"Testing Market Efficiency:
Empirical Evidence from Developed Markets of Asia Pacific"

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Abstract

According to efficient market hypothesis (EMH) the prices of stock should reflect all available information in the market and no investor is able to earn excess return on the basis of some secretly held private, public or historical information. Efficient market hypothesis (EMH) can be further divided into three sub hypotheses depending upon the information set involved and these are weak form efficient market hypothesis, semi strong form efficient market hypothesis and strong form efficient market hypothesis. This study has examined the weak form of efficiency on the seven major stock exchanges that are present in Asia-Pacific including Nikke N225 (Japan), Shanghai Composite (China), Kospi Composite (Korea), Hang Seng Index HIS (Hong Kong), All Ordinaries ASX (Australia), KSE-100 (Pakistan) and BSE SENEX (India). Historical index values were gathered on a monthly, weekly and daily basis for a period of 14 Years (July 1997 to June 2011). We have applied two statistical tests including runs test, and variance ratio test. It is found in the process that three out of seven developed stock markets of Asia Pacific doesn't follow Random-walk and hence Nikke N225, Kospi Composite, Hang Seng Index HIS and All Ordinaries ASX stock exchanges are the weak form of efficient markets.

KEYWORDS: EMH, KSE-100, BSE-SENSEX, Nikke N225, Kospi Composite, Hang Seng Index HIS, All Ordinaries ASX, Random-walk, Weak form of efficient market, Asia Pacific.

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1. Introduction

Stock market is one of the famous and reliable sources of income but investment in the stock market involves an element of risk. Stock market helps enterprises to generate funds and it helps investors to invest and earn dividends and capital gains. Mostly trader of stocks try to make money by buying shares when they are cheaper and selling them when they become expensive. This increase in price is known as capital gain. A realized capital gain occurs when the owner of stocks actually sells it for more than he paid for it. In recent decades governments and business organizations are realizing the importance of capital markets in an economic growth of a country. A capital market is a place where long-term debt and equity securities are traded. It is a platform where business enterprises and governments can raise funds against long term investment by individuals. Broadly capital markets are divided into two categories that are, the stock market and the bond market. The stock market is a place where equity securities such as stocks are traded. These stocks are floated by companies in order to generate funds and in return investors are getting income in the form of dividends and capital gain (appreciation of stock prices). The important attribute of capital market is that prices of the securities must reflect all available information and new information should rapidly adjust into the prices, so that no investor can generate excess returns by the use of such information. Hence capital market is not the only requirement; efficient capital market is the ultimate need. To allocate the resources in productive corporation there is a need for mobilization of funds from investors to well deserving productive corporations and for this market efficiency is vital. The efficient market hypothesis (EMH) suggests that stock prices fully reflect all available information in the market and no investor is able to earn excess return on the basis of some secretly held private, public or historical information. Robert (1967) was the first person who had made efficient market distinction between weak and strong form. Fama (1970) did further analysis and divided the efficient market hypothesis (EMH) into three sub hypotheses depending upon the information set involved. First; Weak form efficient market hypothesis: The "Weak" form asserts that all past market prices and data are fully reflected in prices of securities and no investor is able to earn excess return on the basis of this set of information. Likewise in a weak-form efficient market investors are not able to produce excess returns by applying technical analysis techniques. Second; Semi strong form efficient market hypothesis: The "Semi strong" form asserts that all publicly available information is fully reflected in prices of securities and no investor is able to earn excess return on the basis of this set of information. Likewise in semi-form of efficiency investors are not able to produce excess returns by the help of fundamental analysis techniques as well as by technical analysis techniques. Third; Strong form efficient market hypothesis: The "Strong" form asserts that all information including (private and public) is fully reflected in the prices of securities and no investor is able to earn excess return on the basis of this set of information. To test the efficient market hypothesis it's important to understand the three famous forms of efficient market and test each form individually and categorically. Fama (1970) argued that the categorization of the tests into weak, semi-strong, and strong form will serve the useful purpose, as it allows in identifying the level of information where the efficient market hypothesis is rejected.

In recent decades, stock market is playing significant role in the progress of any country's economy. Stock markets are now considered as one of the most important leading indicator of any economy. In developed economies stock markets are not new trust-worthy investment avenues, whereas in developing economies stock markets are getting momentum as reliable and profitable investment opportunity for investors. For the investors of stock market there is only win or lose position as for trading is concerned. Therefore the necessity of efficient stock market is imperative because in an inefficient market some investors might generate abnormal profits but on the other hand these investors are source of abnormal losses to rest of the market participants. Since market efficiency is fundamental right of investors thus in this study we have tested the market efficiency in developed stock markets of Asia Pacific. According to Wikipedia at the end of year 2010, TSE (Japan) is ranked as number 3 stock exchange in world with the market capitalization of 3827 USD billions, SSE (China) is ranked as number 6 stock exchange in world with the market capitalization of 2717 USD billions, HKSE (Hong Kong) is ranked as number 7 stock exchange in world with the market capitalization of 271 USD billions, ASX (Australia) is ranked as number 12 stock exchange in world with the market capitalization of 1454 USD billions and Kospi (Korea) is ranked as number 17 stock exchange in world with the market capitalization of 1091 USD billions. Like EU and NAFTA unions, a lot other neighboring countries have designed such international trade zones in order to promote international trade. In Same way, South Asian Association for Regional Cooperation (SAARC) is one of the emerging trade-zone in South-Asia. According to SARAC charter the basic responsibilities for SARAC members are, to accelerate economic growth, social progress and cultural development in the region and to provide all individuals the opportunity to live in dignity. According to CIA world fact book, at the end of year 2010 the cumulative GDP for the eight member countries of SARAC is about 4,959,779 million US-dollars and cumulative exports for the eight member countries of SARAC is about 297,120 million US-dollars. Out of these estimations, the 98% GDP (4,890,000 million dollar) and 99% exports (295,048 million dollar) of SARAC region belongs to four major economies of South-Asia that are Pakistan, Indian, Bangladesh and Sri Lanka. Furthermore, in these four countries the banks, stock markets and other financial institutions are far developed and well-established. Thus by such economic indications, we can conclude that Pakistan, Indian, Bangladesh and Sri Lanka are emerging economies in South-Asia. But if we have to conclude the two developed stock exchanges of South-Asia region then there is no doubt the choice would KSE-100 and BSE-SENSEX. These evidences are enough to make an argument that these stock exchanges are the developed stock exchanges Asia Pacific region.

