2000) examined weak form of efficiency of Dhaka stock exchange (DSE). They used monthly data from 1988 to 1997 and after applying the run test, auto regression and AC test the result found that there is a significant autocorrelation at different lags in return series and this shows that the market is not weak form efficient. Buguk & Brorsen (2003) examined weak form of efficiency of Istanbul stock exchange and found the result that it does not follow random walk. Squalli (2006) also used VR tests and run tests to analyze market efficiency in Dubai financial market (DFM) and Abu Dhabi stock market (ADSM). In all sectors, VR test rejects RWH, and run tests reveal that ADSM is weak form efficient. Moustafa et al. (2004) also examined efficiency of UAE markets from 2 October 2001 to 1 September 2003 by applying run test on specific firms return and found the result that the returns of forty out of forty three stock markets of UAE are weak form efficient. Rao et al. (2007) used three years of data to evaluate the BSE-100 index's weak form of efficiency. The serial correlation and run test reveal that market was not weak efficient in first two years, but it was in the third year. Elango & Hussein (2008) has worked on seven countries of Gulf Cooperation in order to test weak form of efficiency by using daily data of indices from October 2001 to October 2006 and found the result that these all the seven countries are not weak form efficient. Magnus et al. (2008) worked on Ghana stock exchange to test the efficiency by using daily returns from 1999 to 2004 and after using Random walk, result has been found that it rejects the hypothesis of weak form efficiency.

Asiri (2008) uses daily data of Bahrain stock exchange and specific sector data from 1 June 1990 to 31 December 2000 to check weak form of efficiency and found that both are weak form efficient. Al-Ahmad (2012) uses Damascus stock exchange in his study in order to test the efficiency by using the daily returns from 31 December 2009 to 30 November 2011 and found the result that prices do not follow random walk. Aumeboonsuke (2012) worked on six ASEAN stock markets for 2001 to 2012 and found it weak form inefficient. Orman (2006) tested RWH for five Middle Eastern markets i.e. Jordan, Morocco, Egypt and Turkey and concluded that these markets do not follow RWM. Worthington (2006) studied weak form of different countries by taking 27 emerging markets. The results from parametric and non-parametric test indicate that these are not weak form efficient. Mustafa and Ahmed (2013) said that less developed countries: emerging markets are thought to be less productive than developed countries. Low capital market development, transaction costs, a higher level of future uncertainty and a lack of proper information are just a few of the key factors of slow advancement in developed markets. Some reasons for inefficiency in emerging markets are: Lack of structured profiles, substandard rules, Speculative activities, lack of monitoring, administrative authorities' failure to implicate existing legislation, and insufficient data. Nankervis and Savin (2010) investigated the efficiency of Sixteen Asian Stock market including five developed markets, nine emergent and two frontier economies. The result found that there is efficiency in developed economies but inefficiency in the frontier economies and there is mixed finding for emerging ones. Muhammad Salehmad (2016) tested stock market efficiency by using four Dow Jones Islamic Indices and found that except for Asian Pacific Islamic for the last two periods (2001-2006 and 2007-2012); Islamic indices are not weak form efficient. Over the whole period from 1996 to 2012, four Dow Jones Islamic stock indices under consideration do not follow random walk. Marashdeh and Shrestha also investigated United Arab Emirates (UAE) and revealed that it is weak form efficient. Oskooe et al. tested the Iran stock price index and found the result that (ISM) is weak form efficient.

Weak form of efficiency is rejected by some researches in markets that are being developed. Gupta and Newberry (1997) used AC and runs tests on daily prices of shares on BSE from 1998 to January 1996 to assess the random walk's fitness. Righi and Ceretta (2011) used the VR test to investigate the stock market's weak form of efficiency in US and Latin America from 2005 to 2010. The results reveal that Latin markets are inefficient in terms of efficiency. Despite this, the RWH for the US market was rejected during the sub-prime crisis. Alexeev and Tapon (2011) investigated the Toronto Stock Exchange, while Narayan (2005) studied prices behavior in Australia and New Zealand and found the result in the favor of RWH. Narayan and Smyth (2006) studied for fifteen European stock exchanges; Hasanov and Omagy (2007) studied for Eastern European republics and found the result that it is weak form efficient. Robinson (2005) investigated the Jamaica Stock Exchange by using AC and runs test and found the result that it is not weak form efficient for at least 65% listed stock. Nwidobie (2014) investigated the listed firms on Nigerian Stock Exchange and found the result that there is not a random walk. Haider and Nishat (2009) tested the Pakistani market and confirmed inefficiency for Pakistani market. Tahir (2011) examined the data for 20 listed firms on PSX for 2000 to 2009 by using technical analysis and rejected weak form EMH. Haque et al. (2011) investigated KSE 100 index from 2000 to 2010 by taking weekly data and found the result that there is not weak form of efficiency and future returns can be predicted by past prices. Kiani (2006) also investigated KSE 100 index and concluded that there is inefficiency in its weak form. Sultan and Wong (2013) investigated Pakistani and Kuwaiti stock market by using data from the period between 2005 and 2010 by employing ADF and AC tests to declare the inefficiency for both exchanges. Rehman et al. (2014) investigated the KSE 100 index by using daily data from the period 2009 to 2010 by employing ADF, ACF and run tests and found the result that there is inefficiency. Chan and Hameed (2006) investigated the Pakistani stock market and found the result that there is inefficiency in Pakistani stock market. Some studies are conducted to study Pakistani stock market.

Worthington (2006) also examined Latin American emerging countries such that Argentina, Brazil, Colombia, Chile, Mexico, Peru and Venezuela by taking daily returns of these countries by using unit root tests and MVR tests and revealed the findings that stock markets of all counties are not weak form efficient. Urrutia (1995) investigated the RWM for four Latin American emerging countries by using monthly index data for Argentina, Brazil, Chile, and Mexico, from December 1975 to March

1991, and revealed that RWH was rejected by VR test, but the runs test revealed the existence of weak form of efficiency in these markets. Huang et al. (1995) used VR test to examine RWH in the equities markets of nine Asian countries, finding shows that the RWH is rejected in the Korean, Malaysian, Hong Kong, Singapore and Thailand equity markets. Mobarek et al. (2008), Khan and Huq (2013), Miah and Banik (2013) used parametric and non-parametric tests, including ARIMA modeling, to assess efficiency of DSE and found the result that there in inefficiency in the market. After reviewing literature carefully, the conclusion has been drawn that emerging market index taken relatively under research. So the result of the study could help investors and portfolio managers in developing investing strategies.

Worthington (2006) and Borges (2010) investigated developed and emerging European equity market for checking random walk by using parametric and non-parametric tests: (ADF, PP and MVR test) and discovered the result that there is random walk in developed countries of Europe. Hungry was the only one country among all the emerging markets which fulfills the conditions of weak form of efficiency and in developed markets, stock markets of Sweden, Portugal, Germany, UK and Ireland also fulfills the same condition. Gupta (2006) said that developed economies markets are more efficient than emergent market. Smith et al. (2002) and Lagoarde-Segot and Lucey (2008) studied African American emerging markets and concluded that there is no random walk, with the exception of South African markets. Chiwira and Muymbiri (2012) used parametric and non-parametric: (AC test, runs test, KS, ADF and PP test to examine the efficiency of Botswana stock market. They discovered that there is no weak form of efficiency. Abraham et al. (2002) and Asiri and Alzeera (2013) investigate by using daily, weekly, and monthly data of

Middle Eastern countries markets and found that the Iranian, Saudi Arabian, and Gulf markets are weak form efficient when parametric and non-parametric tests are used. Many research studies have been conducted in Asian emerging markets after the liberalization of financial markets in the 1990s, when there was an increase in global market integration and a large number of capital transfers from developed markets to emerging markets. Araújo Lima and Tabak (2004) and Charles and Dame (2009) tested the efficiency of Indonesia, Malaysia and Philippines and China and found the result that there is no efficiency in these markets even after the liberalization of these markets in 80's. Pashakwale (1996), Gupta and Basu (2007) and Mobarak et al. (2008) investigated the efficiency of Asian emerging markets such as India, Bangladesh and Srilanka and found the result that there is no random walk present in these markets. Islam and Khaled (2005) also investigated the efficiency of Asian emerging markets by using hetero-scedasticity robust Box-Pierce test and found the result that random walk exists in these markets. Alam et al. (1999) and Karemera et al. (1999) examined Bangladesh stock market efficiency by using runs test and found that there is weak form of efficiency. Haroon (2012) used RWT to examine weak form of efficiency of KSE. The hypothesis was tested using KS test, Runs test, and AC test. The results have shown that KSE is not inefficient.

From the last two decades the Pakistani stock market has become one of South East Asia's best-performing markets. After the financial reforms of the 1990s, the market saw a considerable infusion of capital from developed countries. Uppal (1993), Khiliji (1994), Ahmad and Rosser (1995), Husain (1997), Cooray and Wickramasighe (2007) there are many studies conducted on efficiency of KSE. Pakistani stock markets don't have random walk like other markets of South Asia. Shamshir and Mustafa (2014) found that the unpredictability is an extremely determinant factor in KSE 100 index and least determinant in KSE 30 index. Mustafa and Nishat (2007), Mustafa (2011), Shamshir et al. (2014) found the seasonal anomalies exists in Pakistani stock market. Nicolaas (1997) investigated Australia and New Zealand stock markets. There is a lot of work done on investigating weak form of efficiency of develop markets of Europe and Latin American by using parametric methods. Sufficient literature exists on weak efficiency of emerging markets like Asia. Mobarek and Keasey (2000) studied (DSE) Bangladesh and found it efficient in its weak form. Abrosimova et al. (2019) studied efficiency from 1995 to 2001 in Russian market by using monthly, weekly and daily Russian Trading system (RTS) index. The study found that weekly and daily data do not follow normal hypothesis, but monthly data follow normal hypothesis. On RTS, this outcome provides some evidence of short-term market predictability. Lovatt et al. (2007) investigated the UK stock market from 1992 to 1998 by using AC and finds the signal of certainty for UK returns at daily regularity. Patro and Wu (2004) used VR tests to test the predictability of equity indices in eighteen developed countries and found that there is no RWH in 15 of them. Borges (2010) investigated European markets from 1993 to 2007 and found conflicting findings when it came to the efficient markets concept. The EMH is rejected by Portugal, Greece, France, and UK in the most recent studies; however Germany and Spain are not.

Kim et al. (2008) categorize the crisis with economic and political cause for January 2008 to June 2009. Such eras are marked by much stronger predictability and lower prediction uncertainty, implying that rejecting the weak form efficient market theory is more acceptable at this time. Urquhart and Hudson (2013) investigated weak form EMH for stock markets of US, UK and Japan for years 2005 to 2009. According to their findings, the Dow Jones Industrial Average returns for 2008 has a negative AC. Kim and Shamsuddin (2008) during the Asian financial crisis analyzed the Japanese and Korean markets and the results suggest a shift from weak to EMH. Some studies with respect to econometric tests determine the efficiency of the market technical trading guidelines in relation to buy and hold and sell and hold investment strategy have been thoroughly investigated. Metghalchi et al. (2012) discover sixty six models based on technical indicator from 1990 to 2010. And they discovered that technical trading rules for Taiwanese market are profitable. Fifield et al. (2005) examine eleven European markets from 1991 to 2000 using BH and moving average criteria. The findings suggest that emerging markets are inefficient in terms of information, whereas developed markets are efficient. Metghalchi et al. (2008) used technical trading rules to examine the weak form of efficiency for Swedish market. This research discovered that moving average rules have analytical capacity, these rules can be used to isolate repeating price patterns for profitable trading. Sabbaghi and Sabbaghi (2014) examined efficiency for the twenty-third developed financial markets.

Kin et al. (2011) studied the era from January 2008 to June 2009 is known as the economic and political crisis period. According to previous research, market efficiency is a term used in capital market theory to characterize the point on which prices represent all accessible information. The efficiency of equity markets has crucial consequences for investment policy, and past research suggests that seeking for mispriced assets is a waste of time if the equity market in question is efficient. In both emerging and developing markets, the outcomes of studies from various groups around the world are mixed. According to one group Dickinson and Muragu (1994), Ojah and Karemera (1999), Barnes (1986) states that markets are weak form efficient while other group Cheung et al. (1993) states that the markets are inefficient in its weak form. Although stock price rise and fall are random. For there must be some seasons and variables manipulating price swings, and empirical evidence supporting this hypothesis has been offered. Many studies were conducted on the stock markets in the United States and Europe, with an emphasis on emerging regions such as Africa. Osei (2002) found the Ghana Stock Exchange (GSE) inefficient; however it is semi-strong form of inefficiency when earnings announcements are included into stock pricing. Smith (2002) investigated eight African markets by taking stock market price by using MVR test. They found the result that Botswana, Zimbabwe, Kenya, Morocco, Egypt, Mauritius and Nigeria did not follow Random Walk except for South Africa's All Share Index, results were auto correlated. Olowe (1999) also tested the Nigerian Stock Exchange (NSE) from January 1981 to December 1992 by using correlation analysis to investigate monthly returns of fifty nine randomly selected stocks and found NSE is weak form efficient. Afego (2012) investigated efficiency of NSE by taking monthly index returns and used Run test and found the result that the NSE's stock price changes were not random, and there were exploitable tendencies. Laryea and Simons (2006) used different tests to assess the EMH for 4 African stock markets, and found that South Africa's markets were weak form efficient but Ghana, Mauritius, and Egypt's markets were inefficient in its weak form.

Ntim and Soobaroyen (2013) also used non-parametric and parametric test to study 8 African markets and discovered that the African continent share price index has significant weak form of informational efficiency over eight specific national share prices. Magnusson and Wydick (2002) study 8 African emerging economies and compare them to those in South Asia and Latin America. By employing RWH, Correlation analyses revealed that weak form of efficiency in emerging African markets compares positive to those of other emerging markets. Okpara (2010) used Runs test and ACF as an additional instrument to study the RWH on NSE and discovered that NSE followed random walk. Mlambo and Biekpe (2007) examined efficiency of 10 African markets by using serial correlation and Runs test found the result that rejected the RWH with the exception of Namibia. Lakonishok and Haugen (1988) investigated plenty of studies and the concept of randomness in stock returns for the United States and other developed markets was not rejected. This sign is stable with expected concept of weak form efficient markets. In established stock markets, the most severe violations of the RWM and the concept of weak form efficient markets appear to be linked to calendar timing points like the beginning of the year, the beginning of the month, the beginning of the week and holidays etc. French (1980) discovered that Monday had significantly negative returns and Friday had relatively greater returns in the United States. Gibbons and Hess (1981) examined days of week effects on US stock prices and found evidence to support their findings. Keim (1983) investigated the January effect and discovered that it was entirely a small stock phenomenon. Ariel (1987) investigated the NYSE and AMEX stocks returns and found that in the first half of every month these are positive. In the first half the average monthly returns are higher as compared to second half. Ariel (1990) investigated it again and discovered that almost a third of the gains increased in the US stock market from 1963 to 1982 were obtained on the trading days leading up to the eight holidays that result in market closures each year.

There are large numbers of studies which reject the hypothesis of randomness in the rates of returns series which suggest the existence of largely weak form efficient markets. Harvey and Green (1993) investigated the stock markets of emerging markets and found that these markets are highly expected and they fail to find any seasonal patterns in stock prices. Urrutia (1995) investigates the Argentinean, Brazilian, Chilean and Mexican market indices and found no return predictability on these markets. For Caribbean stock markets, Robinson (2001) investigates Barbados stock exchange and found no evidence of return predictability while Singh (1995) investigates Trinidad and Tobago stock exchange and found that these markets are expected. Koot et al. (1989) investigated the JSE index by using the Runs tests for the period of 1969 to 1986 and sub period 1977 to 1986 and found the result that there is no random walk. Muradoglu et al. (2000) investigates the Istanbul exchange and found the result that many of the time series and cross sectional patterns found in developed markets are also present. Martikainen et al. (2000) investigates Helsinki stock exchange and found the result that most of the identified in major markets are present. Koh et al. (2009) also investigate the Asian markets (Honk Kong, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand) and found similar result. One exception is the January effect which is present in only Malaysia and Singapore. Cervera and Keim (2000) investigated the stock market indices globally; these returns are larger than the average returns on trade days before holidays that result in market closure, according to the findings. The Netherlands is the only market in which pre-holiday returns are lower than the average returns over all days; the effect is strongest on average for non-European markets. Returns in emerging markets are expected and are weak form inefficient. Seasonal patterns identified in developed markets do not appear in emerging markets. Gulf cooperation council (GCC) is investigated by taking daily returns and discovered that they follow a normal distribution (Sharma 2002). Hussein and Elango used daily data from October 2001 to October 2006 to study efficiency across stock markets in GCC countries. KS test has been used in this study. For randomness, the run test was used and found the result that market is inefficient. Ang and Pohlman (1978) investigated 54 equities from five (Japan, Singapore, Australia, Hong Kong and the Philippines) stock exchanges and discovered that these are weak form efficient.

