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TESTING WEAK FORM EFFICIENCY OF SECTORAL INDICES OF NATIONAL STOCK EXCHANGE

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ABSTRACT

Purpose *– This study seeks to measure the weak-form efficiency of Sectoral indices of National Stock Exchange, India.*

Design/methodology/approach *– This paper investigates the Random walk behaviour of different sectoral indices by using statistical tools like Runs test and Wright ranks and signs based variance ratio test.*

Findings *– In results, evidence were found to support weak form inefficiency in all sectors along with nifty in daily and weekly returns while some sectors like Auto, Energy, IT, Media, Metal, Realty and fin. Services exhibited weak form efficiency to some extent in monthly returns. All sectors showing inefficiency in daily and weekly returns need focus to make them efficient.*

Practical implications *– The finding of the study is necessary for all investors investing in sectors by helping in equity stocks diversification in different sectors. Listed firms and regulatory bodies could also benefit from the findings in making their policy framework.*

Originality/value *– This study will add value to the existing studies of market efficiency in sectoral indices of Indian stock market by providing guidance of the their status to the concerned parties.*

Keywords - *Random walk, Sectoral indices, Weak form efficiency.*

Paper type - *Research paper*

1. Introduction

The study intends to measure the behaviour of the Sectoral Indices of NSE that would lead to decide whether these are weak form efficient or not. Weak form efficiency determines the prediction possibility of future price movement on the basis of past price movement. Movement of sectoral indices reflects the movement of composition of all relevant firms' stock prices. So the information on weak form efficiency status becomes important for all investors seeking to invest in them. Sector Index price movement provide guidance for focus prone sectors to the policy makers and helping them in better decision making. Random walk supports weak form efficiency. So in this paper Random walk of different sectors is analysed.
Concept of efficient market hypothesis was put forward by Eugene Fama in 1970 in form of EMH efficient market hypothesis. According to him an Efficient financial market is "one in which prices always fully reflect available information".
Eugene Fama identified three levels of market efficiency:
Weak form efficiency: when in a market current prices of stocks already reflect past information of stocks regarding price and volume then it is called weak form efficient market. So it is not beneficial to do past study or technical analysis to predict future price movement. Everything is random. Semi- strong efficiency: A situation where current prices of stock already reflect past information plus publicly available information regarding company. So to do fundamental analysis to predict future price of stock is useless. Strong form of efficiency: A situation where stock prices fully reflect all relevant information that is public including insider information. Abnormal profits can't be accessed in an efficient market.
Various researches provided the mix of results on weak form efficiency so this paper is also contributing to it because of different sectors inclusion. Indian national stock exchange major index is Nifty and it has various sectoral indices, reflecting movement of prices of firms stocks from different sectors.

2. National Stock Exchange (NSE) and its Sectoral indices : a brief description

The National Stock Exchange (NSE) located in Mumbai, Maharashtra, is India's leading stock exchange to provide a modern, fully automated screen-based trading system ensuring transparency, speed & efficiency, safety and market integrity. It had got its recognition in year 1993. According to data of business growth available at NSE website total market capitalization in June 2016 was about 10100336.48 crore. NSE has its major index Nifty 50. The Nifty 50 is a well diversified 50 stocks index, representing different sectors of the

Indian economy. Stock market indexes are meant to capture the overall behaviour of equity markets.

Sector-based indices of NSE are designed to provide a single value for the aggregate performance of a number of companies representing a group of related industries or within a sector of the economy. These include Auto, Bank, Financial services, FMCG, IT, Media, Metal, Pharma, PSU Bank and realty sector. These sector based indices provide an appropriate benchmark to investors, corporate entities, market intermediaries and regulators to capture the performance of different sectors of economy. Investors can use these indices to allocate their funds rationally in different sectors stocks. Market intermediaries like portfolio managers, merchant banks, trading and clearing agents, asset management companies, investment advisors etc. can use these indices to recognise broad trend in different sectors and to take well informed investment decisions accordingly. Regulators can use these indices to form their policies to focus prone sectors.

3. Literature review

Ayadi & Pyun (1994) confirmed that in Korean stock market from 1984 to dec. 1988 under homoscedastic assumption RWH rejected but under heteroscedastic error term and with longer horizon market was found efficient. Madhusoodanan (1998) examined the persistence behaviour of Indian stock market by using BSE 30 and BSE 100 index at aggregated level and disaggregated level and confirmed that persistence behaviour was shown by indices and thereby random walk was not confirmed. Belaire-Franch J & Opong K. K (2005) Examined the behaviour of UK FTSE (Financial times stock exchange) 4 indices and on the basis of traditional variance ratio test and Wright non parametric variance ratio test results suggested that null hypothesis of martingale difference behaviour get rejected for all indices. Omran & Farrar (2006) examined the WFE of 5 Middle East countries i.e. Egypt, Morocco, Jordan, Turkey and Israel indices from 1996-2000 and confirmed that except Israel all 4 countries supported the inefficiency at weak level. Rawashdeh & Squalli (2006) found that all 4 sectors (Banking, Industry, Insurance and service were not weak form efficient during study period. Zhang B. & Xindan Li (2008) examined the behaviour of 4 Chinese stock indices Shanghai A and B indices and Shenzhen A and B indices and concluded that null hypothesis of martingale difference behaviour got rejected for whole samples but by end of 1996 on the basis of heteroskedastic stochastic disturbance term the random walk hypothesis for B shares get supported and market become more efficient. Benjelloun & Squalli (2008) confirmed that despite the weak form efficient sectors in Jordan, Qatar and UAE, General index of these