The basic purpose of this research is to test the weak form of efficient market hypothesis for developed markets of Asia Pacific region because the results of this research paper will help local and foreign investors of respective stock exchanges in order to design their investment strategies according to nature of their market. Some empirical work for testing the weak form of efficient market hypothesis for Asian Pacific markets has also been done before this study. Some vital work had been done by Worthington & Higgs (2005), Mahmood (2006), Chung (2006), Hassan et al (2007), Xinping et al (2010) and Nisar & Hanif (2012). In this research paper attempt has been made to test the weak form efficient market hypothesis by using two different statistical tests including runs test and variance ration test. It is found in the process that three out of seven developed stock markets of Asia Pacific doesn't follow Random-walk and hence Nikke N225 (Japan), Kospi Composite (Korea), Hang Seng Index HIS (Hong Kong) and All Ordinaries ASX (Australia) stock exchanges are the weak form of efficient markets.

Rest of the study proceeds in following order. Literature review is presented in section 2, followed by Purpose and methodology in section 3, Findings and analysis is presented in section 4, while conclusion and tables are in section 5 and 6 respectively.

2. Literature Review

Since the scope of study is an empirical test of efficient market hypothesis for developed markets of Asia Pacific region, thus there is a need to divide the literature review in two parts that is first part of literature should address the origins of EMH theory and second part of literature should address empirical tests.

Bachelier (1900) was the first person who had formulated the theory of random walks for the first time. Later on Osborne (1959) did more defined work on the formulation of random walk theory. There were two basic assumptions of random walk model presented by Bachelier and Osborne. First assumption was that new information upon which the analysts are used to estimate intrinsic value would occur in an independent or an unsystematic manner over the time. Second assumption was that the evaluation of the new information would also be independent which means that the evaluation by one analyst would not influence the evaluation of another analyst. On these assumptions Bachelier and Osborne had concluded that successive market price changes should be unsystematic. Fama (1965) had defined efficient market that is a place where there are large numbers of rational investors competing actively, where each investor is trying to forecast future market values of stocks and where important current information about stocks is almost freely available to all participants of market. Thus in such market at any point in time, the actual price of a security would be a good estimate of its intrinsic value. He further argued that theory of random walk has born out from the concept of efficient markets. The random walk theory states that prices of securities follow a random walk and thus the prices of the stock market cannot be predicted. He had used the term “instantaneous adjustment" as an essential property of an efficient market that is market where changes in prices of individual securities will be independent and immediate (random walk market). Levy (1967) classified that in an efficient stock market there are a large number of participants who are actively trading the securities, where information is readily and equally available to all participants and where there is complete freedom of entry and exit. In this article he had further focused on three major approaches that are used to test the random walk model. The first approach which can be used to test the validity of the random walk model is serial correlation and also known as auto-correlation, the Second approach which is being used to test the validity of the random walk model is runs test. The third and the least frequently used approach in testing the independence of successive price changes is the simulation model. Fama (1970) gave detail description on efficient markets. Ha elucidated that in an efficient market, prices of stocks entirely reflect all available information regarding stocks. He added that may be in reality efficient market model is not 100% achievable but it would probably server as best viewed as a benchmark against which performance of market efficiency can be judged. Jensen (1978), the efficient market is where prices of securities reflect information up to the point in such a way that marginal benefits of acting on the information don’t exceed than the marginal cost of collecting it. Additionally he said that regarding information a market is said to be efficient, if someone has information set and on the basis of this information set it is impossible to gain economic profits. Economic profits can be defined as the risk adjusted returns net of all costs. The first person who had made efficient market distinction between weak and strong form was Robert (1967). Then Fama (1970), did further analysis on the three types of efficient market based on information set. First, weak form efficient market, where prices of securities fully reflect historical information of past prices and returns in such a manner that no investor can generate excess returns on the basis of this set of information. Secondly Semi-strong form efficiency where prices of securities fully reflect all public information and this public information should known to all investors in such a manner that no investor can generate excess returns on the basis of this set of information.