Panas (1990) investigated Greece stock market and revealed that it is efficient but at a weak level. Grieb and Reyes (1999) also studied these markets and found the result that only Brazil and Mexico supports the RWH in their equity prices. El Erian and Kumar (1995) investigated stock markets of Turkey and Jordan. Serial Correlation and Runs test are used and revealed the result that these markets are not efficient. Antoniou et al. (1997) investigated the stock market of Istanbul and found the result that Turkish stock market is not efficient. Mookerjee and Yu (1999) investigated stock markets of China and revealed that Chinese market is efficient in its weak form. Groenewold et al. (2003) also tested markets of China and revealed the same results. Karemera et al. (1999) and Lima and Tabak (2004) conducted a study on Hong Kong market and revealed the result that Hong Kong market is weak form efficient. Awad and Daraghma (2009) used serial correlation, runs test, ADF (1997) and PP (1988) test to examine efficiency of Palestinian stock and discovered that it is not weak form efficient based on significant serial correlations and runs test. Campbell (1995) investigated twenty emerging stock markets which includes (Africa, Europe, Latin America and the Middle East) and discovered that the emerging stock markets' future returns behavior is more expected than the developed stock markets. Omran and Farrar (2006) also investigated RWH for Egyptian, Israeli, Jordan, Morocco and Turkish stock markets and discovered that the hypothesis was rejected.

Marashdeh and Shrestha (2008) investigated RWH for stock markets of Emirates by using ADF (1979) and PP (1988) and found the result that both test support the RWH. Worthington (2006) test the seven emerging economies by using ADF, PP and KPSS (1992), VR test, serial correlations and runs test and found that majority markets are not efficient. Chan et al. (1992) investigated efficiency in stock market of Hong Kong, South Korea, Singapore and Taiwan by using unit root tests and found the result that shows efficiency in its weak form. Liu et al. (1997) examined efficiency in stock market of Shanghai and Shenzhen Chinese stock market indices and found the result that shows there is weak form of efficiency. Ormos and Mihaley (2014) investigated Hungarian Capital Market efficiency by taking data from period 1991 to 2000 and found it efficient in the semi-strong form. Dickinson and Muragu (1994) investigated the thirty most traded equity of Nairobi Stock Exchange by using the weekly prices for ten years. They found the result from runs test and Q-test statistics that there is no evidence inconsistent with weak form of efficiency. Conrad and Jüttner (1973) investigated German stock market by using parametric and non-parametric tests on daily data and found a result that RWH is not suitable to explain price fluctuations. Cooper (1982) investigated the world stock markets by taking daily, weekly and monthly data for thirty-six countries by using correlation, run tests and found the result that there is no RWH except for UK and US markets. Frennberg and Hansson (1993) investigated the RWH from 1919 to 1990 in Swedish stock prices and revealed the result that there is no evidence for RWH. Hong

(1978) investigated Singapore stock market efficiency and revealed that Singapore market is efficient in its weak form. Ghandi et al. (1980) examined Kuwait stock market and revealed the result that there is inefficiency. Butler and Malaikah (1992) investigated the Saudi Arabian and Kuwait stock market and found that Kuwaiti market was efficient but Saudi market was inefficient. Huber et al. (1997) examined Vienna Stock market and found result that RWH doesn't exist in this market. Balaban (1995) examined weak form of efficiency in Istanbul Stock Exchange (ISE) and found it efficient. Al-Loughani (1997) investigated the Kuwait stock market by taking weekly data from 1986 to 1990. He employed the run test and AC test and found Random Walk. Babaker (2004) investigated all Arab Stock Exchanges efficiency and found that developed markets are highly efficient than emerging markets. During the period 1994 to 2002, all Arab stock markets were not efficient excluding Tunisia and Jordan. The inefficiency is not as good in Bahrain and Oman as in Kuwait and Morocco. During the period 1994 to 1996, Jordan, Kuwait and Morocco were efficient but from 1997 to 1999, Jordan, Kuwait and Tunisia were efficient. For period 2000 to 2002 five markets i.e. Saudi Arabia, Tunisia, Jordan, Egypt and morocco were found to be efficient. Asiri (2000, 2004) also investigated market efficiency of Kuwait stock market from 1999 to 2002 and from 1991 to 2002 by using daily data. By employing unit root tests and AC test, the study found that there is weak form of efficiency. Malhotra et al. (2016) investigated efficiency for ten selected stock exchanges in Asia pacific markets from 1997 to 2012 by taking daily, weekly and monthly data. By employing run test and AC test, they found that there is weak form of efficiency for monthly returns but daily and weekly returns are not weak form efficient. Harper (2015) investigated the efficiency in Russian stock market by using daily returns for 2003 to 2012. He employed AC and Box-

Ljung test and found it inefficient. Ekechi (1989) examined Nigerian Stock Market from 1980 to 1986 and found that this market does not follow Random Walk. Anand and Bley (2011) investigated efficiency of Gulf Stock Market for 10 years from 2000 to 2009 by using daily prices and found it inefficient. Abeyratna et al. (1995) investigated the efficiency of Colombo Stock Market for sample of 20 companies by using daily, weekly and monthly from 1990 to 2001 and found that it is not weak form efficient. Result showed from Jung-Box that from past information the stock price was expected. Ming et al. (2000) investigated the RWH for Kuala-Lumpur stock exchange by using VR and MVR tests and concluded that there is no random walk. Yasir and Kashif (2015) investigated the efficiency of KSE by employing the ADF, Q-Ljung box test, VR test and AC and found that before 9/11 data shows markets inefficiency but after 9/11 data shows market efficiency. After 9/11 stock prices followed random walk. Yasir and zafar (2005) also investigated the efficiency of KSE and extrapolated that before 9/11 the predictability exists in stock returns like weekday effect and the data contain some anomalies in stock returns. After 9/11 data showed that there is no evidence for significant daily patterns in stock market returns. All the studies having shown mixed results suggest that some are in favor of RWH and some studies rejected the RWH.

CHAPTER 3

DATA DESCRIPTION AND METHODOLOGY

3.1 Methodology and data description

The methods for testing weak forms of efficiency are discussed in this chapter. This study puts into work a variety of econometric tests that have been employed in previous research studies. Various econometric approaches were used in past research to examine weak form of efficiency of Pakistani stock market indices.

For this study data is taken from PSX of all Pakistani indices which is a reliable source of information. This study uses all four indices of Pakistan to test robustness. These indices are: KSE-100, KSE-30, KMI-30, and KMI All Share Islamic Index. KSE 100 index comprises of 100 companies selected on the basis of sector representation and highest free float capitalization. KSE 30 index involves dividing the free float market capitalization of 30 companies in the index by a number called the index divisor. KMI 30 index contains 30 most liquid shariah compliant companies listed at Pakistan stock exchange. KMI All Share Islamic Index contains all shariah compliant companies listed at Pakistan stock exchange. All these share price indexes are important and actively used by the market players, so it is important to analyze these indexes. This study uses three different data series i.e. monthly, weekly and daily data to test the performance of all indices and prices behavior and changes in days, weeks and months. High frequency data show more variations but in low frequency the fluctuations averaged out. Monthly, weekly and daily closing prices of KSE-100, KMI-30, KSE-30 and KMI All Share Islamic Index are taken for calculate returns for the period of 8 years from1 June 2013 to 30 June 2021.

With reference to the study of Ahmad (2017), different parametric and non-parametric test are employed with the help of E-view and SPSS i.e., for normality testing: Jarque-Bera (JB) and Kolmogrov-Smironv (KS) test are used, for correlation: runs test and autocorrelation (AC) are used, for stationarity testing: Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Correlogram tests are used. And for testing weak form of efficiency and random walk Multi variance ratio (MVR) tests are used in this study. Normality is the essential property of any data series, battery of tests (parametric and non-parametric) are used to validate the results. Parametric tests are used only where a normal distribution is assumed and non-parametric test are employed when continuous data are not normally distributed. Some econometric tools are given below to examine weak form of efficiency in Pakistan.

3.1.1 Econometric Model

3.1.1.1 Test for Normality

Data distribution properties are investigated using normality tests. Data set is compared to the normal distribution in these tests. According to Fischer et al. (1991), the random incident distribution (returns) must follow normal distribution pattern. The following tests are used to determine whether the data is normal.

3.1.1.1.1 Jarque-Bera (JB) test

The empirical and theoretical normal cumulative distributions are compared in normality tests. Jarque-Bera (1982, 1987) test is a goodness of fit test, used to verify normal distribution of skewness and kurtosis. This is defined as:

$$\boldsymbol{JB = \frac{n}{6}(S^2 + \frac{1}{4}(K-3)^2)} \qquad \textbf{(3.1)}$$

Where

n= Number of observations

S= Skewness

K=Kurtosis

3.1.1.1.2 Kolmogorov-Smirov (KS) test

Kolmogorov (1933) produces number and asymptotic distribution, and Smirnov (1948) supplies table of distribution. KS test is non-parametric test used to check normality of the distribution of return series and comparing it to standard normal distribution and to check random Walk. Formula is given below.

$$\boldsymbol{F_n(z) = \frac{1}{n}\sum_{i=1}^{n} I_{y_{i\leq z}}} \quad \textbf{(3.2)}$$

Where

F_n= Distribution function

N= Independent and identically distributed random observations

$I_{y_{i\leq y}}$= Indicator function equal to 1 otherwise 0

For $F(z)$ KS statistic is

$$\boldsymbol{D_n = sup_y \mid F_n(z) - F(z)|} \quad \textbf{(3.3)}$$

D_n= Cumulative distribution function

sup_y= Supermum of set of distances

If sample arises from the distribution $F(z)$, the D_n coverage to 0 is practically certain, according to the Glivenko Cantelli theorem.

3.1.1.2 Autocorrelation (AC) test

The autocorrelation test is a popular method for determining the link between the series return and its lag value. If the series has both positive and significant AC, it specifies that a trend exists. When negative and significant AC exists in a series, it signals a price movement reversal. If no AC exists then a return series is called random. To test the AC two methods are used in this study.

3.1.1.2.1 Parametric and autocorrelation coefficient

It determines correlation between current and previous period returns. If no AC coefficients present then returns follow random walk. It is defined as

$$\boldsymbol{R_{u,t} = a_u + p_j R_{u,t-k} + \varepsilon_{u,t}} \qquad \textbf{(3.4)}$$

$R_{u,t}$= return of stock (u) at time t

a_u= constant

$\varepsilon_{u,t}$= random error

k= various time lags

3.1.1.2.2 Autocorrelation function and Q-Ljung Box (ACF) test

It's used to test if a data set is random. It's a graph or chart of correlation coefficients. If there is randomness, AC must be close to zero for any or all time lag separations. If there is non-randomness, AC must be non-zero for any or more time lag separations. Correlogram is another name for Auto Correlation Function ACF plot. It's a graphic representation of serial correlation in data that changes over time. Instead of assessing randomness at each lag, the Ljung Box (1978) test is utilized to examine whole randomness.

$$\boldsymbol{Q_{Ljung-Box} = n(n+2)\sum_{t-1}^{k}\frac{\Psi^2(t)}{n-1}} \qquad \textbf{(3.5)}$$

Where

n= number of functional data points

Ψ =accumulated sample AC up to any indicated time lags *t*

3.1.1.3 Non-Parametric Run test

It is a non-parametric test used to test whether change of price is serial or random. Run test is also known as Wald-Wolfowitz test. According to Siegel (1956), a run test is a classification of same symbols followed by different symbols or no symbols at all. It determines whether future price changes have a certain tendency or are unrelated to one another in returns. It does not need uniformly distributed returns. When using a correlation coefficient test to determine the interdependence of returns, extreme values can predominate. As a result, several researchers have employed the run test to solve this problem. In a series of consecutive returns, the null hypothesis is tested. There are two ways, both are based on return.

The first is a positive return (+) while the second is a negative return (-). The term "positive return" refers to returns that are more than zero (returns>0), whereas "negative return" refers to returns that are less than zero (returns<0). The second method has the benefit of approving and correcting the impact. The run test is built on the idea that price changes have an arbitrary tendency, and number of predictable runs is essentially nearby to number of real runs and test statistic is normally distributed for a larger sample size. Wallis and Roberts (1956) gave the formula or runs test which is:

$$\boldsymbol{Z = \frac{(U - U_{\mu})}{\sigma_{ti}}} \quad \textbf{(3.6)}$$

Where

$$\boldsymbol{U_{\mu} = \frac{2n+n_{-}}{n} + 1 and \sigma_{ti} = \sqrt{\frac{2n+n_{--(2n+n_{--}n)}}{n^2(n-1)}}} \quad \textbf{(3.7)}$$

Positive returns (+) are represented by +m, whereas negative returns (-) are represented by –n. “n” is number of observation in a sample.

Where n= (+n) + (-n)

3.1.1.4 Unit root test

It is used to test financial time series stationarity and it is a vital state for random walk. For examining stationarity of time series unit test is used. Gujarati (2008) said that if the data is stationary then mean and variance must be constant over time while testing the unit root for time series. Two test are used.

- **I.** Augmented Dickey Fuller test
- **II.** Phillips-Perron test

3.1.1.4.1 Augmented Dickey Fuller (ADF) test

It is a parametric test used to test the non-stationarity. The Dickey and Fuller (1979) test undertakes that the variance of time series is constant and not dependent upon error term. It is used to determine whether the autoregressive model has a unit root. A simple autoregressive model, AR (1) is.

$$\boldsymbol{y_t} = \mathrm{p}\boldsymbol{y_{t-1}} + \boldsymbol{u_t} \qquad \textbf{(3.8)}$$

Where

y_t = Variable of interest for time t

p = Coefficient

u_t = error term

Auto regression model is defined as:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{a_0} + \boldsymbol{a_1 T} + (\mathrm{p} - \mathbf{1})\boldsymbol{Y_{t-1}} + \sum \boldsymbol{\varphi}_{\boldsymbol{i}^{\Delta X^n}_{i=1}\boldsymbol{t-1}} + \boldsymbol{\varepsilon_t} \qquad \textbf{(3.9)}$$

Where

Y= Natural logarithm

T= Linear time trend term

$\mathfrak{p}$, φ = Parameters

Δ = Operator for first difference

ε_t = Error term

3.1.1.4.2 Phillips-Perron (PP) test

It is a non-parametric test used to test the non-stationarity. Phillips and Perron (1988) give an additional strategy for serial correlation for unit root in their auto regression model. The test undertakes that the error term is heterogeneously distributed and not independent. The following regression is used to introduce this test, which uses the same critical values as ADF.

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\lambda_0} + \boldsymbol{\lambda_1 Y_{t-1}} + \boldsymbol{\lambda_2 T} + \sum_{i=1}^{n} \boldsymbol{\psi_i} \Delta \boldsymbol{Y_{t-i}} + \boldsymbol{\varepsilon_t} \quad \textbf{(3.10)}$$

Y= Natural logarithm

T= Linear time trend term

$\boldsymbol{\lambda}$ = Parameters

Δ = Operator for first difference

ε_t = Error term

3.1.1.5 Multiple Variance ratio (MVR) test

To study hetero-scedasticity and AC in financial series of returns, Chow and Denning (1993) recommend Multiple Variance Ratio test. Formula is

$$\boldsymbol{VR(u)} = \frac{\boldsymbol{\sigma^2(u)}}{\boldsymbol{\sigma^2(1)}} \quad \textbf{(3.11)}$$

Where

$\sigma^2(u)$= 1/uth variance of the u differences

$\sigma^2(1)$ = First differences variance

$VR(u)$ = 1 is for null Hypothesis

2 tests are offered by Lo and Mackinlay (1998)

Z (u) and Z*(u)

Z (u) test is used to evaluate hypotheses of "Homoscedastic increase random walk."

$$\boldsymbol{Z(u)} = \frac{\{\boldsymbol{VR(u)-1}\}}{\boldsymbol{\sigma_0(u)}} \quad \textbf{(3.12)}$$

Where

$$\boldsymbol{\sigma_0(u)} = \left[\frac{\{\boldsymbol{2(2u-1)(u-1)}\}}{\boldsymbol{3u(nu)}}\right]^{\boldsymbol{1/2}} \quad \textbf{(3.13)}$$

The Z*(u) test is used to evaluate the hypothesis of "Hetero-scedastic increase random walk."

$$\frac{\boldsymbol{Z*(u)=VR(u)-1}}{\boldsymbol{\sigma\sigma(u)}} \quad \textbf{(3.14)}$$

Where

$$\boldsymbol{\sigma_0(u)} = \left[\boldsymbol{4}\sum_{\boldsymbol{k=1}}^{\boldsymbol{u=1}}\left(\boldsymbol{1}-\frac{\boldsymbol{k}}{\boldsymbol{u}}\right)^{\boldsymbol{2}}\boldsymbol{\delta_k}\right]^{\boldsymbol{1/2}} \quad \textbf{(3.15)}$$

And

$$\boldsymbol{\delta_k} = \frac{\sum_{\boldsymbol{i=k+1}}^{\boldsymbol{nu}}(\boldsymbol{p_k-p_{k-1}-u}\hat{u})^{\boldsymbol{2}}(\boldsymbol{p_{i-k}-p_{i-k-1}-u}\hat{u})^{\boldsymbol{2}}}{\left[\sum_{\boldsymbol{i=1}}^{\boldsymbol{nu}}(\boldsymbol{p_k-p_{k-1}-u}\hat{u})^{\boldsymbol{2}}\right]} \quad \textbf{(3.16)}$$

MVR tests examine several contrasts of various sets of VR estimates by establishing a process for different calculations with unity. When null hypothesis is VR (u) = 1, the only variance ratio (VR) test is used.