countries exposed them as weak form inefficient. Asiri B. (2008) examined the WFE of Bahrain stock exchange from 1990 to 2000 and found it efficient during study period. Wright J. H. (2000) Proposed and found that in monte carlo simulations variance ratio test based on ranks and signs is more powerful than conventional variance ratio test and are more capable of detecting violations of martingale hypothesis by taking 5 exchange rate series. Awad & Daraghma (2009) examined the WFE of Palestinian securities Market by taking its Alquds index, general index and 5 sector indices from 1998 to 2008 and found that PSE was inefficient at weak level. Gupta (2010) confirmed with the help of 4 sample indices of BSE and NSE that in Indian stock market was weak form efficient during the study period. Patrick & Sushama (2011) confirmed that NSE was weak form efficient while NYSE was not weak form efficient during study period. Guidi F. & Gupta R. (2011) investigated the efficient market hypothesis for ASEAN stock markets from 2000 to 2011 and concluded that EMH got rejected in Indonesia, Malaysia, Philippines and Vietnam but not for Singapore and Thiland so these two were found weak form efficient. Ramkumar *et al.* (2011) confirmed that banking sector was efficient tested through the banking sector companies listed in BSE during the study period. Haque et al. (2011) tested the weak form efficiency of Pakistani stock market by examining the weekly returns of KSE-100 index from 2000 to 2010. With the help of ADF, PP, KPSS, LB Q-statistic, Runs test and Variance ratio if was revealed that Market was weak form inefficient during study period. Borges M.R (2011) examined the weak form efficiency of Portuguese stock index PSI-20 of Lisbon stock market from 1993 to 2006 and found mixed evidence for random walk. Results confirmed that market efficiency had increased since 2000. Nisar & Hanif (2012) examined the WFE of 4 South Asian Markets-India, Pakistan, Bangladesh and Sri Lanka from 1997-2011. It was confirmed that all four markets were weak form inefficient during study period. Sood et al. (2012) confirmed that BSE Bankex 14 companies from april 2006 to march 2011 were found in between the efficiency and inefficiency. Li B. & Liu B. (2012) tested the efficiency of MSCI country indexes from 1988 to 2010. By dividing them in 4 groups G7 markets, Asian markets, Other Developed markets and Emerging and Developing markets. On the basis of variance ratio test it was found that 25 countries out of 34 markets were following random walk and emerging countries were found less efficient compared to developed countries. Misra *et al.* (2012), Kumar & Singh (2013), Shukla & Sakhareliya (2013) & Gondaliya (2013) confirmed the Indian stock market as weak form inefficient during different study periods. Asiri & Alzeera (2013) examined the WFE of Saudi Arabia's stock market Tadawul and confirmed that market was efficient at week level. Salim Lahmiri (2013) examined Middle East and North

Africa region using data from 2010 to 2012. RWH got rejected on the basis of standard variance ratio test, wild bootstrap multiple variance ratio test and Wright VR test for Kuwait, Tunisia and Morocco. For Jordan and Saudi Arabia standard variance ratio and wildbootstrap test null hypothesis of random walk get rejected but Wright test accepted it so these 2 markets were weak form efficient. Jain & Jain (2013) examined the EMH of Indian BSE Sensex and concluded weak form efficiency. Maxim *et al.* (2013) tested the weak form efficiency of DSE before and after market crash of December, 2010 and confirmed that market was weak form efficient after crash. Kapusuzoglu (2013) confirmed the weak form inefficiency in Istanbul national stock exchange during study period. Jethwani & Achuthan (2013) tested Indian stock market by taking CNX Nifty before, during and after financial crisis and concluded that Indian stock market was weak form inefficient in all periods but after 2002 it exhibited some signs of efficiency. Ayyappan *et al.* (2013) concluded that broad indices of NSE were weak form inefficient. Omar *et al.* (2013) confirmed that KSE was weak form inefficient during the study period. K. Sachin & Sanningammanavara (2014) confirmed that Indian stock market was weak form inefficient on the basis of 23 stocks from 6 different sectors of NSE during study period. Rajamohan & Muthukamu (2014) confirmed that all almost the sectoral indices of NSE were getting positively influenced through bank nifty index during the bear and bull phase. Shafi M. (2014) confirmed weak form inefficiency in Indian stock market during study period. Phan K.C & Zhou J. (2014) tested for weak form efficient market hypothesis in Vietnamese stock market with the help of VN-index and 5 representative stocks from 2000 to 2013 by dividing it in 3 cycles and concluded that RWH got rejected in whole and 1st two cycle periods except third cycle. Tripathi & Kumar (2014) confirmed that overall Indian Stock market was weak form efficient except sectors as Bank, Metal, PSU Bank and Realty of NSE during the study period.WF inefficiency in these sectors increased in post crisis period. Lahyani F. E. (2014) examined the martingale behaviour of 7 MENA Middle Eastern, North African and 4 Pacific Basin emerging markets from 1980-2004. By using Lomac, Chow and Denning, wright Variance ratio and wild bootstrap of kim test on monthly return series it was concluded that martingale behaviour traced at high holding horizon but in overall null hypothesis of martingale get strongly rejected for whole sample and sub periods at 5% level. So selected market were inefficient moreover reforms measures didn't contribute to martingale behaviour. Hemalatha & Nedunchezian (2014) concluded that companies listed in FMCG were weak form inefficient. Gilani *et al.* (2014) confirmed that Islamabad Stock Exchange market mix up results of efficiency in different periods. Hemalatha & Nedunchezian (2015) concluded that there was no asymmetries effect in CNX FMCG and

Pharma index by analysing sectoral indices of NSE. Ramkumar *et al.* (2015) indicated that sectoral indices of BSE and NSE except IT were not weak form efficient during study period. Kalsie & Kalra(2015) examined the WFE of Indian stock Market by taking NSE and its 6 sectoral indices from 2001-11 and confirmed that Indian capital market was inefficient.

4. Data and methodology

The data for all Sectoral indices along with Nifty 50 are collected from NSE website. Daily, weekly and monthly closing prices of indices have been used from 1 April 2009 to 31 March 2016. Natural logged returns are calculated from closing prices for the purpose of analysis as follows:

$R=Ln\ (P_t/P_{t-1})$

R= Returns, Ln = Natural log, P_t = Price at time t, P_{t-1}= Price at time t-1.