Finally, strong form efficient market is where prices of securities fully reflects all public & private information and this public & private information should known to all investors in such a manner that no investor can generate excess returns on the basis of this set of information. These three levels of efficient market explained by Jensen (1978) as other than public information, semi strong form of efficient market also includes the past history of prices so the weak form is just a restricted version of this semi strong form of efficient market and other than private information, strong form of efficient market also includes the past history of prices and public information so semi strong form of efficient market is just a restricted version of this strong form of efficient market.

A strong argument had given by Grossman and Siglitz (1980) that is it's not possible to achieve perfectly efficient market, as if markets are perfectly efficient then the return on some gathered information will be nil, hence investors would not find some good reasons to trade and ultimately markets will be collapsed. In contrary, they further argued that in order to understand and achieve the informational efficient market we need to understand this conjecture that the more number of investors who are informed, the more informative is the price system. The equilibrium number of informed and uninformed individuals in the economy will depend on a number of limitations such as the cost of information, quality of information, availability of information and timing of information. For example if the cost of getting the information is higher, then smaller will be the equilibrium percentage of individuals who are informed and market will be inefficient. In the same context Fama (1991) argued that the lower the transaction costs in a market, including the costs of obtaining information and trading, the more efficient the market. In the same paper Fama used and explained the terms 'tests for return predictability' instead of weak-form efficient market hypothesis, 'event studies' instead of semi-strong form of efficient market, and ‘tests of private information’ instead for strong form of efficient market. In the paper he mentioned that to test the efficient market event study is more effective as we just need to investigate the timing of information event and it’s the speed of adjustment in prices. So if the prices react and show change rapidly after the occurrence of an event it means prices absorb the new information and hence market is efficient. He further argued that the events may hold information like investment decisions, dividend changes or changes in capital structure.

Anomalies are other hurdles to make markets efficient. Branch & Chang (1985) had proposed a unique trading rule for the investors who are interested in the tax advantage. At the end of year investors tend to sell the stocks which performed not well during the year in order to get tax saving by establishing the losses on the stock that have declined. After the start of new year the pattern is to buy back theses stocks or buy attractive stocks. This scenario would produce downward pressure on stock prices in December and positive pressure in January. Due to this there is a chance to earn abnormal profits in the month of January as buying of these stocks increases. Hence all such anomalies enable the investor to earn abnormal profit which opposes the theory of efficient market hypothesis.

Lo and Mackinlay (1988), they have proposed a variance ratio tests in order to answer the question of whether the asset prices or returns are predictable or not. In this test they compare the variance of difference of time series data over different intervals. If we assume that there is a random walk in time series data then it means that variance of q period should be q times the variance of the one period difference. Variance ratio test statistics are used to test the random walk under two different assumptions of homoskedastic and hetroskedastic by using asymptotic distributional. In another article Chow and Denning (1993) proposed multiple variance ratio test. The multiple variance ratio test is similar to variance ratio test but the only difference is that variance ratio test provides individual results of each interval while multiple variance ratio test provides the joint probility. If variance ratio is equal to one then it means that stocks follow random walk and stock market would considered as an efficient market.

In past there are lots of valuable empirical studies had been conducted in order to test market efficiency, there are mixed views on efficiency of stock markets and its one of the most contentious issue in the literature of capital market. Moustafa (2004) had founded that the EMH theory is valid in UAE stock market. In contrary, Marashdeh & Shrestha (2008) had tested market efficiency of United Arab Emirates Stock Market. Augmented Dickey Fuller and Philip-Perron (unit root tests) were used. On the basis of results the concluded that United Arab Emirates Stock Market data contains unit root and follow a random walk, thus market meets the criterion of weak-form market efficiency.

Worthington & Higgs (2005) did a detail empirical study in order to test the weak form of market efficiency for different stock markets. In their research they have considered sample of five developed stock markets (Australia, Hong Kong, Japan, New Zealand and Singapore) and ten emerging stock markets of Asia (China, India, Indonesia, Korea, Malaysia, Pakistan, the Philippines, Sri Lanka, Taiwan and Thailand). Serial correlation coefficient, runs tests, unit root tests and multiple variance ratio tests were inspected. On the basis of serial correlation and runs tests, they had concluded that all of the markets are inefficient. In the same research paper results of variance ratio test indicates that none of the emerging markets are characterized by random walks and hence these markets are not weak-form efficient market, while in the developed markets only Hong Kong, New Zealand and Japan are consistent with random walk criteria. A much brief work as compare to Worthington & Higgs had been done by Rahman & Hossain (2006). However both groups had founded the consistent results regarding test for the weak form efficiency of Dhaka Stock Exchange. Gupta & Basu (2007) did study on Indian stock exchanges, and found that these markets are not weak form efficient.