So Mv (u) = VR (u) – 1 = 0

Assume a set of n VR tests under null hypothesis, i.e. random walk.

{Mv (u) A= 1, 2…n} there are various hypothesis

Hoi: Mv (ui) = 0, i = 1, 2…n

Hoi: Mv (ui) = 0, i ≠ 1, 2…n

If any one of the Hoi is rejected, the random walk null hypothesis is clearly rejected. When a variety of tests are used, such as Z (u), Z (ui) A= 1, 2...n, and any of the expected ratios differs from the others, the null hypothesis is rejected. Only the highest worth is understood in the set of test statistics. MVR is founded on following outcome:

$$\boldsymbol{PR}\,\{\boldsymbol{max}\,(\mathbf{1}\boldsymbol{Z}\,(\boldsymbol{u_1})\mathbf{1}\ldots(\mathbf{1}\boldsymbol{Z}\,(\boldsymbol{u_n})\mathbf{1}) \leq \boldsymbol{SNN}\,(\boldsymbol{\alpha};\boldsymbol{n};\boldsymbol{T})) \geq \mathbf{1}-\boldsymbol{\alpha}\} \qquad \textbf{(3.17)}$$

The size of MVR was computed by comparing the SNN critical value with calculated values of standardized test statistic Z (u) OR Z*(u). Rejection of random walk under homoscedasticity is due to existence of AC in series of prices or hetero-scedasticity. Weak form efficiency of Pakistani Stock indices is investigating by taking monthly, weekly and daily closing prices. The following formula is used to determine daily, weekly and monthly compounding returns:

$$\boldsymbol{Return} = \boldsymbol{Ln}\left[\frac{\boldsymbol{P_t}}{\boldsymbol{P_{t-1}}}\right] \qquad \textbf{(3.18)}$$

Where

P_t and P_{t-1} are closing prices of month, week and day t and $t-1$ respectively.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Data Analysis and Empirical Results

Results and discussion of all Pakistan indices which are obtained by using different methods for the period of 1 June 2013 to 30 June 2021 are presented in this chapter.

Table 4.1 contains the statistical performance of daily, weekly, and monthly returns of Karachi Stock Exchange 100 Index (KSE100) from June 1, 2013 to June 30, 2021.

Table 4.1: Descriptive Statistics of KSE100 for 1 June 2013 to 30 June 2021

Statistic	***Monthly Return***	***Weekly Return***	***Daily Return***
Mean	-0.846	-0.179	-0.038
Median	-1.505	-0.247	-0.049
St. dev	6.126	2.587	1.075
Kurtosis	5.889	7.578	7.384
Skewness	0.723	0.598	0.603
Min	-15.438	-11.773	-4.683
Max	26.190	16.200	-0.038

Table 4.1 displays descriptive information for KSE 100 index returns from June 1, 2013 to June 30, 2021. The average daily returns are -0.0382 percent with an average standard deviation of 1.075 percent, but the average weekly returns are -0.179 percent with an average standard deviation of 2.587 percent, and the average monthly returns

are -0.846 percent with an average standard deviation of 6.126 percent, according to the table. Standard deviation for daily, weekly and monthly returns are greater which show high dispersion in the maximum and minimum values of stock prices reflects high volatility in the stock returns. The descriptive statistics demonstrate that for the sample period, all returns are positively skewed reveals increase in returns; it clearly specifies that large positive returns (maximum extreme value) are prominent than large negative returns (minimum extreme value). If the kurtosis is greater than 3 shows all returns are leptokurtic and linked with ‘peaked’ and fat tail but If the kurtosis is less than 3 shows all returns are platykurtic and linked with ‘less peaked’ and thinner tail. All return series of this study have kurtosis values more than 3, indicating that all returns are leptokurtic, implying that the data is higher peaked than the normal distribution. The value of kurtosis is large which shows non-normality of the series.

Table 4.2 contains the statistical performance of daily, weekly, and monthly returns of Karachi Meezan 30 Index (KMI30) from June 1, 2013 to June 30, 2021.

Table 4.2: Descriptive Statistics of KMI30 for 1 June 2013 to 30 June 2021

Statistic	***Monthly Return***	***Weekly Return***	***Daily Return***
Mean	-0.766	-0.169	-0.034
Median	-1.330	-0.235	-0.010
St. dev	6.706	2.919	1.260
Kurtosis	5.777	6.970	6.932
Skewness	0.544	0.251	0.380
Min	-20.910	-14.397	-6.193
Max	27.704	16.381	7.831

Table 4.2 displays descriptive information for the Karachi Meezan 30 Index returns from June 1, 2013 to June 30, 2021. The average daily returns are -0.034 percent with an average standard deviation of 1.260 percent, while the average weekly returns are -0.169 percent with an average standard deviation of 2.919 percent, and the average monthly returns are -0.766 percent with an average standard deviation of 6.706 percent, according to the table. Standard deviation for daily, weekly and monthly returns are greater which show high dispersion in the maximum and minimum values of stock prices reflects high volatility in the stock returns. The descriptive statistics demonstrate that for the sample period, all returns are positively skewed reveals increase in returns; it clearly specifies that large positive returns (maximum extreme value) are prominent than large negative returns (minimum extreme value). If the kurtosis is greater than 3 shows all returns are leptokurtic and linked with ‘peaked’ and fat tail but If the kurtosis is less than 3 shows all returns are platykurtic and linked with ‘less peaked’ and thinner tail. All return series of this study have kurtosis values more than 3, indicating that all returns are leptokurtic, implying that the data is higher

peaked than the normal distribution. The value of kurtosis is large which shows non-normality of the series.

Table 4.3 contains the statistical performance of daily, weekly, and monthly returns of Karachi stock exchange 30 Index (KSE30) from June 1, 2013 to June 30, 2021.

Table 4.3: Descriptive Statistics of KSE30 for 1 June 2013 to 30 June 2021

Statistic	***Monthly Returns***	***Weekly Returns***	***Daily Returns***
Mean	-0.163	-0.021	-0.005
Median	0.685	-0.095	0.010
St. dev	6.665	2.841	1.196
Kurtosis	6.794	7.039	7.145
Skewness	0.828	0.417	0.498
Min	-15.927	-12.886	-4.727
Max	30.670	16.819	7.780

Table 4.3 displays descriptive statistics for KSE 30 Index returns from June 1, 2013, to June 30, 2021. The average daily returns are -0.005 percent with an average standard deviation of 1.196 percent, while average weekly returns are -0.021 percent with an average standard deviation of 2.841 percent, and the average monthly returns are -0.163 percent with an average standard deviation of 6.665 percent, according to the table. Standard deviation for daily, weekly and monthly returns are greater which show high dispersion in the maximum and minimum values of stock prices reflects high volatility in the stock returns. The descriptive statistics demonstrate that for the

sample period, all returns are positively skewed reveals increase in returns; it clearly specifies that large positive returns (maximum extreme value) are prominent than large negative returns (minimum extreme value). If the kurtosis is greater than 3 shows all returns are leptokurtic and linked with ‘peaked’ and fat tail but If the kurtosis is less than 3 shows all returns are platykurtic and linked with ‘less peaked’ and thinner tail. All return series of this study have kurtosis values more than 3, indicating that they all returns are leptokurtic, implying that the data is higher peaked than the normal distribution. The value of kurtosis is large which shows non-normality of the series.

Table 4.4 contains the statistical performance of monthly, weekly and daily returns of All Shares Islamic Index of Pakistan (KMIAS) from June 1, 2013 to June 30, 2021.

Table 4.4: Descriptive Statistics of KMIAS for 1 June 2013 to 30 June 2021

Statistic	***Monthly Returns***	***Weekly Returns***	***Daily Returns***
Mean	-0.457	-0.118	-0.025
Median	-0.575	-0.134	-0.028
St. dev	6.877	2.868	1.163
Kurtosis	4.887	7.291	6.705
Skewness	0.393	0.512	0.470
Min	-19.298	-12.594	-5.222
Max	24.000	15.522	6.871

Table 4.4 displays descriptive data for All Shares Islamic Index returns from June 1, 2013, to June 30, 2021. The average daily returns are -0.025 percent with an average standard deviation of 1.163 percent, while the average weekly returns are -0.118 percent with an average standard deviation of 2.868 percent, and the average monthly returns are -0.457 percent with an average standard deviation of 6.877 percent, according to the table. Standard deviation for daily, weekly and monthly returns are greater which show high dispersion in the maximum and minimum values of stock prices reflects high volatility in the stock returns. The descriptive statistics demonstrate that the all sample's returns are positively skewed reveals increase in returns; it clearly specifies that large positive returns (maximum extreme value) are prominent than large negative returns (minimum extreme value). If the kurtosis is greater than 3 shows all returns are leptokurtic and linked with ‘peaked’ and fat tail but If the kurtosis is less than 3 shows all returns are platykurtic and linked with ‘less peaked’ and thinner tail. All return series of this study have kurtosis values more than 3, indicating that all returns are leptokurtic, implying that the data is higher peaked than the normal distribution. The value of kurtosis is large which shows non-normality of the series.

4.2 Normality Test

4.2.1 Jarque-Bera Test (JB)

The Findings of the JB test for KMIAS are shown in Table 4.5

Table 4.5: Result of JB Test for KMIAS

	Monthly Returns	***Weekly Returns***	***Daily Returns***
JB (Observed value)	10.453*	216.579*	773.914*
JB (Critical value)	5.991	5.991	5.991
p-value	0.000[a]	0.000[a]	0.000[a]

Note [a]: *Indicates that null hypothesis of normality assumption is rejected at 1% significance level*

JB test observed values for KMIAS in daily, weekly , and monthly data for period of 8 years are higher than the critical values in the Table reflects deviation from normal behavior of return series. The normality assumption was rejected by the results of all return series (daily, monthly, and weekly).

The Findings of the JB test for KSE 30 are shown in Table 4.6

Table 4.6: Result of JB Test for KSE 30

	Monthly Returns	***Weekly Returns***	***Daily Returns***
JB (Observed value)	68.5767*	298.508*	1512.79*
JB (Critical value)	5.991	5.991	5.991
p-value	0.000[a]	0.000[a]	0.000[a]

Note [a]: *Indicates that null hypothesis of normality assumption is rejected at 1% significance level*

JB test observed values for KSE 30 in daily, weekly, and monthly data for period of 8 years are higher than the critical values in the Table reflects deviation from normal behavior of return series. The normality assumption was rejected by the results of all return series (daily, monthly, and weekly).

Findings of the JB test for KMI30 are shown in Table 4.7

Table 4.7: Result of JB Test for KMI30

	Monthly Returns	***Weekly Returns***	***Daily Returns***
JB (Observed value)	35.614*	281.017*	1334.790*
JB (Critical value)	5.991	5.991	5.991
p-value	0.000[a]	0.000[a]	0.000[a]

Note [a]: *Indicates that null hypothesis of normality assumption is rejected at 1% significance level*

JB test observed values for KMI 30 in daily, weekly, and monthly data for period of 8 years are higher than the critical values in the Table reflects deviation from normal behavior of return series. The normality assumption was rejected by the results of all return series (daily, monthly, and weekly).

The Findings of the JB test for KSE 100 are shown in Table 4.8

Table 4.8: Result of JB Test for KSE 100

	Monthly Returns	***Weekly Returns***	***Daily Returns***
JB (Observed value)	41.7704*	392.960*	1721.040*
JB (Critical value)	5.991	5.991	5.991
p-value	0.000[a]	0.000[a]	0.000[a]

Note [a]: *Indicates that null hypothesis of normality assumption is rejected at 1% significance level*

JB test observed values for KSE 100 in daily, weekly, and monthly data for period of 8 years are higher than the critical values in the Table reflects deviation from normal behavior of return series. The normality assumption was rejected by the results of all return series (daily, monthly, and weekly).

4.2.2 Kolmogorov-Smirov test

Kolmogorov-Smirnov (KS) test is used to underlying the chance of distribution from an assumed distribution.

Findings of the KS test for KMIAS are shown in Table 4.9

Table 4.9: One-sample KS test for KMIAS

		Daily Returns	***Weekly Returns***	***Monthly Returns***
N		1271	267	60
Normal Parameters [a,b]	Mean	-.025	-.118	-.457
	Std.	1.163	2.868	6.877
	Absolute	.068	.076	.069
Most extreme differences	Positive	.068	.076	.069
	Negative	-.047	-.046	-.049
Kolmogorov-Smirnov Z		2.439	1.236	.531
Asymp. Sig. (2-tailed)		.000*	.094	.940

a. Test distribution is Normal.
b. Calculated from data.
**indicates 1% significance level*

P-value for monthly and weekly return series is 0.940 and 0.094, respectively, which is greater than critical value, according to the KS test results. The results show that weekly and monthly data is not normally distributed, but it is normally distributed at a 90% level of confidence. The p-value for daily returns is 0.000, indicating that the data is not normal for 8 years. All results reflect deviation from assumption of random walk.

The Findings of the KS test for the KSE 30 are shown in Table 4.10

Table 4.10: One-sample KS test for KSE 30

		Daily Returns	*Weekly Returns*	*Monthly Returns*
N		1997	421	96
Normal Parameters [a,b]	Mean	-.005	-.021	-.163
	Std.	1.196	2.841	6.665
	Absolute	.061	.059	.076
Most extreme differences	Positive	.061	.059	.071
	Negative	-.051	-.050	-.076
Kolmogorov-Smirnov Z		2.717	1.214	.742
Asymp. Sig. (2-tailed)		.000*	.105	.640

a. Test distribution is Normal.
b. Calculated from data.
**indicates 1% significance level*

P-value for monthly and weekly return series is 0.640 and 0.105, respectively, which is greater than the critical value, according to the KS test results. The results show that weekly and monthly data is not normally distributed, but it is normally distributed at a 90% level of confidence. The p-value for daily returns is 0.000, indicating that the data is not normal for 8 years. All results reflect deviation from assumption of random walk.

The Findings of the KS test for the KMI 30 are shown in Table 4.11

Table 4.11: One-sample KS test for KMI 30

		Daily Returns	*Weekly Returns*	*Monthly Returns*
N		1997	421	96
Normal Parameters [a,b]	Mean	-.034	-.169	-.766
	Std.	1.260	2.919	6.706
	Absolute	.067	067	.078
Most extreme differences	Positive	.067	067	.069
	Negative	-.055	-.044	-.078
Kolmogorov-Smirnov Z		3.010	1.367	.768
Asymp. Sig. (2-tailed)		.000*	.048	.597

a. Test distribution is Normal.
b. Calculated from data.
**indicates 1% significance level*

P-value for monthly and weekly return series is 0.597 and 0.048 respectively, which is greater than critical value, according to the KS test results. The results show that weekly and monthly data is not normally distributed, but it is normally distributed at a 90% level of confidence. The p-value for daily returns is 0.000, indicating that the data is not normal for 8 years. All results reflect deviation from assumption of random walk.

The Findings of the KS test for the KSE 100 are shown in Table 4.12

Table 4.12: One-sample KS test for KSE100

		Daily Returns	*Weekly Returns*	*Monthly Returns*
N		1997	421	96
Normal Parameters [a,b]	Mean	-.038	-.179	-.846
	Std.	1.075	2.587	6.126
	Absolute	.067	.066	.074
Most extreme differences	Positive	.067	.066	.074
	Negative	-.046	-.031	-.059
Kolmogorov-Smirnov Z		3.012	1.347	.720
Asymp. Sig. (2-tailed)		.000*	.053	.677

a. Test distribution is Normal.
b. Calculated from data.
**indicates 1% significance level*

P-value for monthly and weekly return series is 0.677 and 0.053, respectively, which is greater than critical value, according to the KS test results. The results show that weekly and monthly data is not normally distributed, but it is normally distributed at a 90% level of confidence. The p-value for daily returns is 0.000, indicating that the data is not normal for 8 years. All results reflect deviation from assumption of random walk.