Descriptive statistics have been used to check the normality of indices return. It is composed of mean, median, standard deviation, skewness, kurtosis and Jargue bera test statistics. **Skewness** measures the asymmetry of the distribution of the series around its mean. skewness of a normal distribution is zero. Positive skewness means that the distribution having long right tail and negative skewness means distribution having long left tail. **Kurtosis** measures the peakedness or flatness of the distribution of the series. The kurtosis of the normal distribution is 3. If the kurtosis > 3 then the distribution is peaked (leptokurtic) if the kurtosis < 3, the distribution is flat (platykurtic) relative to the normal. **Jarque-Bera** test statistic for testing whether the series is normally distributed. The test statistic measures the difference of the skewness and kurtosis. A small probability value leads to the rejection of the null hypothesis of a normal distribution.

Then Runs test and Wright ranks and signs based test is used.

Runs test is used for testing the randomness of index return series means whether the successive returns are independent of previous returns. It is a non parametric test so it is used for monthly and weekly returns series that are not normal. Successive positive (+++++) or negative (------) return's sequence is called a run. By taking the data in the given order and marking with + the data greater than the specified value called border (median by default), and with – the data less than the border.

Random walk requires actual number of runs is equal to expected no. of runs.

H0 = Return series is random.

For a returns series test statistics is as follows-

$$z = \frac{r - \mu_r}{\sigma_r} \qquad \mu_r = \frac{2N_1N_2}{N} + 1 \qquad \sigma_r^{\,2} = \frac{2N_1N_2(2N_1N_2 - N)}{(N)^2(N-1)}$$

Where N= total number of runs, N_1= number of positive runs, N_2= number of negative runs.

r = observed number of runs, μ_r = expected number of runs, $\sigma_r^{\,2}$ = variance of runs.

Null hypothesis of randomness get rejected at 5% significance level in case if p value is less than 0.05 and Z statistics with an absolute value do not lie between ±1.96.

Wright (2000) ranks and score based variance ratio test is more robust than Conventional Lo MacKinley **variance ratio test** (1988). Lo Mackinlay VR test is robust for many forms of heteroscedasticity and non normality of stochastic disturbance term. Random walk increments variance is linearly time dependent. For a series of nq+1 observations (P_0, P_1, P_2,….P_{nq}) measured at uniform interval following random walk, variance of qth difference should equal to q times of variance 1st difference.

Variance ratio is defined as:

$$VR_q = \frac{\frac{1}{q}\,Var(P_t - P_{t-q})}{Var(P_t - P_{t-1})} = \frac{\sigma^2(q)}{\sigma^2(1)}, \quad Z(q) = \frac{(VR(q) - 1)}{\sqrt{\theta(q)}} \sim N(0,1), \quad Z^*(q) = \frac{(VR(q) - 1)}{\sqrt{\theta^*(q)}} \sim N(0,1)$$

H_0= VR=1 or Random walk is there in return series.

Where σ^2 (q) is 1/q times the variance of qth difference and σ^2 (1) is the variance of 1st difference. Random walk hypothesis requires variance ratio VR (q) =1, for all lags of q. Z (q) is asymptotic standard normal test statistic under homoscedastic assumption and for time varying volatility when returns are deviated from normality Z*(q) test statistics under hetroscedastic assumption are provided to test the null hypothesis of random walk. VR (q) >1 indicates (mean aversion) returns are positively serially correlated and VR (q) <1 (mean reversion) returns are negatively serially correlated. Z statistics when lie beyond conventional critical value of ±1.96 for 5% significance level then indicates VR is statistically different from 1 and null hypothesis of random walk get rejected.

Wright (2000) non parametric variance ratio test provides alternatives for standard variance ratio tests z (q) and z (q*) using ranks and signs. This test is more robust than conventional variance ratio test because exact distribution can be computed plus it is more powerful in case of non normal data.

Variance ratios test the null hypothesis that Y_t is iid or mds (independent and identical distributed or martingale difference series.

y_t is time series of asset returns with a sample of size T. $y_t = x_t - x_{t-1}$.

$$\mathbf{VR} = \left\{ \frac{1}{Tk} \sum_{t=k+1}^{T} (y_t + y_{t-1} \ldots + y_{t-k} - k\hat{\mu})^2 \right\} \div \left\{ \frac{1}{T} \sum_{t=1}^{T} (y_t - \hat{\mu})^2 \right\}, \text{ where } \hat{\mu} = T^{-1} \sum_{t=1}^{T} y_t$$

VR should be close to 1 if y_t is iid but not if y_t series returns are serially correlated.

$$r_{1t} = \left(r(y_t) - \frac{T+1}{2} \right) \Big/ \sqrt{\frac{(T-1)(T+1)}{12}}, \quad r_{2t} = \Phi^{-1}(r(y_t)/(T+1))$$

r_{1t} is simple linear transformation of ranks standardized to have sample mean 0 and variance 1 and r_{2t} is a inverse normal series having sample mean 0 and variance approximately 1.
$r(y_t)$ is the rank of yt among y_1, y_2,....y_T and ϕ^{-1} is inverse of standard normal cumulative distribution function.

$$R_1 = \left(\frac{\frac{1}{Tk} \sum_{t=k+1}^{T} (r_{1t} + r_{1t-1} \cdots + r_{1t-k})^2}{\frac{1}{T} \sum_{t=1}^{T} r_{1t}^2} - 1 \right) \times \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2}$$

$$R_2 = \left(\frac{\frac{1}{Tk} \sum_{t=k+1}^{T} (r_{2t} + r_{2t-1} \cdots + r_{2t-k})^2}{\frac{1}{T} \sum_{t=1}^{T} r_{2t}^2} - 1 \right) \times \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2}$$

