Article can be accessed online at http://www.publishingindia.com

SECTORAL EFFICIENCY OF THE INDIAN STOCK MARKET AND THE IMPACT OF GLOBAL FINANCIAL CRISIS

Vanita Tripathi*, Arnav Kumar**

Abstract *In a first of its kind, this paper examines the issue of sectoral efficiency of the Indian Stock Market. For this, daily data for 11sectoral indices on NSE viz. Auto, Bank, Energy, Finance, FMCG, IT, Media, Metal, Pharma, PSU Banks, and Realty Index have been used. The study period spans from Jan 2004 to Jan 2014 covering a comprehensive 10 years including the recent global financial crisis. The analysis is done using unit root tests [Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS)]and Variance ratio tests [Chow Denning Joint Test, LoMackinlay Test and Wright (2000) Test based on Ranks and Signs].*

The results suggest that although overall Indian stock market seems to be weak form efficient, but different sectors comprising it are not, especially during total study period. Further we find evidence of increased inefficiency in Bank, Metal, PSU Bank and Realty sectors in the post-crisis period. This may be due to investor's overreaction in Indian stock market. Tripathi & Aggarwal (2009) have reported that Indian investors tend to overreact to bad news and hence post crisis,the price discovery mechanism was not so efficient. The findings on sectoral efficiency in India have important implications for policy makers, mutual funds, portfolio managers and investors at large. Weak form inefficiency in Bank, Metal, PSU Bank and Realty sectors is suggestive of exploitable arbitrage opportunities in these sectors. The regulators and policy makers must also note that overall market efficiency may not imply efficiency at the sectoral level; for this, more efforts and sector specific reforms need to be taken.

Keyword: *Market Efficiency, Sectoral Efficiency, Weak form Market Efficiency, Indian Stock Market, Variance Ratio Test*

JEL Classification: *G12, G14*

INTRODUCTION

Stock market efficiency has probably been the most widely and comprehensively researched area of study in modern finance. There are three forms of efficiency, viz.- Weak, Semi-Strong and Strong. The weak form hypothesis states that current stock prices already reflect all relevant information related to that stock which is available in form of historical prices, volumes etc. Thus technical or trend analysis is a futile exercise as stock prices, which are weak form efficient, show random walk and hence cannot be predicted. This implies lack of arbitrage opportunities and above normal returns cannot be earned by following investment strategies based on historical price movements, volume or any other past data. The semi-strong form of hypothesis states that in addition to past data about prices and volume, all publicly available information about firm's prospects like earning's forecasts, quality of top management, balance sheet composition, patents,and intellectual property rights etc. are already reflected in stock prices, thus rendering fundamental analysis useless.Strong form hypothesis argues that current stock prices already reflect all relevant information relating to the firm including those known only to company insiders. The present paper focuses on weak form efficiency.

The ever evolving audience ofresearch on market efficiency includesinvestors, economists, academicians and policy makers. Investment communities areinterested to know whether the stock prices are predictable. Economists andacademicians are concerned about developing a comprehensive theoretical framework regarding the market efficiency which explains real market behaviour and provides scope for further advancements and research in future. Policy makers are interested because it is proposed that an efficient market leads toefficient allocation of scarce capital resources among several alternatives and an inefficient stock market does not allocate these funds optimally to the most productive sectors of the economy hampering long term growthand productivity. So,inefficientmarket/sectorsprovide economic reason for intervention of policy makers to introduce reforms to improve efficiency in stock market/ sectors.

US sub-prime mortgage crisis in 2007 gave birth to a vicious global financial crisis which soaked liquidity from the global financial system and battered down financial markets all

* Assistant Professor (Finance), Department of Commerce, Delhi School of Economics, University of Delhi, Delhi, India. E-mail: vanitatripathi1@yahoo.co.in

** Department of Commerce, Delhi School of Economics, University of Delhi, Delhi, India. E-mail: arnavk@gmail.com

over the world with some markets almost being halved from their pre-crisis highs. It was further augmented by European sovereign debt crisis which began in 2009. Significant declines in key indicators of economic activity like GDP growth rate, per capita income, employment, output etc. were witnessed across the globe but in different magnitudes. These events sent several economies mostly from the developed world in recession which was worst since Great Depression of 1920s. Also many "too big to fail" financial institutions whose size was bigger than several economies had to file for bankruptcy to be ultimately saved by tax payers' money.