4.3 Autocorrelation function and Q-Ljung Box test (ACF)

ACF is calculated for up to 12 lags, and the test results are shown in tables.

Findings of ACF for KMIAS are given in Table 4.13

Table 4.13: ACF and Q-Ljung Box returns for KMIAS

Lags	1	2	3	4	5	6	7	8	9	10	11	12
Daily Returns												
AC	0.126	0.024	0.061	-0.003	0.089	0.005	0.005	-0.016	-0.022	0.049	-0.030	0.022
Q-Stat	20.360	21.098	25.881	25.895	36.008	36.044	36.078	36.397	36.995	40.123	41.305	41.931
Prob	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Weekly Returns												
AC	0.086	0.011	0.032	0.070	-0.067	0.035	0.040	0.013	-0.021	-0.028	-0.067	-0.008
Q-Stat	1.984	2.018	2.302	3.624	4.846	5.175	5.609	5.655	5.772	5.987	7.265	7.281
Prob	0.159	0.364	0.512	0.459	0.435	0.522	0.586	0.686	0.762	0.816	0.777	0.838
Monthly Returns						9		O0p				
AC	0.053	-0.028	-0.084	-0.131	-0.139	-0.039	0.142	0.133	-0.023	0.079	-0.097	-0.002
Q-Stat	0.176	0.228	0.689	1.834	3.144	3.248	4.670	5.932	5.969	6.432	7.149	7.149
Prob	0.674	0.892	0.876	0.766	0.678	0.777	0.700	0.655	0.743	0.778	0.787	0.848

* *indicates 1% significance level*

The Findings of the ACF and the Q- Ljung Box test for KMIAS show that there is autocorrelation in daily returns, indicating that KMIAS daily returns do not follow random walk for the period of 8 years, while there is no autocorrelation of any lag for weekly and monthly returns. Similar result found in the study of Ahmad et al (2016). The investors adopt mean reversion strategy of buying the stocks which had lower returns in the past in the expectations of higher returns today and selling the stocks having higher returns previously in expectations of lower returns in future.

Findings of ACF for KSE 30 are given in the Table 4.14

Table 4.14: ACF and Q-Ljung Box returns for KSE 30

Lags	1	2	3	4	5	6	7	8	9	10	11	12
Daily Returns												
AC	0.137	0.015	0.033	-0.001	0.065	0.009	0.019	-0.011	-0.044	0.037	-0.042	0.001
Q-Stat	37.469	37.948	40.106	40.108	48.665	48.816	49.509	49.745	53.684	56.399	59.916	59.917
Prob	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Weekly Returns												
AC	0.089	-0.022	-0.026	0.039	-0.068	0.002	-0.007	0.028	0.001	-0.027	-0.080	-0.016
Q-Stat	3.348	3.556	3.834	4.492	6.445	6.446	6.469	6.811	6.811	7.137	9.907	10.02
Prob	0.067	0.169	0.280	0.343	0.265	0.375	0.486	0.557	0.657	0.712	0.539	0.614
Monthly Returns												
AC	-0.088	-0.012	-0.035	-0.142	-0.145	0.091	0.028	0.017	0.076	0.008	-0.099	0.069
Q-Stat	0.761	0.775	0.897	2.963	5.151	6.016	6.098	6.129	6.748	6.755	7.833	8.362
Prob	0.383	0.678	0.826	0.564	0.398	0.421	0.528	0.633	0.663	0.748	0.728	0.756

** indicates 1% significance level*

The Findings of the ACF and the Q-Ljung Box test for KSE 30 demonstrate that there is autocorrelation in daily returns, indicating that KSE 30 daily returns do not follow random walk for the period of 8 years, but there is no autocorrelation of any lag for weekly and monthly returns. Similar result found in the study of Ahmad et al (2016). The investors adopt mean reversion strategy of buying the stocks which had lower returns in the past in the expectations of higher returns today and selling the stocks having higher returns previously in expectations of lower returns in future.

Findings of ACF for KMI 30 are given in the Table 4.15

Table 4.15: ACF and Q-Ljung Box returns for KMI 30

Lags	1	2	3	4	5	6	7	8	9	10	11	12
Daily Returns												
AC	0.117	-0.010	0.019	0.002	0.062	-0.002	0.003	-0.009	-0.036	0.038	-0.038	0.005
Q-Stat	27.165	27.376	28.077	28.084	35.852	35.863	35.881	36.035	38.679	41.635	44.473	44.517
Prob	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Weekly Returns												
AC	0.075	-0.034	-0.009	0.060	-0.067	-0.008	-0.003	0.031	0.019	-0.019	-0.095	-0.005
Q-Stat	2.369	2.850	2.888	4.434	6.370	6.398	6.401	6.810	6.966	7.126	11.074	11.085
Prob	0.124	0.240	0.409	0.350	0.272	0.380	0.494	0.557	0.641	0.713	0.437	0.522
Monthly Returns												
AC	-0.051	-0.027	-0.023	-0.118	-0.139	0.045	0.081	0.057	0.040	0.025	-0.042	0.018
Q-Stat	0.256	0.327	0.380	1.801	3.808	4.019	4.715	5.063	5.239	5.305	5.497	5.532
Prob	0.612	0.849	0.944	0.772	0.577	0.674	0.695	0.751	0.813	0.870	0.905	0.938

** indicates 1% significance level*

The Findings of the ACF and the Q- Ljung Box test for KMI 30 demonstrate that there is autocorrelation in daily returns, indicating that KMI 30 daily returns do not follow random walk for the period of 8 years, but there is no autocorrelation of any lag for weekly and monthly returns. Similar result found in the study of Ahmad et al (2016). The investors adopt mean reversion strategy of buying the stocks which had lower returns in the past in the expectations of higher returns today and selling the stocks having higher returns previously in expectations of lower returns in future.

Findings of ACF for KSE 100 are given in Table 4.16

Table 4.16: ACF and Q-Ljung Box returns for KSE 100

Lags	1	2	3	4	5	6	7	8	9	10	11	12
Daily Returns												
AC	0.145	0.030	0.042	0.003	0.066	0.011	0.015	-0.009	-0.035	0.043	-0.043	0.005
Q-Stat	42.028	43.859	47.361	47.376	56.213	56.474	56.945	57.093	59.594	63.298	67.096	67.147
Prob	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Weekly Returns												
AC	0.113	-0.020	-0.010	0.053	-0.047	0.015	-0.001	0.042	0.014	-0.026	-0.078	-0.005
Q-Stat	5.433	5.597	5.642	6.861	7.789	7.891	7.892	8.645	8.730	9.022	11.668	11.679
Prob	0.020	0.061	0.130	0.143	0.168	0.246	0.342	0.373	0.463	0.530	0.389	0.472
Monthly Returns												
AC	-0.017	0.017	-0.046	-0.151	-0.132	0.096	0.029	0.074	0.062	0.013	-0.077	0.033
Q-Stat	0.029	0.058	0.274	2.608	4.402	5.360	5.450	6.038	6.452	6.470	7.125	7.245
Prob	0.863	0.971	0.965	0.625	0.493	0.499	0.605	0.643	0.694	0.774	0.789	0.841

** indicates 1% significance level*

The Findings of the ACF and the Q-Ljung Box test for the KSE 100 demonstrate that there is autocorrelation in daily returns, indicating that daily returns of the KSE 100 do not follow random walk for the period of 8 years, while there is no autocorrelation of any lag for weekly and monthly returns. Similar result found in the study of Ahmad et al (2016). The investors adopt mean reversion strategy of buying the stocks which had lower returns in the past in the expectations of higher returns today and selling the stocks having higher returns previously in expectations of lower returns in future.

4.4 Non-parametric Run test

The run test determines whether future variations in return series have an expected trend or are independent of one another.

Table 4.17 contains results of the Runs test for KMIAS.

Table 4.17: Runs Test for KMIAS

	Daily Return	***Weekly Return***	***Monthly Return***
Test Value [a]	-.028	-.134	-.575
Cases < Test Value	635	133	30
Cases >= Test Value	636	134	30
Total Cases	1271	267	60
Number of Runs	537	126	28
Z	-5.584	-1.042	-.781
Asymp. Sig. (2-tailed)	.000**	.297	.435

Note:[a]. Mean
Z- Statistics is ≥1.96 then we cannot be accepted null hypothesis at 5% significance level
*** indicates 5% significance level*

Runs test shows that weekly and monthly returns are insignificant, their p-values are greater than their critical values (0.297>0.05) and (0.435>0.05), respectively, indicating no AC in weekly and monthly returns. P-value for daily returns is smaller than its critical value 0.05, rejecting the null hypothesis of randomness and indicating that daily returns have autocorrelation for 8 years. The values of Z daily returns are bigger than their critical value of -1.96 with significant p-values signifying too many runs in the sample shows that there are negative serial correlations or autocorrelation. It can be concluded from the results of runs test that prices do not move independently and randomly and the Pakistani market does not follow random walk. Some investor can make higher profit by taking advantage of over-reaction. Results are consistent with Ahmad et al (2016), Abraham et al (2002), Abeysekera (2001), Mustafa (2007), Mishra (2011) and Hauque et al (2011). It is concluded the some investors can make excess profits in the said market by taking advantage of over-reaction to moving and unanticipated information.

Table 4.18 contains the results of the Runs test for KSE 30.

Table 4.18: Runs Test for KSE 30

	Daily Return	*Weekly Return*	*Monthly Return*
Test Value [a]	.010	-.095	-.685
Cases < Test Value	998	210	48
Cases >= Test Value	999	211	48
Total Cases	1997	421	96
Number of Runs	839	196	48
Z	-7.185	-1.513	-.205
Asymp. Sig. (2-tailed)	.000**	.130	.837

Note:[a]. Mean
Z- Statistics is ≥1.96 then we cannot be accepted null hypothesis at 5% significance level
*** indicates 5% significance level*

Runs test shows that weekly and monthly returns are insignificant, their p-values are greater than their critical values (0.130>0.05) and (0.837>0.05), respectively, indicating no AC in weekly and monthly returns. P-value for daily returns is smaller than its critical 0.05, rejecting the null hypothesis of randomness and indicating that daily returns have autocorrelation for 8 years. The values of Z daily returns are bigger than their critical value of -1.96 with significant p-values signifying too many runs in the sample shows that there are negative serial correlations or autocorrelation. It can be concluded from the results of runs test that prices do not move independently and randomly and the Pakistani market does not follow random walk. Some investor can make higher profit by taking advantage of over-reaction. Results are consistent with Ahmad et al (2016), Abraham et al (2002), Abeysekera (2001), Mustafa (2007), Mishra (2011) and Hauque et al (2011). It is concluded the some investors can make excess profits in the said market by taking advantage of over-reaction to moving and unanticipated information.

Table 4.19 contains the results of the Runs test for KMI 30.

Table 4.19: Runs Test for KMI 30

	Daily Returns	*Weekly Returns*	*Monthly Returns*
Test Value [a]	-.010	421	-1.330
Cases < Test Value	998	-.169	48
Cases >= Test Value	999	2.919	48
Total Cases	1997	.067	96
Number of Runs	887	.067	46
Z	-5.036	-.044	-.616
Asymp. Sig. (2-tailed)	.000**	1.367	.538

Note:[a]. Mean
Z- Statistics is ≥1.96 then we cannot be accepted null hypothesis at 5% significance level
*** indicates 5% significance level*

Runs test shows that weekly and monthly returns are insignificant, their p-values are greater than their critical values (1.367>0.05) and (0.538>0.05), respectively, indicating no AC in weekly and monthly returns. P-value for daily returns is smaller than its critical value 0.05, rejecting the null hypothesis of randomness and indicating that daily returns have autocorrelation for 8 years. The values of Z daily returns are bigger than their critical value of -1.96 with significant p-values signifying too many runs in the sample shows that there are negative serial correlations or autocorrelation. It can be concluded from the results of runs test that prices do not move independently and randomly and the Pakistani market does not follow random walk. Some investor can make higher profit by taking advantage of over-reaction. Results are consistent with Ahmad et al (2016), Abraham et al (2002), Abeysekera (2001), Mustafa (2007), Mishra (2011) and Hauque et al (2011). It is concluded the some investors can make excess profits in the said market by taking advantage of over-reaction to moving and unanticipated information.

Table 4.20 contains the results of the Runs test for KSE 100.

Table 4.20: Runs test for KSE 100

	Daily Returns	*Weekly Returns*	*Monthly Returns*
Test Value [a]	-.049	-.247	-1.505
Cases < Test Value	998	210	48
Cases >= Test Value	999	211	48
Total Cases	1997	421	96
Number of Runs	831	188	48
Z	-7.543	-2.293	-.205
Asymp. Sig. (2-tailed)	.000**	.022	.837

Note:[a]. Mean
Z- Statistics is ≥1.96 then we cannot be accepted null hypothesis at 5% significance level
*** indicates 5% significance level*

Runs test shows that monthly returns are insignificant, their p-values are greater than their critical values (0.837>0.05), indicating that no AC in weekly and monthly returns. P-value for daily returns is smaller than its critical value 0.05, rejecting the null hypothesis of randomness and indicating that daily and weekly returns have autocorrelation for 8 years. The values of Z daily and weekly returns are bigger than their critical value of -1.96 with significant p-values signifying too many runs in the sample shows that there are negative serial correlations or autocorrelation. It can be concluded from the results of runs test that prices do not move independently and randomly and the Pakistani market does not follow random walk. Some investor can make higher profit by taking advantage of over-reaction. Results are consistent with Ahmad et al (2016), Abraham et al (2002), Abeysekera (2001), Mustafa (2007), Mishra (2011) and Hauque et al (2011). It is concluded the some investors can make excess profits in the said market by taking advantage of over-reaction to moving and unanticipated information.

4.5 Unit Root Test

Determine whether or not Pakistani stock market indices are stationary at level and 1st difference, two unit root tests (ADF and PP) are used.

4.5.1 Augmented Dickey-fuller (ADF) test

Distribution theory which supports the ADF test hypothesis that data is distributed independently and specifically.

Results of ADF test for KMIAS are listed below in Table 4.21

Table 4.21: ADF test for KMIAS

ADF test Statistic	***Daily Returns***	***Weekly Returns***	***Monthly Returns***
Level	-30.261	-14.915	-7.177
Ist difference	-31.926*	-16.474*	-8.358*
Critical value at 5%	-2.863	-2.872	-2.911
Critical value at 1%	-3.435	-3.454	-3.546

*Indicates 1% significance level

The returns of ADF test statistics at level are higher than critical values, according to the results; the returns are stationary so follows an asymptotic distribution. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values. It can be concluded that the free floating nature of the KMIAS may be partly responsible for the affinity of randomness of returns.

Results of ADF test for KSE 30 are listed below in Table 4.22

Table 4.22: ADF test for KSE 30

ADF test Statistic	*Daily Returns*	*Weekly Returns*	*Monthly Returns*
Level	-37.757	-18.704	-10.679
Ist difference	-40.519*	-20.784*	-11.847*
Critical value at 5%	-2.862	-2.868	-2.892
Critical value at 1%	-3.433	-3.445	-3.500

*Indicates 1% significance level

The returns of ADF test statistics at level are higher than critical values, according to the results; the returns are stationary so follows an asymptotic distribution. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values. It can be concluded that the free floating nature of the KSE 30 may be partly responsible for the affinity of randomness of returns.

Results of ADF test for KMI 30 are listed below in Table 4.23.

Table 4.23: ADF test for KMI 30

ADF test Statistic	*Daily Returns*	*Weekly Returns*	*Monthly Returns*
Level	-38.580	-18.971	-10.249
Ist difference	-41.540*	-21.234*	-11.779*
Critical value at 5%	-2.862	-2.868	-2.892
Critical value at 1%	-3.433	3.445	3.500

*Indicates 1% significance level

The returns of ADF test statistics at level are higher than critical values, according to the results; the returns are stationary so follows an asymptotic distribution. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values. It can be concluded that the free floating nature of the KMI 30 may be partly responsible for the affinity of randomness of returns.

Results of ADF test for KSE 100 are listed below in Table 4.24

Table 4.24: ADF test for KSE-100

ADF test Statistic	***Daily Returns***	***Weekly Returns***	***Monthly Returns***
Level	-37.388	-18.249	-9.936
Ist difference	-40.110*	-20.823*	-11.244*
Critical value at 5%	-2.862	-2.868	-2.892
Critical value at 1%	-3.433	-3.445	-3.500

*Indicates 1% significance level

The returns of ADF test statistics at level are higher than critical values; according to the results; the returns are stationary so follows an asymptotic distribution. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values. It can be concluded that the free floating nature of the KSE 100 may be partly responsible for the affinity of randomness of returns.