Sign based test S_1 remains exact in presence of conditional heteroskedasticity. For any series x_t, let u (x_t,q)=1(x_t>q)-.05. So u (x_t, 0) is ½ if x_t is positive and -1/2 otherwise. S_1 assumes drift parameter μ = 0. St= 2u (y_t, 0) =2 (ε_t, 0). S_t is iid with mean 0 and variance 1. Each element of S_t is equal to 1 with probability ½ and -1 otherwise.

$$S_1 = \left(\frac{\frac{1}{Tk} \sum_{t=k+1}^{T} (s_t + s_{t-1} \cdots + s_{t-k})^2}{\frac{1}{T} \sum_{t=1}^{T} s_t^2} - 1 \right) \times \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2}$$

5. The findings

Descriptive statistics of daily returns and weekly returns are presented in table 1 and 2 respectively. By seeing these both tables it is observed that auto sector along with IT, Pharma, FMCG, Bank, Financial services has the highest return while Metal, Energy and Realty sectors have lowest returns. Standard deviation is highest in Realty followed by PSU bank, Metal and Bank while lowest in Pharma, FMCG, Auto and Energy. Except IT in table 1 and IT, FMCG and Pharma in table 2 all indices returns are positively skewed. Kurtosis values show peacked distribution. J.B- p values are less than 0.05 indicates distribution of

return series is deviated from normality. In table 3 of monthly returns auto sector has highest return and metal has lowest returns. Standard deviation is also high in realty and lowest in FMCG. Except IT, Pharma and Fin. Services all sectors have positively skewed data. J.B P-values indicates that except FMCG, IT and Pharma sector are returns are not normal.

Runs test results are shown in table 4, 5 and 6. By seeing the results of table 4 it can be seen that z statistics in Auto, Media, Metal, Realty, Bank and PSU Bank falls outside ±1.96 and p values is also less than 0.05 so H0 of random walk get rejected in these sector so these sectors are not weak form efficient. In table 5 of weekly returns results show that H0 can't be rejected means all indices follow random walk and are weak form efficient. In Table 6 of monthly return series only H0 get rejected in Pharma sector only means random walk is not there so this sector is not weak form efficient.

Wright test results are given in 7, 8 and 9. Variance ratios in all three tables are decreasing with increasing lags means has much stronger rejection of null hypothesis of Random walk. Variance ratio in all tables is less than 1 indicating returns are negatively serially correlated suggesting therefore mean reversion of returns. Table 7 provides result of Wright test on daily returns. It can be seen that p value of nifty along with all sectors is less than 0.05 in rank, rank score and sign based tests so H_0 of random walk get rejected. Similarly in Table 8 of weekly returns, p value in all sectors along with nifty is less than 0.05 in rank, rank score and in sign based test except auto and FMCG at k 30, so null hypothesis of random walk again get rejected. In table 9 of monthly returns, p value in all sectors along with nifty is less than 0.05 in rank and rank score based tests but in sign based test that is more robust to martingale difference sequence do not violate the null hypothesis of mds in all sectors. Except Auto, Energy, IT, Media, Metal, Pharma, Realty and financial services at k 30 and Media, Realty and Financial services at k 10 Null hypotheses get rejected in all remaining sectors along with nifty.

Conclusion

In this paper weak form efficiency of sectoral indices of NSE is analysed by taking the daily weekly and monthly returns from 1 April 2009 to 31 March 2016. In descriptive statistics data came to deviated from normal distribution. So Runs test and Wright variance ratio test are applied to check the random behaviour of returns of sectoral indices along with NSE. Table 10 shows the overall result. It can be seen that Runs test do not reject null hypothesis of random walk in energy, FMCG, IT, Pharma and Fin. Services in daily returns but wright test of daily return has rejected null hypothesis in all sectors likewise in weekly returns runs test

did not reject null hypothesis but wright test rejected H0 again in all sectors. So we can say that if we take daily and weekly returns all indices are not weak form efficient. Profit opportunity is there. Now if we take monthly returns in runs test H0 of random walk get rejected in Pharma sector only but in wright test monthly results Auto, Energy, IT, Media, Metal, Realty and fin. Services seem to be weak form efficient to some extent in sign based test at higher lags. Rank based test rejects the null hypothesis in monthly returns. FMCG, Bank and PSU Bank sectors can be concluded as weak form inefficient on the bases of both test results. While nifty in daily, weekly and monthly returns shows efficiency in runs test results but wright test results shows inefficiency during the study period. Because wright test is more powerful test so we can conclude that all the sectors are weak form inefficient in daily and weekly returns but in monthly returns few sectors like Auto, Energy, IT, Media, Metal, Realty and Fin. Servies shows weak form efficiency to some extent.

So all sectors reflecting inefficiency are predicable and provide profit opportunities to investors.Inefficient market attracts global investors because of its predictable nature and profitable opportunities. It also helps in equity diversification in different sectors. Investors can gain through abnormal profit by investing in inefficient sectors. But stock market efficiency is the sign of a developed market. Market remains inefficient when information flow in the economy is not efficient and effective plus reforms measures undertaken by the government do not contribute in different sectors up to the desired level. So the government should check not only the implementation of different programmes contributing to development of different sectors of economy but also smooth transmission of information regarding the progress of these programmes from time to time. An adequate regulatory structure helps in corporate governance that leads to transparency in the information system, economical and industrial system.