Maghayereh (2003) investigates the monthly effect on stock returns and January effect anomaly for Amman Stock Exchange (ASE), Jordan. For data analysis daily returns for time period of 1994-2002 were considered by employing three statistical models that are GARCH, exponential GARCH (EGARCH) and the GJR models. The results have shown strong evidence that the seasonality does not exist in the ASE. Hence ASE is an efficient market. Maheran et al (2010) had inspected day of the week effect on the stock exchange of Malaysia. The main purpose was to investigate whether the information processed during weekends will affect at the index return of Kuala Lumpur Composite Index (KLCI) after the opening of market on Monday. Researchers had considered the daily prices of Kuala Lumpur Composite Index from January 1999 until December 2006, due some financial crisis in 1997-98 the researchers had further divided the sample into two sub periods; (1) January 1999 until December 2002, representing four year of immediate period after financial crisis; and (2) January 2003 until December 2006 representing the four years period after financial crisis. In order to test the "day-of-the week effect" they have used Ordinary Least Square (OLS). After the application of test it was concluded that there is a presence of weekend effect in Malaysian stock market, thus market is not efficient. Das & Arora (2007) had investigated, "day of the week effect" for the Stocks which are listed on the National Stock Exchange. They used ANOVA test and results confirm the existence of seasonality in the form of "day of the week effect". Thus Indian National Stock Exchange is an inefficient market. Regarding the evidence of efficient market hypothesis in Bangladesh stock exchange, Mollik & Bepari (2009) concluded that successive returns series of DSE-GEN & DSE 20 do not follow a random walk; hence Dhaka stock market is not efficient.

Borges (2010) has done detailed empirical work on European stock markets. He has examined the weak form of market efficiency on the stock markets of UK, France, Spain, Germany, Greece and Portugal. He has gathered data of closing index values from 1993 to 2007 and then he applied runs test and variance ratio test. After the appliance of these tests, he has founded that only Germany and Spain are weak form of efficient market and rest of four markets are not at all efficient stock markets. A much detailed work had been done by Nisar and Hanif (2012) they have tested weak for of market efficient hypothesis on developed markets of North America and Europe. On the basis of runs test and multiple variance ratio test they have concluded that two out of six developed stock markets of North-America and Europe doesn't follow Random-walk and hence NYSE Composite, S&P TSX Composite, DAX 30 (Germany) and IBEX 35 (Spain) are the weak form of efficient markets.

Lots of empirical studies have been done on different Chinese stock markets. Chung (2006) had examined whether the two major Chinese stock markets Shanghai and Shenzhen are weak-form efficient markets during the period of 1992-2005. He had used autocorrelation test, runs test, unit root test and multiple variance ratio test. Results of all these four statistical tests have shown that the two major Chinese stock markets are not weak-form efficient markets. Therefore some investors can generate excess return on the basis of having inside information. In contrary, Xinping et al (2010) have investigated the evidence of weak form of efficient market hypothesis on two main stock exchanges of China that are Shanghai and Shenzhen stock exchange. On the basis unit root test, the result of the study has shown that data series are non-stationary, hence Chinese stock market is weak form efficient market.

Some valuable empirical work regarding testing efficient market hypothesis has also been done in scenario of Pakistan stock exchanges. Mahmood (2006) tested the market efficiency by doing an empirical analysis on KSE 100 Index. Eight companies were selected that are Engro Chemicals, Fauji Fertilizer, Sui Northern Gas, Sui Southern Gas and Adamjee Insurance, Indus motors, ICI and Pakistan State Oil. He had used ANOVA to quantify the data by analyzing the day of the week effect or the month effect and concluded that on basis of monthly and daily returns market is efficient, as there is no “day of the week effect” or the “month effect”. But in contrary results of Nisar and Hanif (2012) have revealed that Karachi stock exchange is not an efficient market. They have examined the market efficiency of Karachi stock exchange, Bombay stock exchange, Colombo stock exchange and Dhaka stock exchange. They have applied four different statistical tests that are test for serial correlation, runs test, unit root tests and multiple variance ratio tests. They have concluded that these four major stock exchanges of South Asia are not weak form of efficient markets.

3. Purpose and Methodology

As discussed above, most of the leading economies are belonged to Asia-Pacific region; hence this study is an attempt to uncover market efficiency of leading developed stock markets of this region. This study is conducted in an empirical format by using secondary data. I am considering the historical index values of Nikke N225 (Japan), Shanghai Composite (China), Kospi Composite (Korea), Hang Seng Index HIS (Hong Kong), All Ordinaries ASX (Australia), KSE-100 (Pakistan) and BSE -SENEX (India) on a monthly, weekly and daily basis, most of the these stock markets covers period of July 01, 1997 to June 30, 2011. Table 1 is a detail of sample data.

Table 1: Sample Data

Economy	**Stock Market Index**	**Sample Data Collected**	
		Starting Date	**Ending Date**
Japan	Nikke N225	1/July/1997	30/June/2011

China	Shanghai Composite	1/July/2000	30/June/2011
Korea	Kospi Composite	1/July/1997	30/June/2011
Hong Kong	Hang Seng Index HSI	1/July/1997	30/June/2011
Australia	All Ordinaries ASX	1/July/1997	30/June/2011
Pakistan	KSE 100	1/July/1997	30/June/2011
India	BSE SENEX	1/July/1997	30/June/2011

The daily, weekly and monthly closing index values of Nikke N225, Shanghai Composite, Kospi Composite, Hang Seng Index HIS, All Ordinaries ASX, KSE-100 and BSE SENEX are used to calculate the daily, weekly and monthly returns. The continuously compounded annual rate of return is used to measure the returns for the specific period with help of following equation.

$$Rt = \ln (pt / pt\text{-}1) \qquad (1)$$

Where Rt is return, ln is natural log, pt is current price and pt-1 is pervious price. This study is conducted by using following two different statistical tests including runs test and multiple variance ratio tests.