4.5.2 Phillips-Perron (PP) test:

Phillips-Perron test is an alternate test that allows for weakly dependent and heterogeneously distributed error conflicts.

The following Table 4.25 contains the results of the PP test for KMIAS.

Table 4.25: PP test for KMIAS

PP test Statistic	*Daily Returns*	*Weekly Returns*	*Monthly Returns*
Level	-30.623	-14.951	-7.165
Ist difference	-156.641*	-82.277*	-32.523*
Critical value at 5%	-2.863	-2.872	-2.911
Critical value at 1%	-3.435	-3.454	-3.546

*Indicates 1% significance level

The returns of PP test statistics at level are higher than critical values, according to the results. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values.

The following Table 4.26 contains the results of the PP test for KSE 30.

Table 4.26: PP test for KSE 30

PP test Statistic	*Daily Returns*	*Weekly Returns*	*Monthly Returns*
Level	-37.992	-18.651	-10.695
Ist difference	-175.532*	-176.989*	-43.203*
Critical value at 5%	-2.862	-2.868	-2.892
Critical value at 1%	-3.433	-3.445	-3.500

*Indicates 1% significance level

The returns of PP test statistics at level are higher than critical values, according to the results. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values.

The following Table 4.27 contains the results of the PP test for KMI 30.

Table 4.27: PP test for KMI 30

PP test Statistic	*Daily Returns*	*Weekly Returns*	*Monthly Returns*
Level	-38.614	-18.947	-10.247
Ist difference	-185.478*	-225.756*	-44.610*
Critical value at 5%	-2.862	-2.868	-2.892
Critical value at 1%	-3.433	-3.445	-3.500

*Indicates 1% significance level

The returns of PP test statistics at level are higher than critical values, according to the results. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values.

The following Table 4.28 contains the results of the PP test for KSE 100.

Table 4.28: PP test for KSE-100

PP test Statistic	*Daily Returns*	*Weekly Returns*	*Monthly Returns*
Level	-37.388	-18.217	-9.932
Ist difference	-40.110*	-183.474*	-39.360*
Critical value at 5%	-2.862	-2.868	-2.892
Critical value at 1%	-3.433	-3.445	-3.500

*Indicates 1% significance level

The returns of PP test statistics at level are higher than critical values, according to the results. The data is stationary at level but non-stationary at first difference for period of 8 years, as shown by all values.

4.6 Multi Variance Ratio Test

With assumption of heteroscedasticity and homoscedasticity, Multi Variance Ratio test is utilized.

4.6.1 MVR test (Heteroscedasticity)

Under the assumption of hetero-scedasticity, the null and alternative hypotheses for MVR tests are as follows:

H_0: VR (ui) =1

H_1: VR (ui) ≠1

MVR test (Hetero-scedasticity) results for KMIAS are listed in Table 4.29

Table 4.29: MVR test (Hetero-scedasticity) for KMIAS

	U	2	4	6	8	10	12	14	16
Daily Returns	**VR (u)**	0.574	0.291	0.195	0.150	0.113	0.097	0.086	0.079
	Z* (u)	-9.322*	-8.570*	-7.525*	-6.689*	-6.152*	-5.678*	-5.300*	-4.988*
Weekly Returns	**VR (u)**	0.544	0.259	0.181	0.140	0.119	0.098	0.089	0.079
	Z* (u)	-3.850*	-3.650*	-3.262*	-3.012*	-2.829*	-2.713*	-2.602*	-2.518*
Monthly Returns	**VR (u)**	0.556	0.327	0.208	0.138	0.126	0.120	0.118	0.092
	Z* (u)	-2.270*	-2.035*	-1.958	-1.891	-1.744	-1.634	-1.546	-1.515

**indicates 5% significance level*

Under the assumption of hetero-scedasticity, standardized VR test statistics for Z* (u) are obtained for daily, weekly, and monthly returns. These are significant for weekly and daily returns, according to the results. For monthly returns u=2 and u=4 periods, standardized VR test statistics for Z*(u) are significant. Finding proved that under hetero-scedasticity, there is no random walk for all periods (u). Findings of MVR test are matched with Fraz and Hassan (2016), and Hassan et al. (2007).

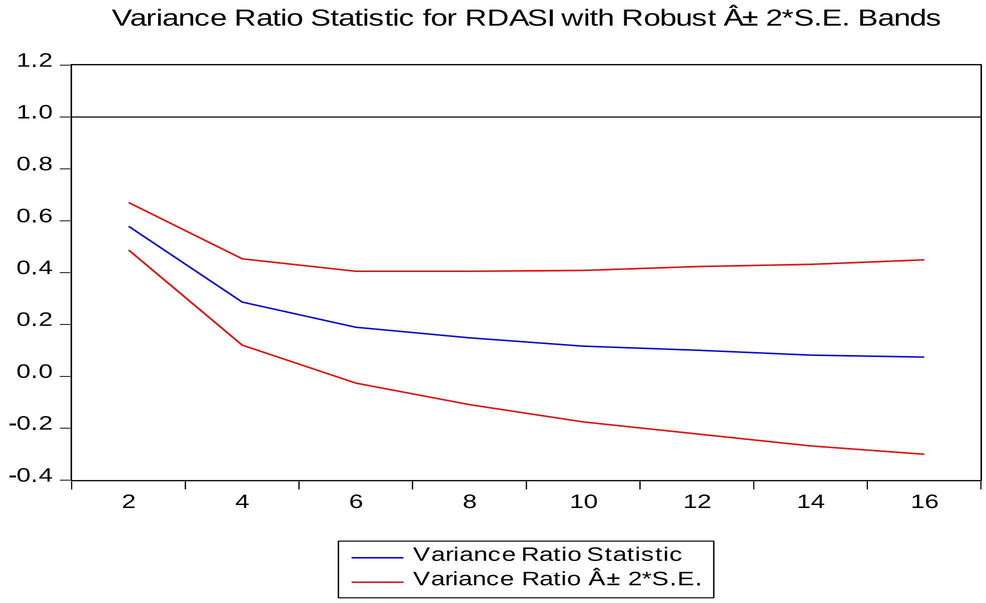


Fig 4.1 **Daily Returns for KMIAS (Hetro)**

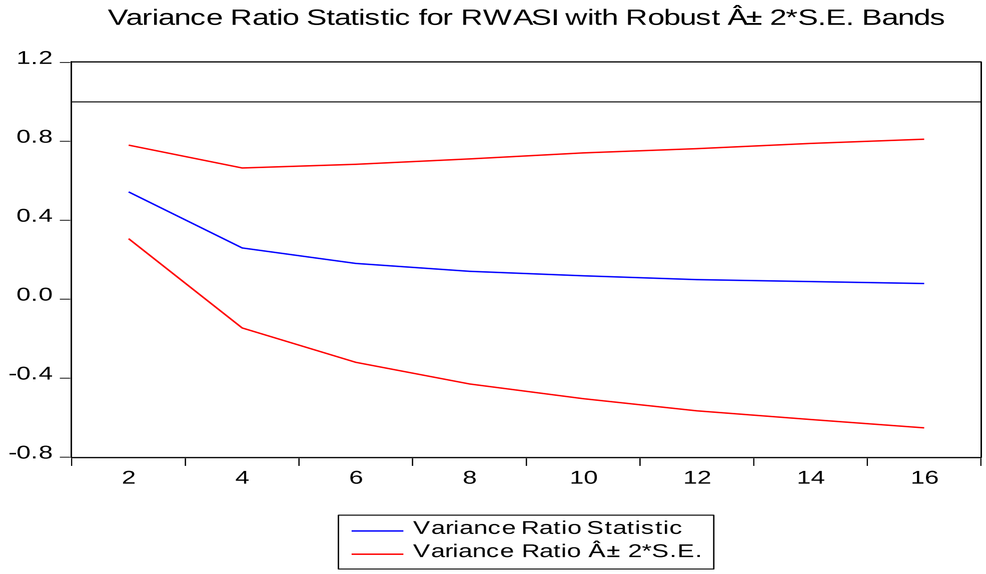


Fig 4.2 **Weekly Returns for KMIAS (Hetro)**

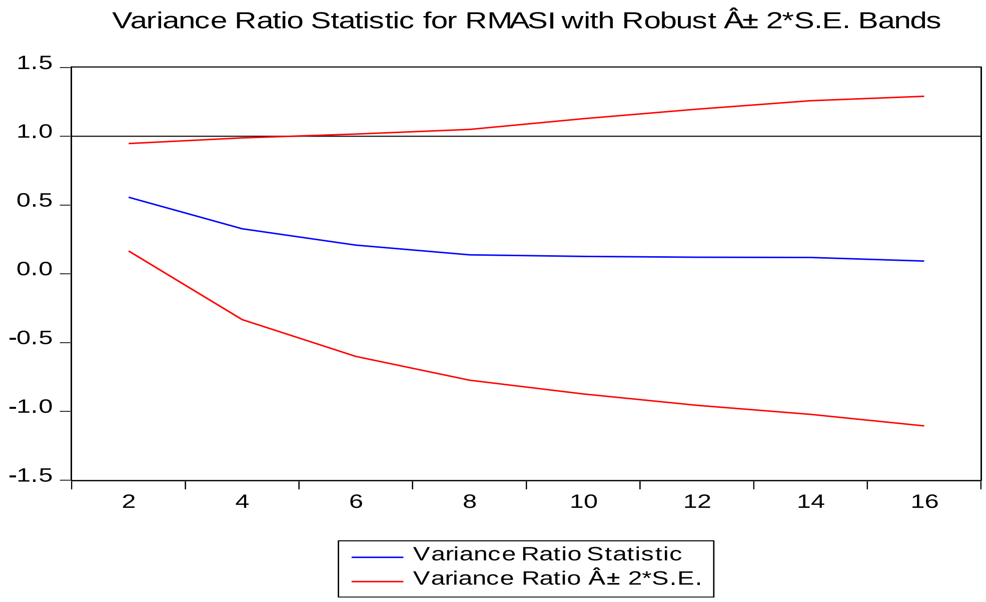


Fig 4.3 **Monthly Returns for KMIAS (Hetro)**

VR statistics for daily, weekly and monthly returns are mentioned in all graphs, with a horizontal reference line at 1 representing null hypothesis under assumption of hetero-scedasticity and + or - two asymptotic standard error bands. The RWH with hetero-scedasticity is rejected by the null reference line inside the bands.

MVR test (Hetero-scedasticity) results for KSE 30 are listed in Table 4.30

Table 4.30: MVR test (Hetero-scedasticity) for KSE 30

	U	2	4	6	8	10	12	14	16
Daily Returns	**VR (u)**	0.583	0.290	0.195	0.149	0.114	0.099	0.088	0.077
	Z* (u)	-11.469*	-10.543*	-9.171*	-8.138*	-7.455*	-6.865*	-6.412*	-6.055*
Weekly Returns	**VR (u)**	0.561	0.264	0.184	0.135	0.115	0.095	0.083	0.075
	Z* (u)	-4.968*	-4.906*	-4.437*	-4.141*	-3.867*	-3.687*	-3.530*	-3.388*
Monthly Returns	**VR (u)**	0.470	0.276	0.151	0.129	0.109	0.088	0.096	0.075
	Z* (u)	-3.047*	-2.544*	-2.488*	-2.284*	-2.145*	-2.052*	-1.925	-1.878

**indicates 5% significance level*

Under the assumption of hetero-scedasticity, standardized VR test statistics for Z* (u) are obtained for daily, weekly, and monthly returns. These are significant for weekly and daily returns, according to the results. For monthly returns u=2, u=4, u=6, u=8, u=10 and u=12 periods, standardized VR test statistics for Z*(u) are significant. Finding proved that under hetero-scedasticity, there is no random walk for all periods (u).

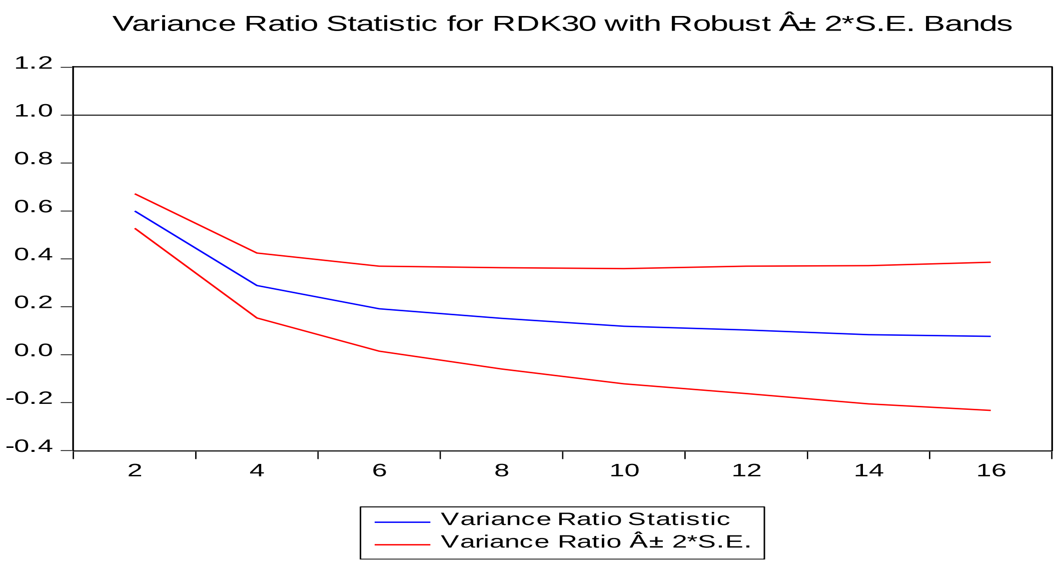


Fig 4.4 **Daily Returns for KSE 30 (Hetro)**

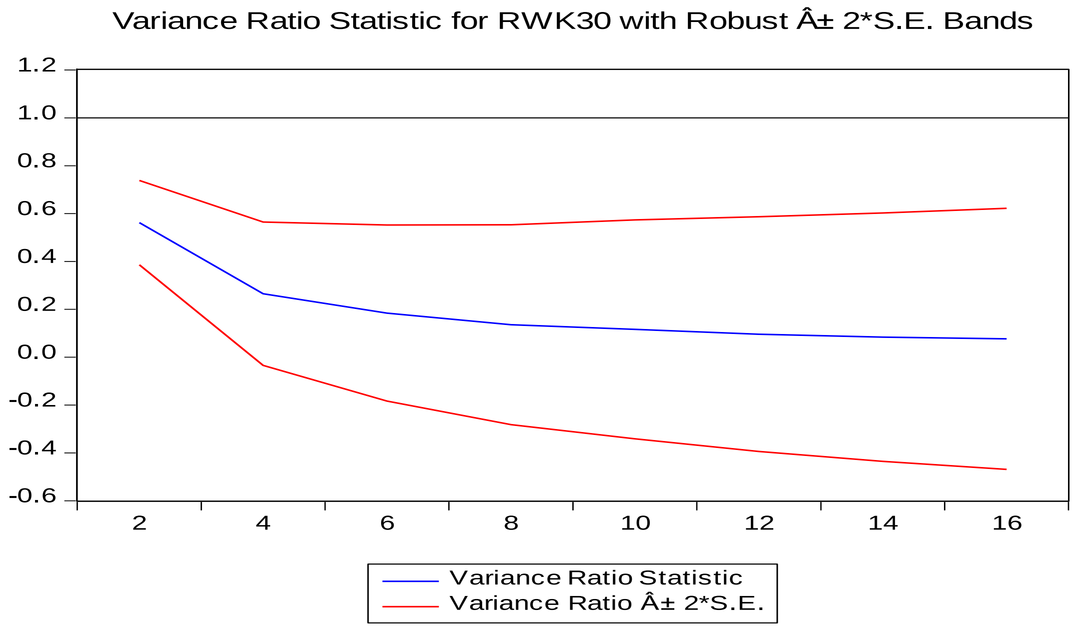


Fig 4.5 **Weekly Returns for KSE 30 (Hetro)**

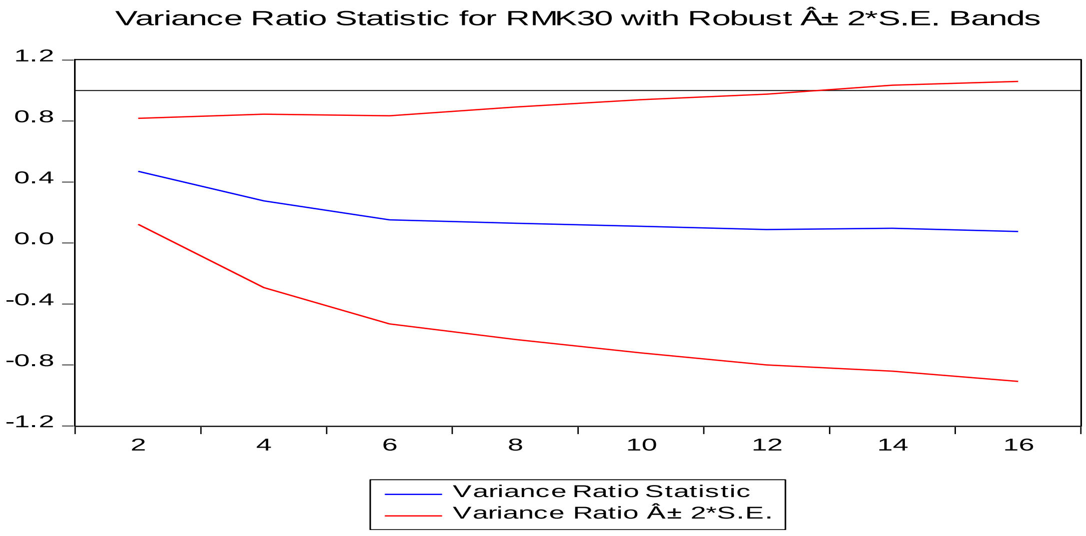


Fig 4.6 **Monthly Returns for KSE 30 (Hetro)**

VR statistics for daily, weekly and monthly returns are mentioned in all graphs, with a horizontal reference line at 1 representing null hypothesis under assumption of hetero-scedasticity and + or - two asymptotic standard error bands. The RWH with hetero-scedasticity is rejected by the null reference line inside the bands.