Table 10

Test	Runs test			Wright test					
	D	W	M	D		W		M	
Test Based on				Ranks	Sign	Ranks	Sign	Ranks	Sign
Nifty				Reject	Reject	Reject	Reject	Reject	Reject
Auto	Reject			Reject	Reject	Reject	Reject	Reject	
Energy				Reject	Reject	Reject	Reject	Reject	
FMCG				Reject	Reject	Reject	Reject	Reject	Reject
IT				Reject	Reject	Reject	Reject	Reject	
Media	Reject			Reject	Reject	Reject	Reject	Reject	
Metal	Reject			Reject	Reject	Reject	Reject	Reject	
Pharma			Reject	Reject	Reject	Reject	Reject	Reject	
Realty	Reject			Reject	Reject	Reject	Reject	Reject	
Bank	Reject			Reject	Reject	Reject	Reject	Reject	Reject
fin. Ser.				Reject	Reject	Reject	Reject	Reject	
PSU Bank	Reject			Reject	Reject	Reject	Reject	Reject	Reject

References

1. Asiri, B. & Alzeera, H. (2013). Is the Saudi Stock Market Efficient? A case of weak form efficiency. *Research Journal of Finance and Accounting, 4*(6), 35-48.
2. Asiri, B. (2008). Testing weak form efficiency in the Bahrain stock market. *International Journal of Emerging Markets, 3*(1), 38-53.
3. Awad, I., & Daraghma, Z. (2009). Testing the WFE of the Palestinian securities Market. *International Research Journal of Finance and Economics, 32*, 7-17.
4. Ayadi, O.F., & Pyun, C.S. (1994). An application of variance ratio test to the Korean securities Market. *Journal of Banking and Finance*, *18*(4), 643-658.
5. Ayyappan, S., Nagarajan, S., Sakthivadivel, M., & Prabhakaran, K. (2013). Empirical Analysis of Weak Form Efficiency Evidence from National Stock Exchange of India Ltd.. *Beykent University Journal of Social Science, 6*(2), 125-137.

6. Belaire-Franch, J., & Opong, K. K. (2005). A Variance Ratio Test of the Behaviour of some FTSE Equity indices Using Ranks and Signs, *Review of Quantitative Finance and Accounting*, 24(1), 93-107.
7. Benjelloun, H., & Squalli, J. (2008). Do general Indexes mask sectoral efficiencies? *International Journal of Managerial Finance, 4*(2), 136-151.
8. Borges, M. R (2011). Random walk tests for the Lisbon Stock Market. *Applied Economics, 43*(5), 631-639.
9. Fama, E. F (1991). Efficient capital markets: II. *The Journal of Finance, 46*(5), 1575-1617.
10. Fama, E. F (1995). Random walks in stock market prices. *Financial Analysts Journal, 51*(1), 75-80.
11. Gilani, S. T. R., Nawaz, M., Shakoor, M. I., & Asab, M. Z. (2014). Testing the Weak Form Efficiency of Islamabad Stock Exchange (ISE). *IISTE Developing Country Studies, 4*(11), 79-86.
12. Gondaliya, V. (2013). An Empirical study on Weak form of market efficiency on NSE. *International Journal of Research In Commerce, IT & Managemenet, 3*(6), 89-93.
13. Guidi, F., & Gupta, R. (2011). Are ASEAN stock markets efficient? Evidence from Univariate and Multivariate Variance Ratio tests. *Discussion Papers in Finance No, 13*.
14. Gupta, A. (2010). A critical analysis of weak form efficiency in Indian Stock Market. Asian Journal of Management Research, 657-665. Available at : ipublishing.co.in/ajmrvol1no1/EIJMRS1049.pdf
15. Haque, A., Liu, H.C., & Nisha, F.U. (2011). Testing the weak form efficiency of Pakistani stock market (2000-2010). *International Journal of Economics and Financial Issues, 1*(4), 153-162.
16. Hemalatha, K., & Nedunchezian, V. R. (2014). Testing on weak form efficiency & volatility of FMCG sector: The evidence from NSE. *International Journal on Recent and Innovation trends in Computing and Communication, 2*(9), 2656-2661.
17. Hemalatha, K., & Nedunchezian, V. R. (2015). An Analysis of Weak Form Efficiency in Sectoral Indices: A study with a special reference to National stock exchange in India. *Indian Journal of Applied Research, 5*(3), 197-200.
18. Jain, K., & Jain, P. (2013). Empirical study of the Weak form of EMH on Indian Stock Market. *International Journal of Management and Social Sciences Research, 2*(11), 52-59.

19. Jethwani K., & Achuthan, S. (2013). Stock Market Efficiency and Crisis: Evidence from India. *Asia-Pacific Finance and Accounting Review, 1*(2), 35-43.
20. Kalsie, A., & Kalra, J.K. (2015). An Empirical Study on Efficient capital market Hypothesis of Indian Capital Market. *International Journal of Research and Development in Technology and Management Science-Kailash, 22*(2), 15-26.
21. Kapusuzoglu, A. (2013). Testing weak form market efficiency on the Istanbul stock exchange (ISE). *International Journal of Business Management and Economic Research, 4*(2), 700-705.
22. Kumar, S., & Singh, M. (2013). Weak form of market efficiency: A study of selected Indian stock Market Indices. *International Journal of Advances Research in Management and Social Sciences. 2*(11), 141-150.
23. Lahmiri, S. (2013). Do MENA stock market returns follow a random walk process? *International Journal of Industrial Engineering Computations, 4*(1), 165-172.
24. Lahyani, F. E. (2014). Are MENA and Pacific Basin Stock Equity Markets Predictable? *SAGE Open, 4*(4), 1-14.
25. Li, B., & Liu, B. (2012). A Variance-Ratio Test of Random walk in International Stock Markets. *The Empirical Economics Letters, 11*(8), 775-782.
26. Lo, A. W., & MacKinlay, A. C. (1988). Stock market prices do not follow random walks: Evidence from a simple specification test. *Review of Financial Studies, 1*(1), 41-66.
27. Madhusoodanan, T.P. (1998). Persistence in the Indian Stock Market Returns: An application of Variance Ratio test. *Vikalpa, 23*(4), 61-73.
28. Maxim, M. R., Miti, T.A., & Arifuzzaman, S. M. (2013). Is Dhaka Stock Exchange Efficient? A Comparison of Efficiency before and after the Market Crisis of 2010. *Asian Business Review, 3*(6), 78-81.
29. Misra, V., Misra, A.K., & Rastogi, S. (2012). Testing efficient capital Market Model in Indian Sub-continent. *Ganpat university-Faculty of Management Studies Journal of Management and Research GFJMR, 5*, 1-14.
30. Nisar, S., & Hanif, M. (2012). Testing weak form efficient market hypothesis: empirical evidence from South Asia. *World Applied Science Journal, 17*(4), 414-427.
31. Omar, M. Hussain, H., Bhatti, G. A., & Altaf, M. (2013). Testing Random walks in Karachi stock exchange. *Elixir fin. Mgmt. 54*, 12293-12299. Available at: *www.elixirpublishers.com (Elixir International Journal).*
32. Omran, M., & Farrar, S.V. (2006). Tests of weak form efficiency in the Middle East emerging markets. *Studies in Economics and Finance, 23*(1), 13-26.