3.1. Runs Test:

Run test was first method used to test the market efficiency. Following equation was used.

$$Z = \quad R - X / \sigma \qquad (2)$$

Where, R=Total number of runs

X = 2n1n2+1/ n1+ n2

n1=number of positive runs

n2 =number of negative runs

$\sigma = \sqrt{}\ 2\ n1n2\ (2\ n1n2 - n) / n^2\ (n - 1)$

n = n1+ n2

z = normal variate

If Z-value is more than -1.96 and less than + 1.96 then value will be known as significant which means that prices of the security appears in random fashion. And if Z-value is less than -1.96 and more than + 1.96 then value will be known as insignificant which means that prices of the security are not appearing in random fashion.

3.2. Variance Ratio Test:

Second method selected for analysis was variance ratio test. In an article by Lo and Mackinlay (1988), they have proposed a variance ratio tests in order to answer the question of whether the asset prices or returns are predictable or not. In this test they compare the variance of difference of time series data over different intervals. If we assume that there is a random walk in time series data then it means that variance of q period should be q times the variance of the one period difference. Variance ratio test statistics are used to test the random walk under two different assumptions of homoskedastic and hetroskedastic by using asymptotic distributional. In another article Chow and Denning (1993) proposed multiple variance ratio test. The multiple variance ratio test is similar to variance ratio test but the only difference is that variance ratio test provides individual results of each interval while multiple variance ratio test provides the joint probility. If variance ratio is equal to one then it means that stocks follow random walk and null hypothesis will be accepted. In this paper multiple variance ratios test under assumption of homoskedastic and hetroskedastic was selected. After applying variance ratio test we got two types of results, one is joint test that is result of multiple variance ratio test and other is individual period results that is result of variance ratio test. We focused on the results of multiple variance ratio test because it explains the joint probility as mentioned above, in order to accept the null hypothesis the joint probility should be greater than 0.05, which means calculated Z-test statistic does fall between $\pm$ 1.96 and joint variance ratio of all period is equal to one. In other words, if the calculated value will be equal to one then null hypothesis will be accepted hence we can infer that there is random walk and market is efficient. If the calculated value will not be equal to one then null hypothesis will be rejected and we can infer that market is not efficient.

Following hypothesis were developed for testing by application of above mentioned methods.

FOR Nikke N225 Ho: Tokyo stock exchange is a weak form of efficient market.

H1: Tokyo stock exchange is not a weak form of efficient market.

FOR Shanghai Composite Ho: Shanghai stock exchange is a weak form of efficient market.

H1: Shanghai stock exchange is not a weak form of efficient market.

FOR Kospi Composite Ho: Korea stock exchange is a weak form of efficient market.

H1: Korea stock exchange is not a weak form of efficient market.

FOR Hang Seng index Ho: Hong Kong stock exchange is a weak form of efficient market.

H1: Hong Kong stock exchange is not a weak form of efficient market.

FOR All Ordinaries ASX Ho: Australian Securities exchange is a weak form of efficient market.

H1: Australian Securities exchange is not a weak form of efficient market.

FOR KSE-100 Ho: Karachi stock exchange is a weak form of efficient market.

H1: Karachi stock exchange is not a weak form of efficient market.

FOR BSE-SENSEX Ho: Bombay stock exchange is a weak form of efficient market.

H1: Bombay stock exchange is not a weak form of efficient market.

4. Empirical Results and Analysis

4.1. Results of Runs Test:

Runs test is conducted on daily, weekly and monthly closing index returns series of Nikke N225, Shanghai Composite, Kospi Composite, Hang Seng Index HIS, All Ordinaries ASX, KSE-100 and BSE SENEX. Minitab has been used for testing the runs test. Nikke N225 results for daily, weekly and monthly returns are consistent with each other. For daily, weekly and monthly returns **P-value is 0.096, 0.487 & 0.569** respectively, which is clearly greater than alpha (i-e. 0.05). If P-value is greater than alpha it means that value of z-statistic does fall between $\pm$ 1.96 hence we accept the null hypothesis that is for daily weekly and monthly basis successive returns are randomly generated. Shanghai Composite results for daily, weekly and monthly returns are consistent with each other. For daily, weekly and monthly returns **P-value is 0.015, 0.043 & 0.039** respectively, which is clearly smaller than alpha (i-e. 0.05). If P-value is smaller than alpha it means that value of z-statistic doesn't fall between $\pm$ 1.96 hence we reject the null hypothesis that is for daily weekly and monthly basis successive returns are not randomly generated. Kospi Composite results for daily, weekly and monthly returns are consistent with each other. For daily, weekly and monthly returns **P-value is 0.087, 0.256 & 0.227** respectively, which is clearly greater than alpha (i-e. 0.05). If P-value is greater than alpha it means that value of z-statistic does fall between $\pm$ 1.96 hence we accept the null hypothesis that is for daily weekly and monthly basis successive returns are randomly generated. Hang Seng Index HIS results for daily, weekly and monthly returns are consistent with each other. For daily, weekly and monthly returns **P-value is 0.896, 0.534 & 0.510** respectively, which is clearly greater than alpha (i-e. 0.05). If P-value is greater than alpha it means that value of z-statistic does fall between $\pm$ 1.96 hence we accept the null hypothesis that is for daily weekly and monthly basis successive returns are randomly generated. All Ordinaries ASX results for daily, weekly and monthly returns are consistent with each other. For daily, weekly and monthly returns **P-value is 0.842, 0.067 & 0.371** respectively, which is clearly greater than alpha (i-e. 0.05). If P-value is greater than alpha it means that value of z-statistic does fall between $\pm$ 1.96 hence we accept the null hypothesis that is for daily weekly and monthly basis successive returns are randomly generated. KSE-100 results for daily and weekly returns are consistent with each other, for both daily and weekly returns **P-value is 0.000** which is clearly too small than alpha (i-e. 0.05). If P-value is smaller than alpha it means that value of z-statistic doesn't fall between $\pm$ 1.96 hence we reject the null hypothesis that is for daily and weekly basis successive returns are not randomly generated. Further more for monthly returns **P-value is 0.376** which is greater than alpha (i-e. 0.05). If P-value is greater than alpha it means that value of z-statistic do fall between $\pm$ 1.96 hence we accept the null hypothesis that is for monthly basis successive returns are randomly generated. In case of BSE-SENSEX, results for daily returns concluded that **P-value is 0.000** which is clearly too small than alpha (i-e. 0.05). If P-value is smaller than alpha it means that value of z-statistic doesn't fall between $\pm$ 1.96 hence we reject the null hypothesis that is for daily basis successive returns are not randomly generated. Further more for weekly and monthly returns **P-value is 0.060** and **0.560** respectively, in both cases P-value is greater than alpha (i-e. 0.05). If P-value is greater than alpha it means that value of z-statistic do fall between $\pm$ 1.96 hence we accept the null hypothesis that is for weekly and monthly basis successive returns are randomly generated.