MVR test (Hetero-scedasticity) results for KMI 30 are listed in Table 4.31

Table 4.31: MVR test (Hetero-scedasticity) for KMI 30

	U	2	4	6	8	10	12	14	16
Daily Returns	**VR (u)**	0.586	0.283	0.193	0.145	0.112	0.097	0.085	0.075
	Z* (u)	-10.956*	-10.426*	-9.078*	-8.116*	-7.445*	-6.866*	-6.415*	-6.054*
Weekly Return	**VR (u)**	0.560	0.255	0.184	0.133	0.113	0.093	0.085	0.073
	Z* (u)	-4.805*	-4.788*	-4.254*	-3.971*	-3.713*	-3.545*	-3.382*	-3.262*
Monthly Returns	**VR (u)**	0.491	0.278	0.164	0.127	0.110	0.096	0.096	0.077
	Z* (u)	-3.050*	-2.596*	-2.483*	-2.319*	-2.166*	-2.054*	-1.941	-1.886

**indicates 5% significance level*

Under the assumption of hetero-scedasticity, standardized VR test statistics for Z* (u) are obtained for daily, weekly, and monthly returns. These are significant for weekly and daily returns, according to the results. For monthly returns u=2, u=4, u=6, u=8, u=10 and u=12 periods, standardized VR test statistics for Z*(u) are significant. Finding proved that under hetero-scedasticity, there no is random walk for all periods (u). Findings of MVR test are matched with Fraz and Hassan (2016), and Hassan et al. (2007).

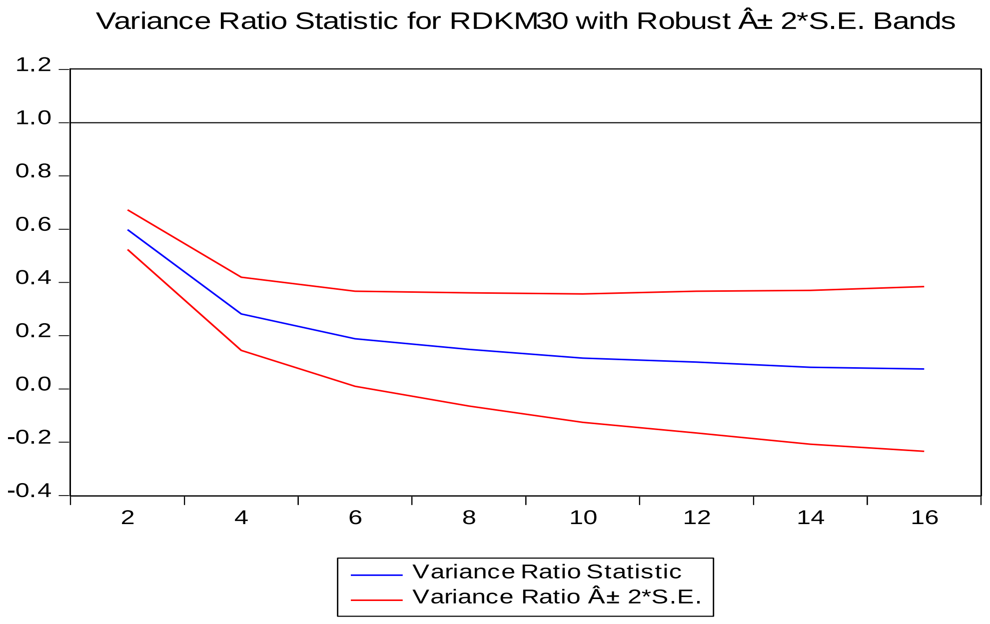


Fig 4.7 **Daily Returns for KMI 30 (Hetro)**

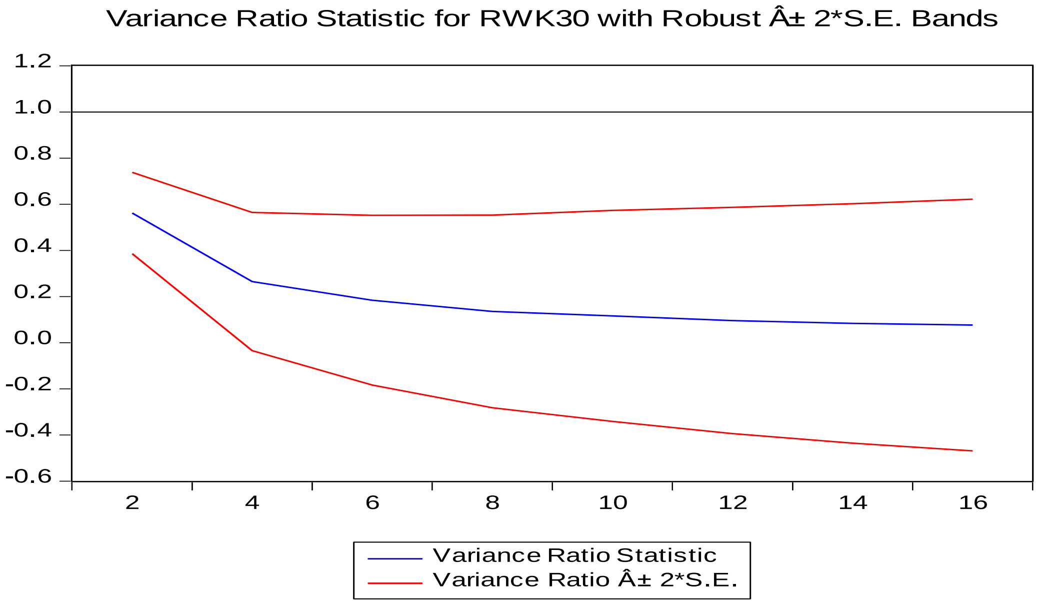


Fig 4.8 **Weekly Returns for KMI 30 (Hetro)**

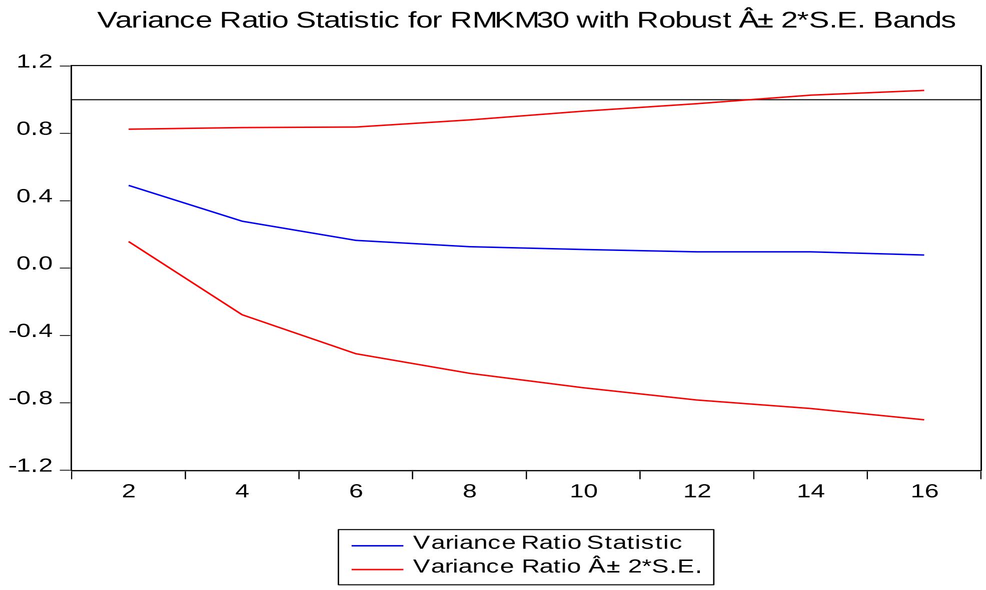


Fig 4.9 **Monthly Returns for KMI 30 (Hetro)**

VR statistics for daily, weekly and monthly returns are mentioned in all graphs, with a horizontal reference line at 1 representing null hypothesis under assumption of hetero-scedasticity and + or - two asymptotic standard error bands. The RWH with hetero-scedasticity is rejected by the null reference line inside the bands.

MVR test (Hetero-scedasticity) results for KSE 100 are listed in Table 4.32

Table 4.32: MVR test (Hetero-scedasticity) for KSE 100

	U	2	4	6	8	10	12	14	16
Daily Returns	**VR (u)**	0.580	0.292	0.196	0.150	0.115	0.100	0.089	0.078
	Z* (u)	-11.341*	-10.512*	-9.234*	-8.226*	-7.559*	-6.969*	-6.512*	-6.159*
Weekly Returns	**VR (u)**	0.575	0.267	0.186	0.137	0.118	0.097	0.085	0.078
	Z* (u)	-4.842*	-4.825*	-4.342*	-4.053*	-3.784*	-3.621*	-3.471*	-3.333*
Monthly Returns	**VR (u)**	0.487	0.298	0.160	0.128	0.114	0.096	0.100	0.079
	Z* (u)	-3.169*	-2.610*	-2.565*	-2.357*	-2.183*	-2.072*	-1.948	-1.895

**indicates 5% significance level*

Under the assumption of hetero-scedasticitc, standardized VR test statistics for Z* (u) are obtained for daily, weekly, and monthly returns. These are significant for daily and weekly returns, according to the results. For monthly returns u=2, u=4, u=6, u=8, u=10 and u=12 periods, standardized VR test statistics for Z*(u) are significant. Finding proved that under hetero-scedasticity, there is no random walk for all periods (u).

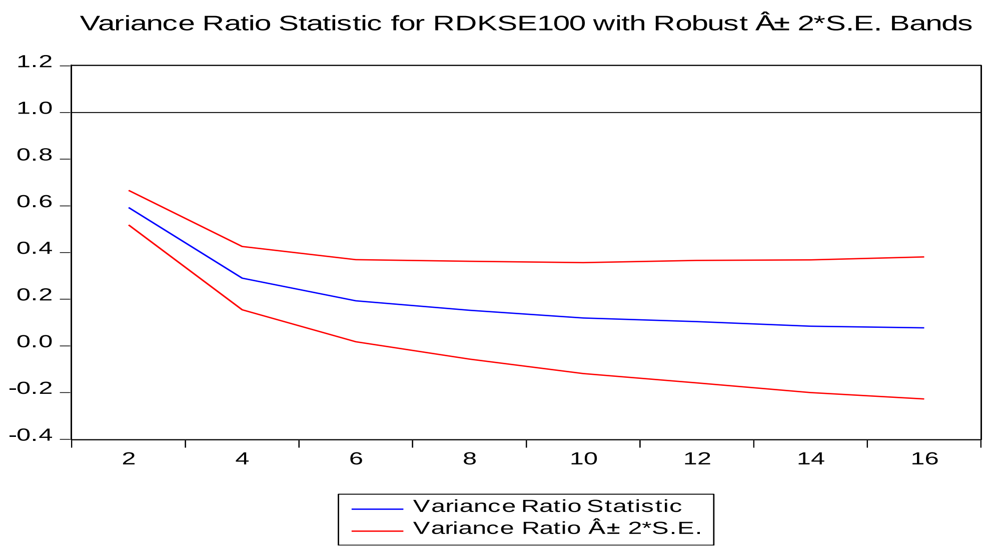


Fig 4.10 **Daily Returns for KSE 100 (Hetro)**

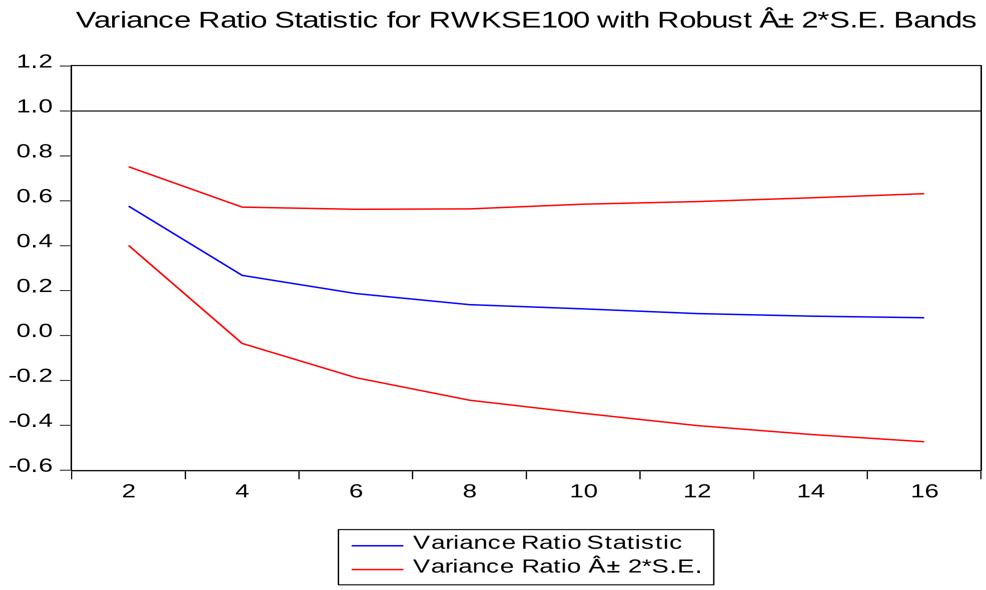


Fig 4.11 **Weekly Returns for KSE 100 (Hetro)**

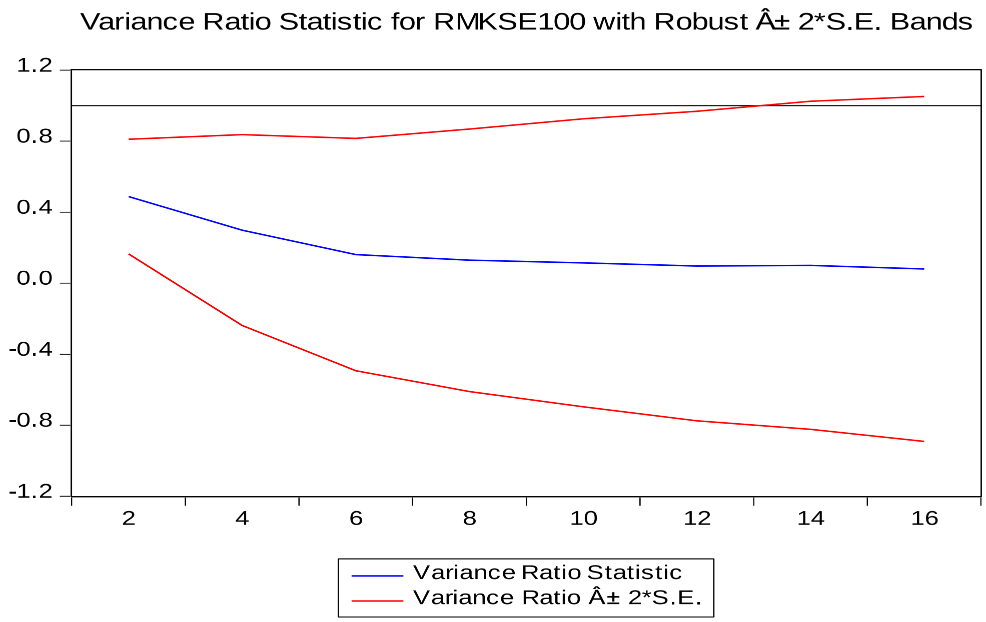


Fig 4.12 **Monthly Returns for KSE 100 (Hetro)**

VR statistics for daily, weekly and monthly returns are mentioned in all graphs, with a horizontal reference line at 1 representing null hypothesis under assumption of hetero-scedasticity and + or - two asymptotic standard error bands. The RWH with hetero-scedasticity is rejected by the null reference line inside the bands.