33. Patrick & Sushama (2011). Efficiency of Stock Markets-Comparing the behaviour of stock indices of NSE and NYSE. *International Journal of Multidisciplinary Research, 1*(8), 419-427.
34. Phan, K.C., & Zhou, J. (2014). Market efficiency in emerging stock markets: A case study of the Vietnamese stock market. *IOSR Journal of Business and Management, 16*(4), 61-73.
35. Rajamohan, S., & Muthukamu, M. (2014). Bank Nifty Index and Other Sectoral Indices of NSE- A Comparative study. *Indian Journal of Research, 3*(4), 147-149.
36. Gunasekaran, I., Ramkumar, R. G., & Selvam, M. (2011). Analysis of sectoral market efficiency-A study on banking sector. Available at: http://ssrn.com/abstract=1940886.
37. Ramkumar, R. R., Selvam, M., Raja, M., Lingaraja, K., & Vasanth, V. (2015). Efficiency of Sectoral Indices: A Comparative Study on BSE and NSE Ltd. *International Business Management, 9*(3), 258-266.
38. Rawashdeh, M., & Squalli, J. (2006). A sectoral efficiency analysis of Amman Stock Exchange. *Applied Financial Economics Letters, 2*(6), 407-411.
39. Sachin, K. & Sanningammanavara (2014). The Efficiency Testing of Weak Form of Indian Stock Market. *International Journal of Engineering and Management Research, 4*(4), 44-53.
40. Shafi, M. (2014). Testing of market efficiency in the weak form taking CNX Nifty as a benchmark Index: A study. *Research Journali's Journal of Finance, 2*(2), 1-20.
41. Shukla, H. J., & Sakhareliya, R. H. (2013). Testing the EMH on Indian stock market: with special reference to weak form efficiency. *Business Spectrum, 3*(1), 11-23.
42. Totala, D., Saluja, H., Bapna, D., & Sood, V. (2012). Does BSE Bankex Walk Randomly? An innovative investment approach. *Pacific Business Review International, 5*(2), 11-22.
43. Tripathi, V., & Kumar, A. (2014). Sectoral Efficiency of the Indian Stock market and the impact of Global Financial crisis. *Journal of Commerce and Accounting Research, 3*(4), 15-27.
44. Wright, J. H. (2000). Alternative Variance Ratio tests using Ranks and Signs, *Journal of Business & Economics statistics, 18*(1), 1-9.
45. Zhang, B., & Xindan, L. (2008). A variance Ratio test of the behaviour of Chinese Stock Indices, *Applied Economics Letters,* 15(7), 567-571.

Appendix –

Table -1

Description	Mean	Median	Std. Dev.	Skew.	Kurt.	J.B.	Prob.	Observations
NIFTY	0.001	0.000	0.012	1.275	22.354	27565.570	0.000	1736
AUTO	0.001	0.001	0.014	0.583	10.246	3896.547	0.000	1736
ENERGY	0.000	0.000	0.014	0.611	13.817	8571.454	0.000	1736
FMCG	0.001	0.001	0.011	0.113	6.331	806.253	0.000	1736
IT	0.001	0.001	0.015	-0.173	13.157	7471.128	0.000	1736
MEDIA	0.001	0.001	0.015	0.285	7.475	1471.695	0.000	1736
METAL	0.000	0.000	0.019	0.469	7.307	1405.489	0.000	1736
PHARMA	0.001	0.001	0.011	0.006	12.164	6074.887	0.000	1736
REALTY	0.000	0.001	0.025	0.190	7.420	1423.336	0.000	1736
BANK	0.001	0.001	0.017	0.663	10.483	4177.642	0.000	1736
FIN_SERVICES	0.001	0.001	0.016	0.799	12.963	7364.034	0.000	1736
PSU Bank	0.000	0.001	0.020	0.410	6.991	1192.650	0.000	1724

Table-2

Description	Mean	Median	Std. Dev.	Skew.	Kurt.	J.B.	Prob.	Observations
NIFTY	0.002	0.002	0.026	0.285	5.383	91.086	0.000	364
AUTO	0.005	0.005	0.030	0.302	4.395	35.040	0.000	364
ENERGY	0.000	0.000	0.030	0.256	5.657	111.070	0.000	364
FMCG	0.004	0.004	0.023	-0.172	3.686	8.935	0.011	364
IT	0.004	0.004	0.030	-0.274	4.418	35.031	0.000	364
MEDIA	0.003	0.004	0.035	1.206	12.092	1342.053	0.000	364
METAL	0.000	-0.003	0.042	0.657	4.871	79.288	0.000	364
PHARMA	0.004	0.004	0.024	-0.195	3.767	11.219	0.004	364
REALTY	-0.001	-0.001	0.059	0.429	5.957	143.771	0.000	364
BANK	0.004	0.005	0.038	0.318	5.641	111.929	0.000	364
FIN_SERVICES	0.004	0.005	0.035	0.316	5.811	125.933	0.000	364
PSU BANK	0.001	0.005	0.048	0.335	5.067	71.010	0.000	361