4.2. Results of Variance Ratio test:

Variance ratio test is conducted on daily, weekly and monthly closing index returns series of Nikke N225, Shanghai Composite, Kospi Composite, Hang Seng Index HIS, All Ordinaries ASX, KSE-100 and BSE SENEX. In following interpretation ***first case*** belongs to test specification which is used under assumption of homoskedastic by using asymptotic distributional and ***second case*** belongs to test specification which is used under assumption of hetroskedastic by using asymptotic distributional.

Nikke N225: In ***first case***, test specification is used under assumption of homoskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.427 and **joint probility value is 0.149**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.392 and **joint probility value is 0.157**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.369 and **joint probility value is 0.177**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1

In ***second case***, test specification is used under assumption of hetroskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.409 and **joint probility value is 0.155**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.381 and **joint probility value is 0.166**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.341 and **joint probility value is 0.189**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1.

Shanghai Composite: In ***first case***, test specification is used under assumption of homoskedastic by using asymptotic distributional. For daily return series the z-statistic value is 17.78 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that daily return series don't follow random walk or VR ≠ 1. For weekly return series the z-statistic value is 13.180 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that weekly return series don't follow random walk or VR ≠ 1. For monthly return series the z-statistic value is 7.185 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that monthly return series don't follow random walk or VR ≠ 1.

In ***second case***, test specification is used under assumption of hetroskedastic by using asymptotic distributional. For daily return series the z-statistic value is 16.89 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that daily return series don't follow random walk or VR ≠ 1. For weekly return series the z-statistic value is 12.012 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that weekly return series don't follow random walk or VR ≠ 1. For monthly return series the z-statistic value is 6.970 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that monthly return series don't follow random walk or VR ≠ 1.

Kospi Composite: In ***first case***, test specification is used under assumption of homoskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.632 and **joint probility value is 0.131**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.422 and **joint probility value is 0.147**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.371 and **joint probility value is 0.167**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1

In ***second case***, test specification is used under assumption of hetroskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.610 and **joint probility value is 0.126**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.413 and **joint probility value is 0.156**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.366 and **joint probility value is 0.174**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1.

Hang Seng index HSI: In ***first case***, test specification is used under assumption of homoskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.334 and **joint probility value is 0.175**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.310 and **joint probility value is 0.207**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.132 and **joint probility value is 0.266**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1

In ***second case***, test specification is used under assumption of hetroskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.321 and **joint probility value is 0.183**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.296 and **joint probility value is 0.215**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.212 and **joint probility value is 0.278**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1.

All Ordinaries ASX: In ***first case***, test specification is used under assumption of homoskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.732 and **joint probility value is 0.102**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.443 and **joint probility value is 0.154**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.335 and **joint probility value is 0.169**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1

In ***second case***, test specification is used under assumption of hetroskedastic by using asymptotic distributional. For daily return series the z-statistic value is 1.649 and **joint probility value is**

0.114, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that daily return series do follow random walk or VR = 1. For weekly series the z-statistic value is 1.420 and **joint probility value is 0.161**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that weekly return series do follow random walk or VR = 1. For monthly return series the z-statistic value is 1.322 and **joint probility value is 0.181**, which is greater than alpha (i-e. 0.05). Since joint probility value is greater than alpha and z-statistic does fall between ± 1.96, hence we accept the null hypothesis and concluded that monthly daily return series do follow random walk or VR =1.