4.6.2 MVR test (Homoscedasticity)

The strong MVR test is used with assumption of homoscedasticity for further examining of mean reversion against random walk in All Pakistani indices. In that assumption, the null and alternative hypotheses are built.

MVR tests (homoscedasticity) results for KMIAS are listed in Table 4.33

Table 4.33: MVR test (Homoscedasticity) for KMIAS

	U	2	4	6	8	10	12	14	16
Daily Returns	**VR (u)**	0.578	0.286	0.189	0.148	0.116	0.100	0.081	0.074
	Z (u)	-15.01*	-13.590*	-11.682*	-10.257*	-9.321*	-8.548*	-8.002*	-7.492*
Weekly Returns	**VR (u)**	0.544	0.259	0.181	0.140	0.119	0.098	0.089	0.079
	Z (u)	-7.437*	-6.454*	-5.399*	-4.737*	-4.254*	-3.920*	-3.631*	-3.410*
Monthly Returns	**VR (u)**	0.556	0.327	0.208	0.138	0.126	0.120	0.118	0.092
	Z (u)	-3.404*	-2.762*	-2.460*	-2.237*	-1.986	-1.802	-1.656	-1.584

**indicates 5% significance level*

Under the assumption of homoscedasticity, standardized VR test statistics for Z (u) are obtained for daily, weekly, and monthly returns. These are significant for daily and weekly returns, according to results. For monthly returns u=2, u=4, u=6 and u=8 periods, Standardized VR test results for Z (u) are significant. This finding proved that under homoscedasticity, there is no random walk for all periods (u). Findings of MVR test are matched with Fraz and Hassan (2016), and Hassan et al. (2007).

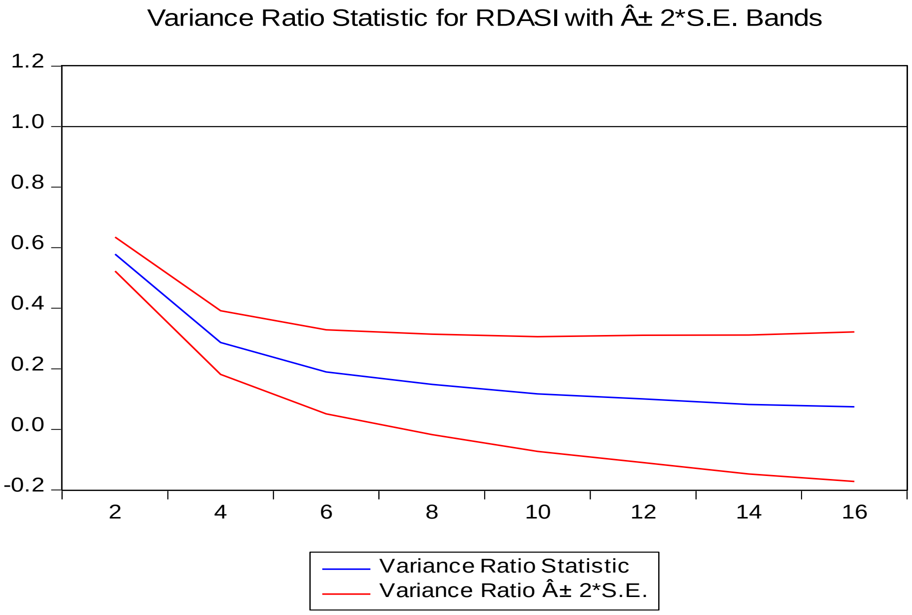


Fig 4.13 **Daily Returns for KMIAS (Homo)**

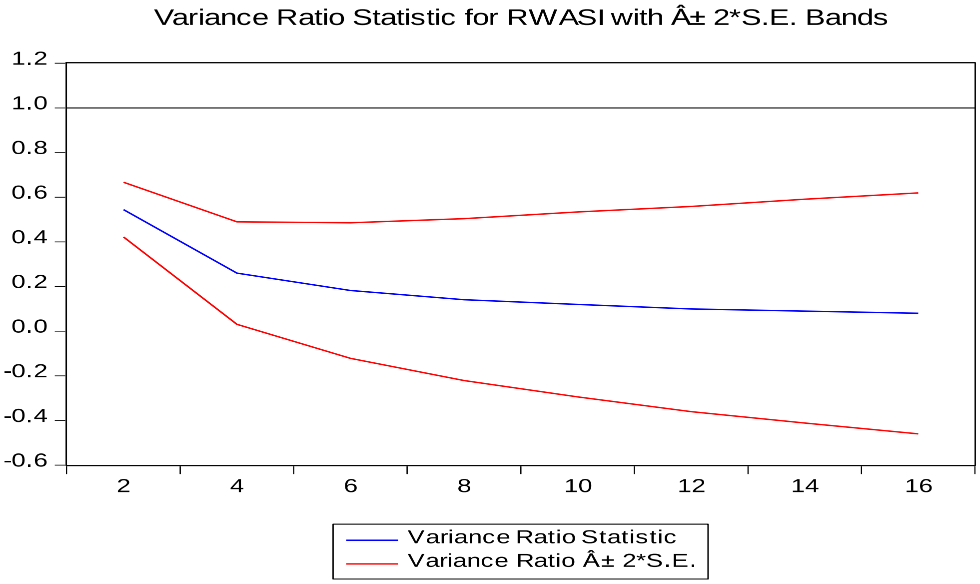


Fig 4.14 **Weekly Returns for KMIAS (Homo)**

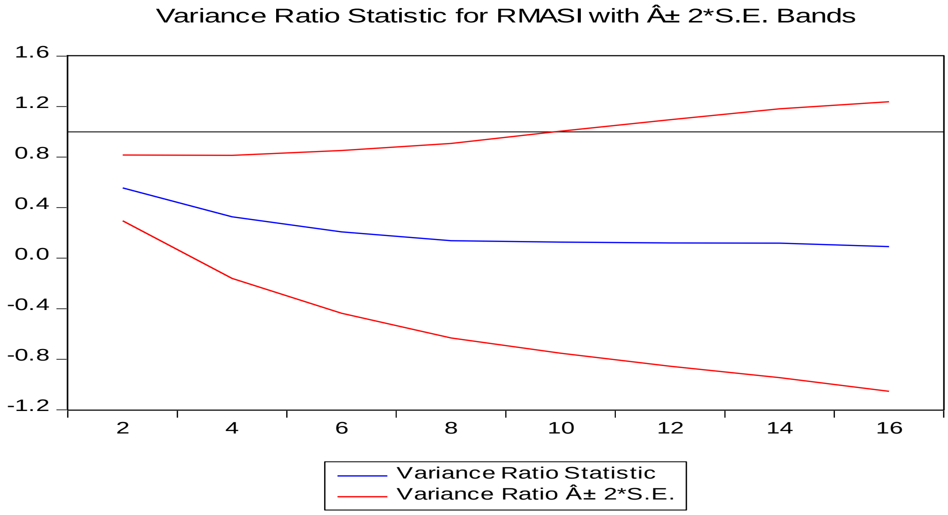


Fig 4.15 **Monthly Returns for KMIAS (Homo)**

VR statistics for daily, weekly, and monthly returns are mentioned in all graphs. The RWH with homoscedasticity is rejected by the null reference line inside the bands.

MVR tests (homoscedasticity) results for KSE 30 is given in the table 4.34

Table 4.34: MVR test (Homoscedasticity) for KSE 30

	U	2	4	6	8	10	12	14	16
Daily Returns	**VR (u)**	0.599	0.288	0.191	0.152	0.118	0.103	0.083	0.076
	Z (u)	-17.894*	-16.991*	-14.603*	-12.806*	-11.663*	-10.682*	-10.014*	-9.373*
Weekly Returns	**VR (u)**	0.561	0.264	0.184	0.135	0.115	0.095	0.083	0.075
	Z (u)	-8.979*	-8.055*	-6.764*	-5.989*	-5.367*	-4.941*	-4.594*	-4.302*
Monthly Returns	**VR (u)**	0.470	0.276	0.151	0.129	0.109	0.088	0.096	0.075
	Z (u)	-5.162*	-3.769*	-3.345*	-2.868*	-2.571*	-2.369*	-2.153*	-2.046*

**indicates 5% significance level*

Under the assumption of homoscedasticity, standardized VR test statistics for Z (u) are obtained for daily, weekly, and monthly returns. These are significant for daily, weekly, and monthly returns, according to findings. This finding proves that under homoscedasticity, there is no random walk for all periods (u). Findings of MVR test are matched with Fraz and Hassan (2016), and Hassan et al. (2007).

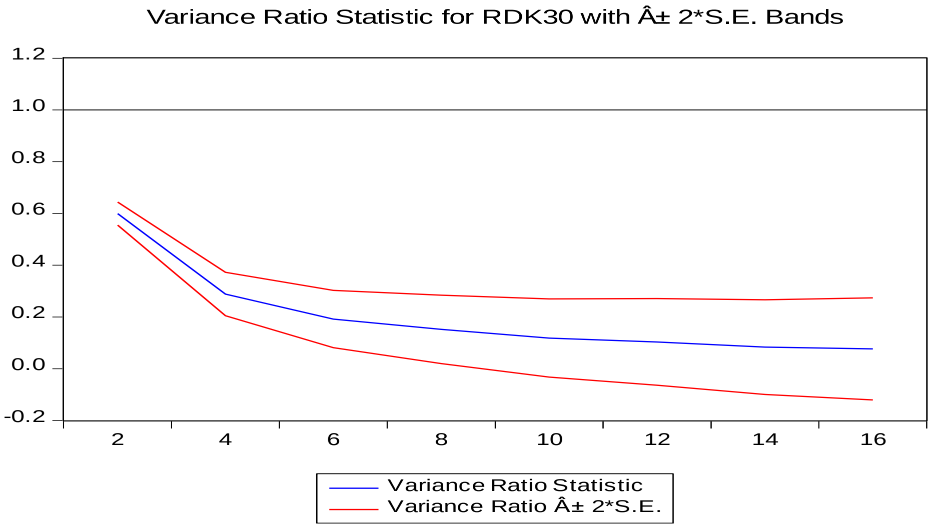


Fig 4.16 **Daily Returns for KSE 30 (Homo)**

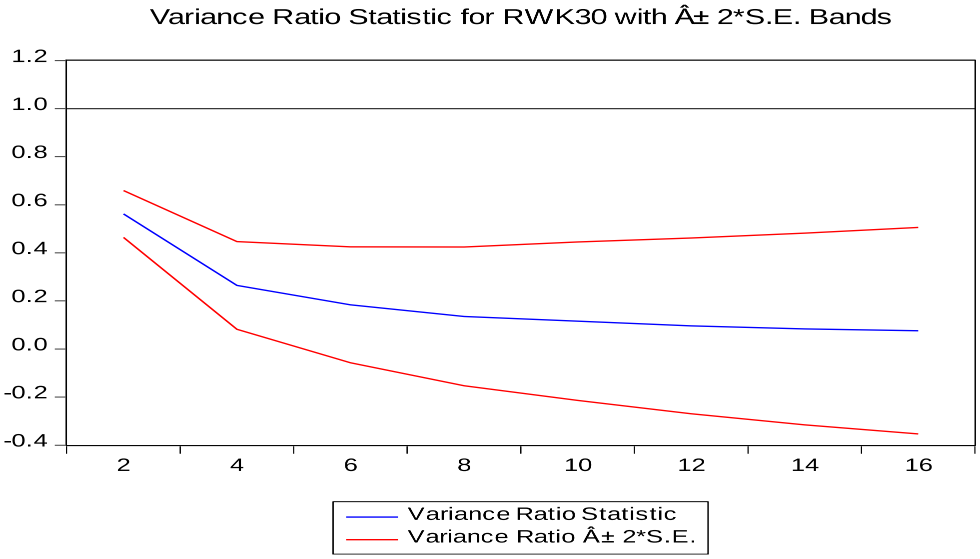


Fig 4.17 **Weekly Returns for KSE 30 (Homo)**

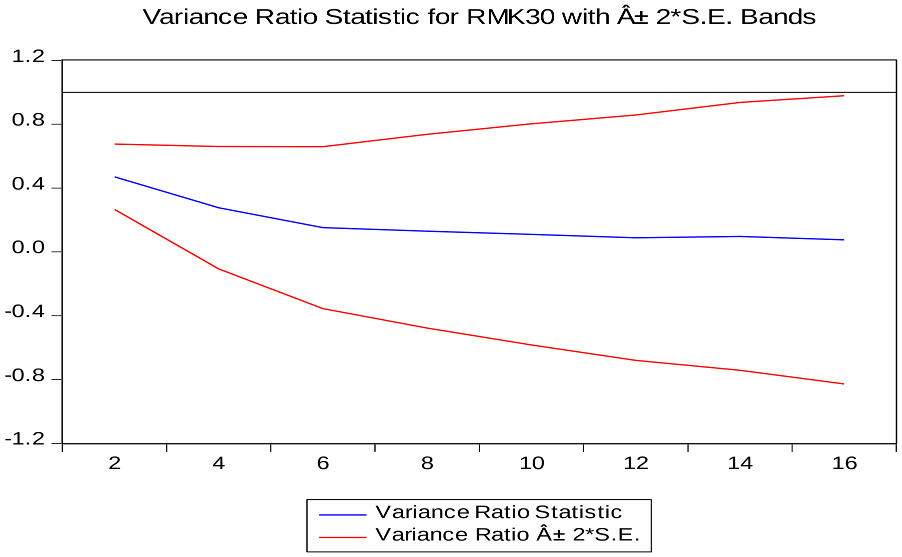


Fig 4.18 **Monthly Returns for KSE 30 (Homo)**

VR statistics for daily, weekly, and monthly returns are mentioned in all graphs. The RWH with homoscedasticity is rejected by the null reference line inside the bands.

MVR tests (homoscedasticity) results for KMI are given in the Table 4.35

Table 4.35: MVR test (Homoscedasticity) for KMI 30

	U	2	4	6	8	10	12	14	16
Daily Returns	**VR (u)**	0.598	0.281	0.188	0.148	0.115	0.100	0.081	0.074
	Z (u)	-17.957*	-17.150*	-14.662*	-12.864*	-11.699*	-10.716*	-10.038*	-9.390*
Weekly Returns	**VR (u)**	0.560	0.255	0.184	0.133	0.113	0.093	0.085	0.073
	Z (u)	-9.015*	-8.154*	-6.763*	-6.001*	-5.380*	-4.953*	-4.584*	-4.313*
Monthly Returns	**VR (u)**	0.491	0.278	0.164	0.127	0.110	0.096	0.096	0.077
	Z (u)	-4.959*	-3.759*	-3.294*	-2.876*	-2.568*	-2.349*	-2.153*	-2.042*

**indicates 5% significance level*

Under the assumption of homoscedasticity, standardized VR test statistics for Z (u) are obtained for daily, weekly, and monthly returns. These are significant for daily, weekly, and monthly returns, according to findings. This finding proves that under homoscedasticity, there is no random walk for all periods (u). Findings of MVR test are matched with Fraz and Hassan (2016), and Hassan et al. (2007).