Table-3

Description	Mean	Median	Std. Dev.	Skew.	Kurt.	J.B.	Prob.	Observations
NIFTY	0.010	0.006	0.057	0.821	5.457	30.200	0.000	83
AUTO	0.020	0.019	0.072	0.403	4.301	8.098	0.017	83
ENERGY	0.002	0.003	0.062	0.603	4.359	11.408	0.003	83
FMCG	0.016	0.015	0.047	0.302	3.333	1.643	0.440	83
IT	0.017	0.022	0.067	-0.102	3.567	1.257	0.533	83
MEDIA	0.012	0.007	0.074	1.059	7.019	71.370	0.000	83
METAL	0.000	-0.020	0.097	1.126	5.644	41.730	0.000	83
PHARMA	0.018	0.025	0.049	-0.422	3.231	2.648	0.266	83
REALTY	-0.007	-0.017	0.133	1.262	6.610	67.083	0.000	83
BANK	0.014	0.006	0.086	0.983	5.516	35.267	0.000	83
FIN_SERVICES	0.002	0.006	0.128	-3.430	26.482	2069.711	0.000	83
PSU_BANK	0.015	-0.006	0.123	2.162	11.697	326.211	0.000	83

Table 4

Runs test (Daily observations)

	Nifty	Auto	Energy	FMCG	IT	Media	Metal	Pharma	Realty	Bank	fin. Ser.	PSU Bank
Test Value[a]	.0005	.0010	.0001	.0011	.0010	.0006	.0001	.0010	.0005	.0007	.0006	.0007
Cases < Test Value	865	868	866	868	868	868	868	868	868	866	868	862
Cases >= Test Value	871	868	870	868	868	868	868	868	868	870	868	862
Total Cases	1736	1736	1736	1736	1736	1736	1736	1736	1736	1736	1736	1724
Number of Runs	832	810	884	860	831	823	818	839	811	822	834	814
Z	-1.776	-2.833	.720	-.432	-1.825	-2.209	-2.449	-1.440	-2.785	-2.257	-1.681	-2.361
Asymp. Sig. (2-tailed)	.076	.005	.471	.666	.068	.027	.014	.150	.005	.024	.093	.018

Median based

Table 5

Runs test (weekly observations)

	Nifty	Auto	Energy	FMCG	IT	Media	Metal	Pharma	Realty	Bank	fin. Ser.	PSU Bank
Test Value[a]	.0022	.0048	.0004	.0038	.0039	.0040	-.0027	.0042	-.0012	.0052	.0050	.0046
Cases < Test Value	182	182	182	182	182	182	182	182	182	182	182	180
Cases >= Test Value	182	182	182	182	182	182	182	182	182	182	182	181
Total Cases	364	364	364	364	364	364	364	364	364	364	364	361
Number of Runs	173	171	193	187	185	193	191	171	181	173	175	165
Z	-1.050	-1.260	1.050	.420	.210	1.050	.840	-1.260	-.210	-1.050	-.840	-1.739
Asymp. Sig. (2-tailed)	.294	.208	.294	.675	.834	.294	.401	.208	.834	.294	.401	.082

Median based

Table 6

Runs test (monthly observations)

	Nifty	Auto	Energy	FMCG	IT	Media	Metal	Pharma	Realty	Bank	fin. Ser.	PSU Bank
Test Value[a]	.0055	.0191	.0032	.0146	.0224	.0071	-.0203	.0248	-.0175	.0063	.0065	-.0061
Cases < Test Value	41	41	41	41	41	41	41	41	41	41	41	41
Cases >= Test Value	42	42	42	42	42	42	42	42	42	42	42	42
Total Cases	83	83	83	83	83	83	83	83	83	83	83	83
Number of Runs	49	43	47	41	47	41	41	52	43	45	45	39
Z	1.437	.112	.995	-.330	.995	-.330	-.330	2.100	.112	.554	.554	-.772
Asymp. Sig. (2-tailed)	.151	.911	.320	.741	.320	.741	.741	.036	.911	.580	.580	.440

Table 7

Wright test (Daily observations)

Indices	D	Rank				Rank score				Sign			
	Lags	2	5	10	30	2	5	10	30	2	5	10	30
Nifty	VR	0.563	0.254	0.149	0.078	0.540	0.219	0.112	0.046	0.712	0.496	0.401	0.311
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Auto	VR	0.579	0.259	0.149	0.071	0.556	0.230	0.114	0.044	0.718	0.472	0.386	0.323
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Energy	VR	0.546	0.243	0.139	0.081	0.522	0.211	0.105	0.040	0.682	0.461	0.380	0.351
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FMCG	VR	0.530	0.244	0.153	0.084	0.519	0.210	0.115	0.044	0.639	0.442	0.371	0.321
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT	VR	0.565	0.260	0.164	0.108	0.545	0.223	0.126	0.057	0.710	0.486	0.412	0.391
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Media	VR	0.563	0.281	0.171	0.106	0.533	0.233	0.121	0.051	0.708	0.527	0.466	0.544
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Metal	VR	0.544	0.248	0.141	0.078	0.524	0.219	0.108	0.045	0.696	0.478	0.413	0.375
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pharma	VR	0.580	0.268	0.157	0.091	0.548	0.233	0.122	0.051	0.722	0.497	0.401	0.351
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Realty	VR	0.567	0.273	0.167	0.096	0.545	0.234	0.126	0.055	0.682	0.493	0.441	0.418
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Bank	VR	0.597	0.264	0.153	0.080	0.582	0.234	0.118	0.046	0.731	0.466	0.386	0.337
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
fin. Ser.	VR	0.592	0.261	0.152	0.076	0.578	0.229	0.117	0.049	0.717	0.461	0.381	0.320
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PSU Bank	VR	0.583	0.270	0.160	0.092	0.565	0.242	0.118	0.048	0.711	0.485	0.441	0.388
	P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 8 **Wright test (Weekly observations)**