KSE-100: In ***first case***, test specification is used under assumption of homoskedastic by using asymptotic distributional. For daily return series the z-statistic value is 15.958 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that daily return series don't follow random walk or VR ≠ 1. For weekly return series the z-statistic value is 8.221 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that weekly return series don't follow random walk or VR ≠ 1. For monthly return series the z-statistic value is 4.162 and **joint probility value is 0.001**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that monthly return series don't follow random walk or VR ≠ 1. In ***second case***, test specification is used under assumption of hetroskedastic by using asymptotic distributional. For daily return series the z-statistic value is 13.217 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that daily return series don't follow random walk or VR ≠ 1. For weekly return series the z-statistic value is 6.834 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that weekly return series don't follow random walk or VR ≠ 1. For monthly return series the z-statistic value is 3.270 and **joint probility value is 0.016**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that monthly return series don't follow random walk or VR ≠ 1.

BSE-SENSEX: In ***first case***, test specification is used under assumption of homoskedastic by using asymptotic distributional. For daily return series the z-statistic value is 16.602 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that daily return series don't follow random walk or VR ≠ 1. For weekly return series the z-statistic value is 8.413 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that weekly return series don't follow random walk or VR ≠ 1. For monthly return series the z-statistic value is 4.980 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ±

1.96, hence we reject the null hypothesis and concluded that monthly return series don't follow random walk or VR ≠ 1. In ***second case***, test specification is used under assumption of hetroskedastic by using asymptotic distributional. For daily return series the z-statistic value is 15.619 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that daily return series don't follow random walk or VR ≠ 1. For weekly return series the z-statistic value is 7.840 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that weekly return series don't follow random walk or VR ≠ 1. For monthly return series the z-statistic value is 4.211 and **joint probility value is 0.000**, which is clearly too small than alpha (i-e. 0.05). Since joint probility value is smaller than alpha and z-statistic doesn't fall between ± 1.96, hence we reject the null hypothesis and concluded that monthly return series don't follow random walk or VR ≠ 1.

5. Conclusion

The wide literature argues that in a weak form of efficient market, there will no undervalued or overvalued securities and thus no investor can earn abnormal returns at a given level of risk based on technical analysis. Since the weak form of efficient market asserts that all past market prices and data are fully reflected in present prices of securities and in long run there should be random returns for investor, therefore random walk hypothesis (RMH) is the core fundamental for the theory of weak form of efficient market hypothesis. This study is an attempt to uncover market efficiency of leading developed stock markets of Asia-Pacific. This study has examined the weak form of efficiency on the seven major stock exchanges that are present in Asia-Pacific including Nikke N225, Shanghai Composite, Kospi Composite, Hang Seng Index HIS, All Ordinaries ASX, KSE-100 and BSE SENEX. Two different statistical tests including runs test, and variance ratio test were applied for analysis and results.

After application of runs test on the all seven major stock exchanges of Asia Pacific, it has found that Shanghai Composite (China), KSE-100 (Pakistan) and BSE SENEX (India) stock exchanges are not weak form of efficient markets because their successive return doesn't generate randomly. Whereas Nikke N225 (Japan), Kospi Composite (Korea), Hang Seng Index HIS (Hong Kong) and All Ordinaries ASX (Australia) are weak form of efficient markets because their successive return series generate randomly. Second test has applied to test the market efficiency was multiple variance ratio test, which had proposed by Chow and Denning in 1993. As the weak form of efficient market states that there should be a random walk in return series and no investor can earn abnormal returns. On the basis of results it is concluded that in Shanghai Composite (China), KSE-100 (Pakistan) and BSE SENEX (India) stock exchanges, successive return series (daily, weekly and monthly) don't follow random walk, hence it is evidence of market inefficiency. While in Nikke N225 (Japan), Kospi Composite (Korea), Hang Seng Index HIS (Hong Kong) and All Ordinaries ASX (Australia) stock exchanges, successive return series (daily, weekly and monthly) do follow random walk, hence it is evidence of market efficiency.

Results of all tests are consistent with each other providing evidence against market efficiency of the stock markets under review for the study period. It is found in the process that three out of seven developed stock markets of Asia Pacific doesn't follow Random-walk and hence Nikke N225 (Japan), Kospi Composite (Korea), Hang Seng Index HIS (Hong Kong) and

All Ordinaries ASX (Australia) stock exchanges are the weak form of efficient markets. Our results are in line with the results of Worthington & Higgs (2005), Chung (2006) and by Hassan et. al; (2007), but against the results of Mahmood (2006) and Xinping et al (2010). In last, we would like to give some important recommendations to all the policy makers and regulatory bodies of all the stock markets. First of all policy makers and regulatory bodies have to realize the importance of market efficiency. Regulatory bodies should develop and provide efficient market to investors as it's their fundamental right. In order to reform the whole systems of trading in stock market and making the markets efficient, we need to introduce massive audit and information technology. Providing online investor account, broker account and trading software are not enough, we need to interlink all financial sector, we need to interlink and online all the listed companies with stock exchanges, brokerage houses and investors. We need to provide information freely, timely and equally to all investors. We need to decrease the transaction cost.