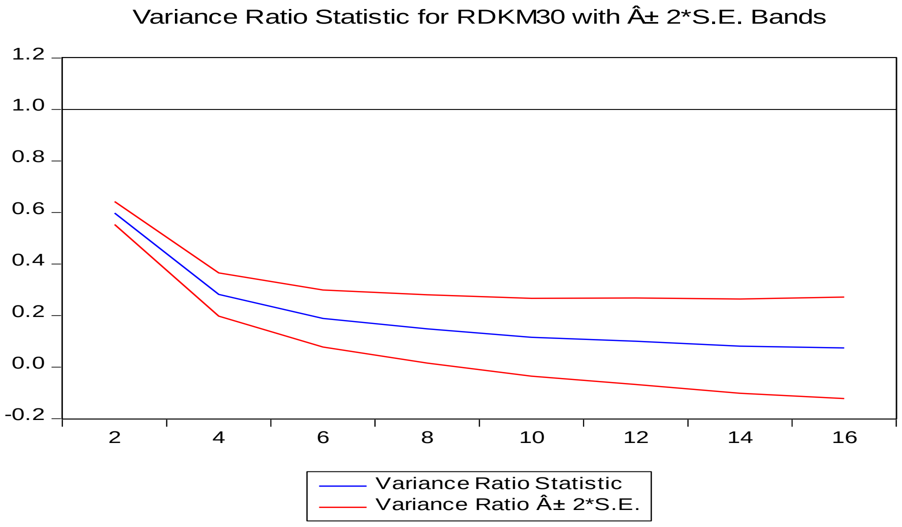


Fig 4.19 **Daily Returns for KMI 30 (Homo)**

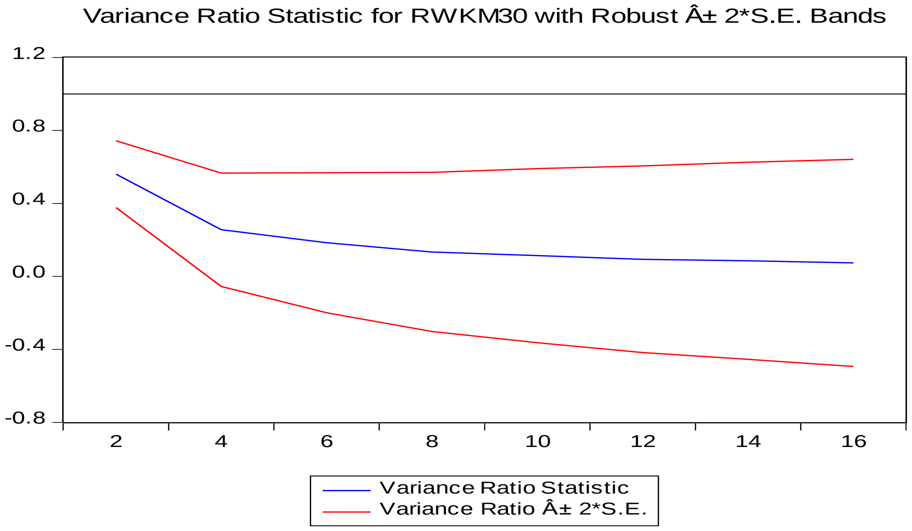


Fig 4.20 **Weekly Returns for KMI 30 (Homo)**

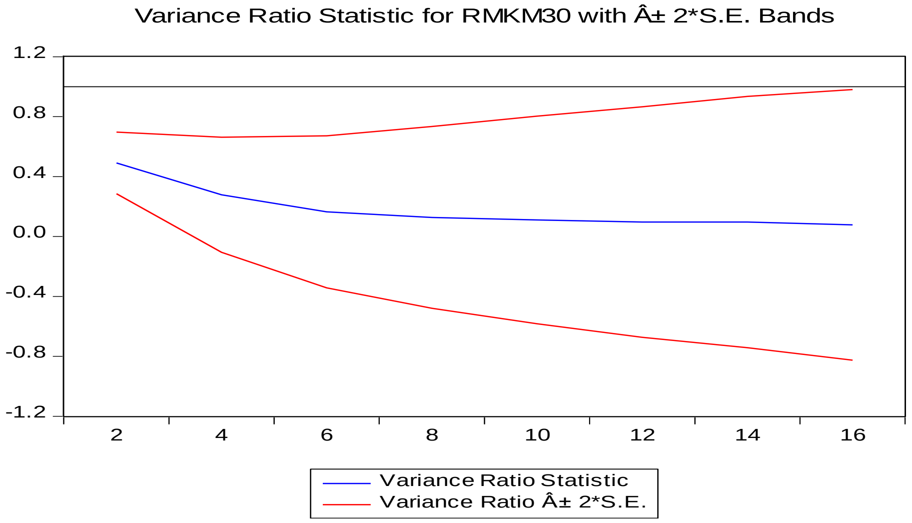


Fig 4.21 **Monthly Returns for KMI 30 (Homo)**

VR statistics for daily, weekly, and monthly returns are mentioned in all graphs. The RWH with homoscedasticity is rejected by the null reference line inside the bands.

MVR tests (homoscedasticity) results for KSE 100 is given in the Table 4.36

Table 4.36: MVR test (Homoscedasticity) for KSE 100

	U	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
Daily Returns	**VR (u)**	0.592	0.290	0.193	0.152	0.119	0.104	0.084	0.077
	Z (u)	-18.210*	-16.943*	-14.574*	-12.797*	-11.653*	-10.675*	-10.005*	-9.368*
Weekly Returns	**VR (u)**	0.575	0.2678	0.186	0.137	0.118	0.097	0.085	0.078
	Z (u)	-8.691*	-8.020*	-6.742*	-5.976*	-5.348*	-4.933*	-4.584*	-4.288*
Monthly Returns	**VR (u)**	0.487	0.298	0.160	0.128	0.114	0.096	0.100	0.079
	Z (u)	-4.991*	-3.654*	-3.308*	-2.871*	-2.556*	-2.348*	-2.145*	-2.038*

**indicates 5% significance level*

Under the assumption of homoscedasticity, standardized VR test statistics for Z (u) are obtained for daily, weekly, and monthly returns. These are significant for daily, weekly, and monthly returns, according to the findings. This finding proves that under homoscedasticity, there is no random walk for all periods (u). Findings of MVR test are matched with Fraz and Hassan (2016), and Hassan et al. (2007).

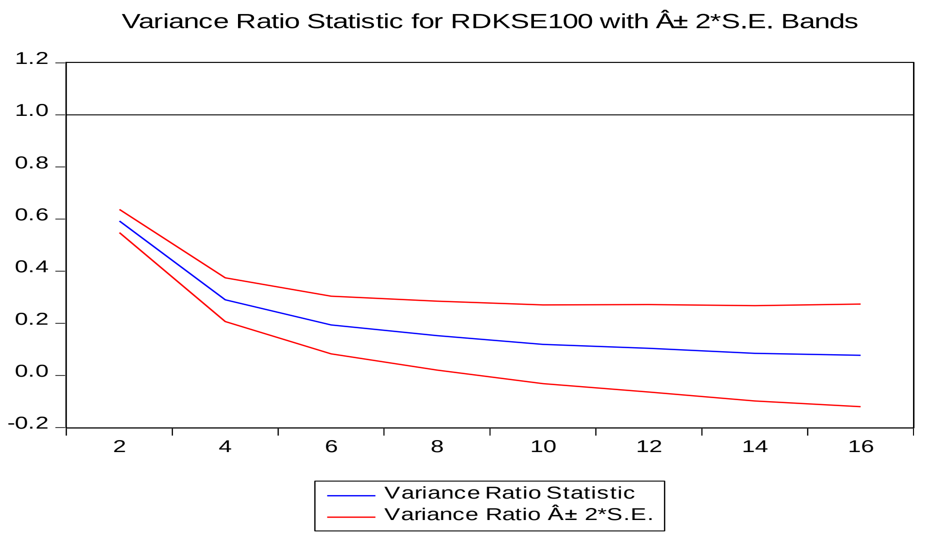
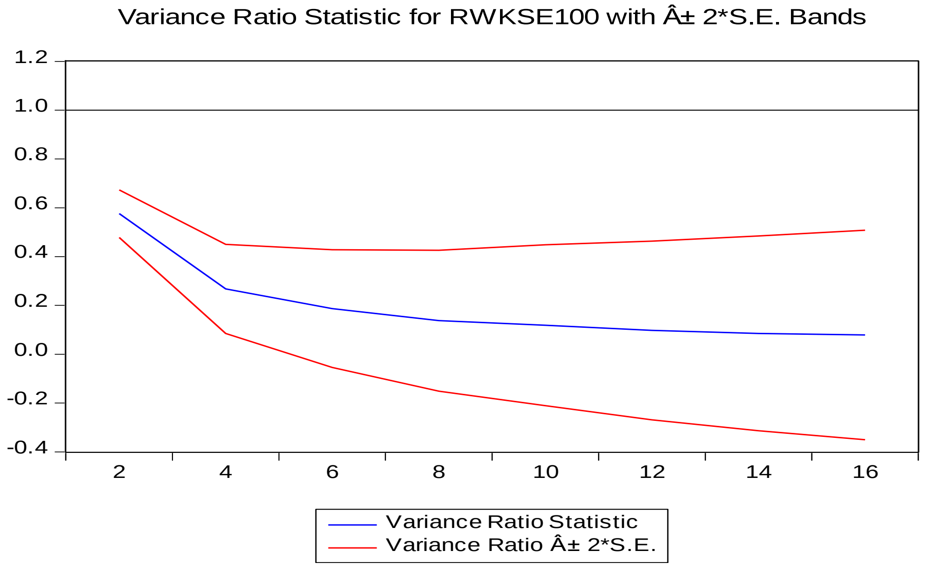


Fig 4.22 **Daily Returns for KSE 100 (Homo)**



4.23 **Weekly Returns for KSE 100 (Homo)**

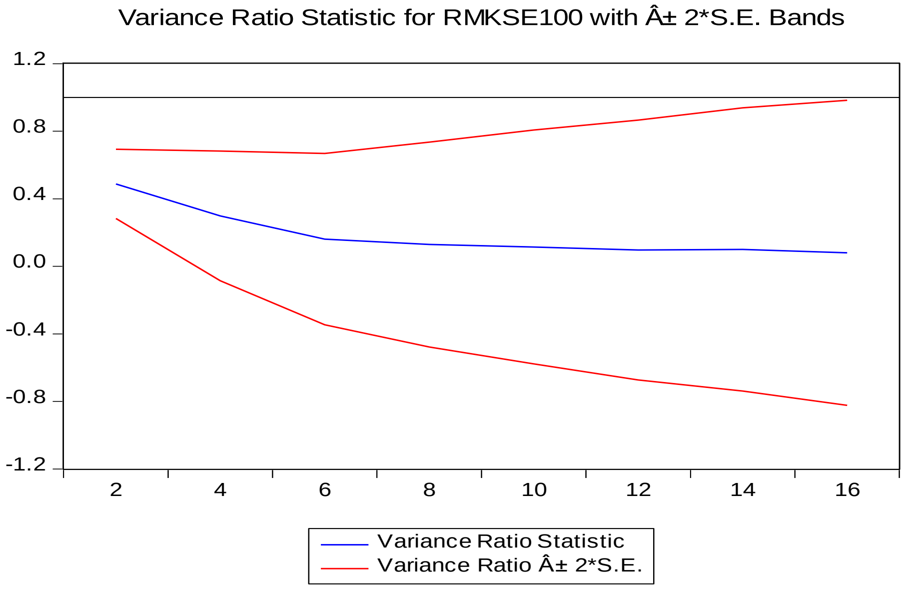


Fig 4.24 **Monthly Returns for KSE 100 (Homo)**

VR statistics for daily, weekly, and monthly returns are mentioned in all graphs. The RWH with homoscedasticity is rejected by the null reference line inside the bands.

CHAPTER 5

CONCLUSION AND FUTURE IMPLICATIONS

5.1 Conclusion

The primary goal of this study is to examine Pakistan's weak form efficiency in all indices for eight years, from 1 June 2013 to 30 June 2021 using daily, weekly and monthly data. If change in a series follows a normal distribution pattern, then the series is said to be random. Results of descriptive statistics for all indices i.e. KMIAS, KSE 30, KMI 30 and KSE 100 shows that the standard deviation for daily, weekly and monthly returns are greater which show high dispersion in the maximum and minimum values of stock prices reflects high volatility in the stock returns. The descriptive statistics demonstrate that the all sample's returns are positively skewed reveals increase in returns; it clearly specifies that large positive returns (maximum extreme value) are prominent than large negative returns (minimum extreme value). All return series of this study have kurtosis values more than 3, indicating that all returns are leptokurtic, implying that the data is higher peaked than the normal distribution. The value of kurtosis is large which shows non-normality of the series. For normality, the Jaque-Bera and Kolmogrov-Smirnov tests are utilized. JB test observed values for KMIAS, KSE 30, KMI 30 and KSE 100 in daily, weekly , and monthly data for period of 8 years are higher than the critical values. The normality assumption was rejected by the results of all return series. P-value for monthly and weekly return series for KMIAS, KSE 30, KMI 30 and KSE 100 for period of 8 years are greater than critical value, according to the KS test results show that weekly and monthly data is not normally distributed, but it is normally distributed at a 90% level of confidence. Returns appear to be expected, according to the JB and KS tests. The series is referred to as random if no autocorrelation exists. AC is obtained by the use of autocorrelation and the Run test. The Findings of the ACF and the Q- Ljung Box test for KMIAS, KSE 30, KMI 30 and KSE 100 show that there is autocorrelation in daily returns, indicating that daily returns do not follow random walk for the period of 8 years, while there is no autocorrelation of any lag for weekly and monthly returns. Similar result found in the study of Ahmad et al (2016). Runs test shows that weekly and monthly returns are insignificant, their p-values are greater than their critical values for KMIAS, KSE 30 and KMI 30 indicating no AC in weekly and monthly returns. P-value for daily returns is smaller than its critical 0.05, rejecting the null hypothesis of randomness and indicating that daily returns have autocorrelation for 8 years. Results are consistent with Ahmad et al (2016), Abraham et al (2002), Abeysekera (2001), Mustafa (2007), Mishra (2011) and Hauque et al (2011). Augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) tests are employed for unit root; results of both tests ADF and PP test statistics at level are higher than critical values showed that the monthly, weekly and daily returns are stationary at level but non-stationary at first difference for all the Pakistani indices for the period of 8 years. An essential fact for random walk is that financial time series is non-stationary. MVR ratio test is used with both assumptions of heteroscesdicity as well as homoscesdicity. Finding proved that under hetero-scedasticity and homoscedasticity, random walk null hypothesis is rejected for all periods. Results of MVR testing reveal that the series of all Pakistani indices do not follow a random walk. Findings of MVR test are consistent with Fraz and Hassan (2016), and Hassan et al. (2007).

By using all approaches and from all the results and findings of this study reveal that in Pakistani indices daily returns are showing significant results and they are efficient as compared to weekly and monthly returns and weekly and monthly returns of Pakistani indices do not follow random walk pattern and further conclusions have been drawn that Pakistani stock market is inefficient in its weak form, so all stakeholders have a chance to earn profit from Pakistani market's expected behavior. Investors can use technical analysis to forecast future prices and plan a good short-term investment strategy. When making decisions about new stock, managers can profit from market timing. Rejection to normality means, the series are not symmetric and the probability of extreme values is much higher than that of normal series (that is 0.3%). This is very useful information for market players who assume conventional normality and may face loss in predictions. Rejection of normality from all test means that markets is not efficient. Fama, (1970) reject the idea that equity price changes are not expected based on previously past pricing information. The investors can adopt mean reversion strategy of buying the stocks which had lower returns in the past in the expectations of higher returns today and selling the stocks having higher returns previously in expectations of lower returns in future. It is concluded the some investors can make excess profits in the said market by taking advantage of over-reaction to moving and unanticipated information. It can be concluded that the free floating nature of all the Pakistani indices may be partly responsible for the affinity of randomness of returns. Based on the acceptance of the random walk hypothesis any market participant who feels that all available information is yet not reflected in the market prices and he has better insight, it should be kept in mind that his insights are of no true significance till these are actually accepted by the market. If his insights are more valuable, then his choices should outperform the randomly selected securities. The issue of testing market efficiency is important to security analysts, investors for investment decision, and stock market regulators for governing financial market regarding flow of information in the market. The availability of all "free of cost" information to the investors and the usage of more sophisticated system for the floatation of information will make it difficult for the investors to beat the market with past prices information and make abnormal returns.

5.2 Policy Recommendations

Market efficiency is essential because it serves as a medium for money distribution from savers to investors via the price mechanism. Because of its sensitivity to political uncertainty, expectations, and stock forecast, as well as insider knowledge, the stock market in Pakistan has a specific relevance. Since there is a link between stock markets and economic development, efficiency of Pakistani stock market is essential for an economy to achieve its development goals. Regulatory entities must play a dynamic role in enhancing stock exchange efficiency in order to achieve this goal. Policy makers need to work hard to overcome weak form of efficiency. This study aims to provide guidelines to be more efficient in the market especially for policy makers, brokers as well as financial analysts. The efficiency of market is much needed to be developed in the current time of crisis; this study aims to fill the gap to increase the investment potential of stock market. Market efficiency is considered as necessary for open and transparent dissipation of information. Inefficiency may result due to numerous reasons including the functioning of planning brokerages, the absence of sophisticated intercommunication and technology for scattering information, the absence of regulation implication, the existence of monopolistic patterns and insider roles. By adopting stringent policies that may help in eliminating the causes of inefficiency, emerging economies can move toward efficiency.

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