Indices	W	Rank				Rank score				Sign			
	Lags	2	5	10	30	2	5	10	30	2	5	10	30
Nifty	VR	0.551	0.275	0.171	0.119	0.517	0.242	0.138	0.075	0.700	0.515	0.414	0.420
	P value	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.009	0.000	0.000	0.002	0.024
Auto	VR	0.600	0.254	0.137	0.080	0.557	0.230	0.102	0.034	0.738	0.484	0.468	0.540
	P value	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.002	0.000	0.000	0.003	0.131
Energy	VR	0.500	0.256	0.131	0.047	0.485	0.237	0.102	0.035	0.628	0.462	0.390	0.215
	P value	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.008
FMCG	VR	0.515	0.227	0.107	0.058	0.529	0.211	0.092	0.037	0.623	0.462	0.406	0.433
	P value	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.003	0.000	0.000	0.020	0.069
IT	VR	0.519	0.250	0.136	0.062	0.495	0.214	0.105	0.040	0.672	0.506	0.448	0.403
	P value	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.001	0.042
Media	VR	0.415	0.200	0.106	0.048	0.402	0.190	0.086	0.033	0.534	0.334	0.304	0.296
	P value	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.011
Metal	VR	0.513	0.259	0.129	0.049	0.466	0.224	0.107	0.036	0.678	0.493	0.383	0.274
	P value	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.008
Pharma	VR	0.505	0.229	0.115	0.053	0.503	0.209	0.093	0.032	0.689	0.453	0.367	0.266
	P value	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.007
Realty	VR	0.586	0.264	0.173	0.132	0.550	0.235	0.125	0.064	0.678	0.453	0.417	0.381
	P value	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.002	0.000	0.000	0.004	0.029
Bank	VR	0.518	0.239	0.142	0.109	0.494	0.206	0.102	0.044	0.667	0.423	0.332	0.275
	P value	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.012
fin. Ser.	VR	0.531	0.243	0.133	0.093	0.500	0.209	0.099	0.042	0.705	0.480	0.399	0.369
	P value	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.024
PSU Bank	VR	0.542	0.259	0.157	0.095	0.508	0.212	0.104	0.037	0.713	0.503	0.465	0.350
	P value	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024

Table 9 **Wright test (Monthly observations)**

Indices	M	Rank				Rank score				Sign			
	Lags	2	5	10	30	2	5	10	30	2	5	10	30
Nifty	VR	0.497	0.184	0.077	0.019	0.482	0.174	0.065	0.018	0.585	0.385	0.307	0.098
	P value	0.000	0.001	0.003	0.002	0.000	0.000	0.002	0.001	0.001	0.003	0.026	0.036
Auto	VR	0.532	0.178	0.079	0.022	0.475	0.153	0.069	0.019	0.732	0.424	0.361	0.241
	P value	0.000	0.001	0.008	0.003	0.000	0.000	0.006	0.002	0.008	0.010	0.039	0.270
Energy	VR	0.541	0.163	0.086	0.017	0.503	0.151	0.076	0.020	0.634	0.366	0.263	0.182
	P value	0.000	0.000	0.006	0.003	0.000	0.000	0.000	0.000	0.001	0.006	0.015	0.202
FMCG	VR	0.527	0.194	0.088	0.063	0.493	0.170	0.071	0.036	0.659	0.346	0.190	0.088
	P value	0.000	0.001	0.003	0.008	0.000	0.000	0.008	0.004	0.000	0.000	0.005	0.013
IT	VR	0.428	0.173	0.091	0.021	0.468	0.199	0.107	0.036	0.488	0.346	0.341	0.380
	P value	0.000	0.000	0.003	0.001	0.000	0.002	0.007	0.004	0.000	0.002	0.048	0.560
Media	VR	0.528	0.209	0.114	0.036	0.504	0.198	0.097	0.026	0.683	0.502	0.424	0.311
	P value	0.000	0.000	0.005	0.005	0.000	0.000	0.007	0.005	0.003	0.019	0.065	0.233
Metal	VR	0.543	0.204	0.102	0.024	0.533	0.212	0.111	0.047	0.683	0.405	0.234	0.215
	P value	0.000	0.000	0.002	0.003	0.000	0.001	0.004	0.002	0.002	0.006	0.009	0.173
Pharma	VR	0.377	0.162	0.085	0.028	0.370	0.159	0.088	0.027	0.585	0.366	0.273	0.171
	P value	0.000	0.001	0.003	0.004	0.000	0.001	0.001	0.001	0.000	0.002	0.011	0.134
Realty	VR	0.528	0.215	0.103	0.026	0.493	0.179	0.087	0.023	0.634	0.483	0.415	0.202
	P value	0.000	0.000	0.004	0.005	0.000	0.000	0.002	0.002	0.000	0.014	0.087	0.181
Bank	VR	0.584	0.181	0.106	0.030	0.568	0.166	0.088	0.028	0.683	0.327	0.229	0.107
	P value	0.000	0.000	0.003	0.000	0.000	0.000	0.006	0.001	0.004	0.001	0.007	0.030
fin. Ser.	VR	0.612	0.186	0.091	0.022	0.616	0.190	0.086	0.028	0.732	0.424	0.380	0.215
	P value	0.003	0.002	0.005	0.003	0.000	0.001	0.007	0.001	0.01	0.008	0.064	0.151
PSU Bank	VR	0.645	0.212	0.114	0.024	0.610	0.200	0.100	0.022	0.683	0.385	0.298	0.057
	P value	0.001	0.001	0.003	0.002	0.000	0.002	0.002	0.002	0.005	0.006	0.02	0.005