6. TABLES

Table 1: Data Sample

Economy	**Stock Market Index**	**Sample Data Collected**	
		Starting Date	**Ending Date**
Japan	Nikke N225	1/July/1997	30/June/2011
China	Shanghai Composite	1/July/2000	30/June/2011
Korea	Kospi Composite	1/July/1997	30/June/2011
Hong Kong	Hang Seng Index HSI	1/July/1997	30/June/2011
Australia	All Ordinaries ASX	1/July/1997	30/June/2011
Pakistan	KSE 100	1/July/1997	30/June/2011
India	BSE SENEX	1/July/1997	30/June/2011

Table 2: Results of Runs Test:

Results of Runs Test							
Results / **Markets**		K	Observed no. Of runs	Expected no. Of runs	Observations above K	Observations below K	**P-value**
Nikke N225	**Daily**	0.00021	1779	1718	1745	1689	**0.096**
	Weekly	0.00098	345	363	343	384	**0.487**
	Monthly	0.0044	80	84	75	92	**0.569**
Shanghai Composite	**Daily**	0.00022	1405	1471	1445	1496	**0.015**
	Weekly	0.00534	274	296	268	325	**0.043**
	Monthly	0.0188	61	69	64	83	**0.039**
Kospi Composite	**Daily**	0.00003	1665	1721	1815	1634	**0.087**
	Weekly	0.00136	346	361	395	331	**0.256**
	Monthly	0.00496	74	61	72	85	**0.227**
Hang Seng Index HSI	**Daily**	0.000110	1746	1742	1767	1716	**0.896**
	Weekly	0.000535	357	365	380	300	**0.534**
	Monthly	0.00188	79	83	94	73	**0.510**
All Ordinaries ASX	**Daily**	0.00015	1779	1773	1840	1709	**0.842**
	Weekly	0.00073	338	362	401	329	**0.067**
	Monthly	0.00319	77	83	96	71	**0.371**
KSE 100	**Daily**	0.000600	1567	1701.83	1771	1636	**0.000**
	Weekly	0.002776	302	356.52	408	315	**0.000**
	Monthly	0.010828	79	84.70	89	79	**0.376**
BSE	**Daily**	0.000427	1597	1728.17	1800	1660	**0.000**
	Weekly	0.002017	338	364.20	397	333	**0.060**

SENEX	**Monthly**	0.008840	88	84.26	88	79	**0.560**

Table 3: VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Nikke N225

VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Nikke N225		under assumption of homoskedastic	under assumption of hetroskedastic
Results for daily return series	z-statistic value(max)	1.427	1.409
	joint probility value	**0.149**	**0.155**
Results for weekly return series	z-statistic value(max)	1.392	1.381
	joint probility value	**0.157**	**0.166**
Results for monthly return series	z-statistic value(max)	1.369	1.341
	joint probility value	**0.177**	**0.189**

Table 4: VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Shanghai Composite

VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Shanghai Composite		under assumption of homoskedastic	under assumption of hetroskedastic
Results for daily return series	z-statistic value(max)	17.78	16.89
	joint probility value	**0.000**	**0.000**
Results for weekly return series	z-statistic value(max)	13.180	12.012
	joint probility value	**0.000**	**0.000**
Results for monthly return series	z-statistic value(max)	7.185	6.970
	joint probility value	**0.000**	**0.000**

Table 5: VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Kospi Composite

VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Kospi Composite		under assumption of homoskedastic	under assumption of hetroskedastic
Results for daily return series	z-statistic value(max)	1.632	1.610
	joint probility value	**0.131**	**0.126**
Results for weekly return series	z-statistic value(max)	1.422	1.413
	joint probility value	**0.147**	**0.156**
Results for monthly return series	z-statistic value(max)	1.371	1.366
	joint probility value	**0.167**	**0.174**

Table6: VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Hang Seng Index HSI

VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR Hang Seng Index HSI		under assumption of homoskedastic	under assumption of hetroskedastic
Results for daily return series	z-statistic value(max)	1.334	1.321
	joint probility value	**0.175**	**0.183**
Results for weekly return series	z-statistic value(max)	1.310	1.296
	joint probility value	**0.207**	**0.215**
Results for monthly return series	z-statistic value(max)	1.132	1.212
	joint probility value	**0.266**	**0.278**

Table 7: VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR All Ordinaries ASX

VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR All Ordinaries ASX		under assumption of homoskedastic	under assumption of hetroskedastic
Results for daily return series	z-statistic value(max)	1.732	1.648

	joint probility value	**0.102**	**0.114**
Results for weekly return series	z-statistic value(max)	1.443	1.420
	joint probility value	**0.154**	**0.161**
Results for monthly return series	z-statistic value(max)	1.335	1.322
	joint probility value	**0.169**	**0.181**

Table 8: VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR KSE 100

VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR KSE 100		under assumption of homoskedastic	under assumption of hetroskedastic
Results for daily return series	z-statistic value(max)	15.958	13.217
	joint probility value	**0.000**	**0.000**
Results for weekly return series	z-statistic value(max)	8.221	6.824
	joint probility value	**0.000**	**0.000**
Results for monthly return series	z-statistic value(max)	4.162	3.270
	joint probility value	**0.001**	**0.016**

Table 9: VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR BSE SENEX

VARIANCE RATIO TEST JOINT PROBILITY TABLE FOR BSE SENEX		under assumption of homoskedastic	under assumption of hetroskedastic
Results for daily return series	z-statistic value(max)	16.602	15.619
	joint probility value	**0.000**	**0.000**
Results for weekly return series	z-statistic value(max)	8.413	7.840
	joint probility value	**0.000**	**0.000**

Results for monthly return series	z-statistic value(max)	4.980	4.211
	joint probility value	**0.000**	**0.000**

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