Stock markets are considered to be barometers of economic activity. The study of individual sectors of stock market provides important information about the behaviour of constituents that make up the market. It provides information regarding efficiency of different sectors.

This is significant because even though the overall market may be efficient, its individual sectors might not be efficient (The Samuelson dictum by Samuelson, 1998). The sectoral analysis will point out the sectors which are laggards in efficiency. Policy makers and regulators can then introduce sector specific reforms and policies to weed out inefficiency. Sectoral analysis is also very useful to investors in portfolio construction and management, comparing the return and risk of different sectors and in identifying sectors which offer opportunities to earn excess returns through arbitrage.

This paper is among the firsts to investigate if different sectors of Indian stock market are weak form efficient in the context of the global financial crisis. This rest of the paper is organised as follows: Section 2 presents the review of related literature. Section 3 provides the data and methodology. Section 4 discusses the empirical results and their economic interpretation. The conclusions and implication are presented in Section 5.

We examine 11 sectors of Indian stock market, viz., Auto, Bank, Energy, Finance, FMCG, IT, Media, Metal, Pharma, PSU Banks, and Realty.We also test whether the assumption that while "overall market may be efficient, it's components may not be efficient" holds true in the context of Indian Stock Markets. Choice of India as country of study was driven by virtue of it being one of the top 10 world economies, one of the fastest growing economy (thus catching lot of attention), 2nd most populous country.

REVIEW OF LITERATURE

Stock market efficiency has been a very comprehensively researched area over the past five decades. A plethora of research studies have examined the issue of market efficiency since 1970s (Fama, 1965, 1970; Lo & MacKinlay, 1988; Lee, 1992; Choudhry, 1994; Bos, 1998; Gu, 2004; Gan *et al*., 2005; Vieito *et al*., 2013 among several others). Fama (1965) suggested that an efficient stock market is one in which security prices fully reflect all available information. In weak-form efficiency, future prices cannot be predicted by analysing prices, volume data from the past. Thus excess returns cannot be earned in the long run by using investment strategies based on historical share prices or other historical data.

Earliest of studies on weak form efficiency were mostly focussed on developed markets. Results for US are mixedwith many researchers including Chan & Gup (1992), Lee (1992), Choudhry (1994), Chan *et al*. (1997), Bos (1998), Gu (2004), Gan *et al*. (2005), and Divis & Teply (2005), finding US market to be weak form efficient while others including Lo & MacKinlay (1988), Atkins & Dyl (1993), Jarret & Kyper (2005), Jarret (2008) found that they did not follow a random walk.

In case of European markets, Lee (1992), Choudhry (1994), Chan *et al*. (1997), Milionis & Moschos (2000), Worthington & Higgs (2004), and Gillete & Hardle (2005)found Austria, UK, France, Germany, Belgium, Ireland, Italy, Netherlands, Switzerland, Denmark, Greece, Norway, Portugal, Spain, Sweden markets to be efficient while others Al-Loughani & Chappel (1997), Buguk & Brorsen (2003), Worthington & Higgs (2004), Gillete & Hardle (2005), Dorina & Simina (2007) found UK, France, Germany, Finland, Netherlands and Turkey markets respectively to be weak form inefficient. For Australia, Lee (1992), Batten & Craig (1996), Chan *et al*. (1997), Gan *et al*. (2005) stated that Australian stock market is efficient while Worthington & Higgs (2009) and Hasanov (2009) reported it to be weak form inefficient. In relation to Japan, Cheung & Coutts (1999), Ko & Lee (1991), Lee (1992), Choudhry (1994), Chan *et al*. (1997) and Gan *et al*. (2005) reported Japanese stock market to be efficient.

Then the focus of studies and research shifted to emerging economies with their growing economies attracting investor's attention worldwide. In terms of Chinese markets, Laurence *et al*. (1997), Liu *et al*. (1997), Long *et al*. (1999), Lima & Tabak (2004), Chung (2006) found them to be efficient while Mookerjee & Yu (1999), Li (2003) and Ma (2004) reported these to be weak form inefficient. For Latin American markets, Ojah & Kamera (1999) found Argentina, Brazil, Chile, and Mexico to be weak form efficient but Worthington & Higgs (2004) reported them to be inefficient along with Colombia and Peru.

About Russian Stock Market, Abrosimova *et al*. (2002) found market to be efficient with monthly data and inefficient with daily data,whereas Worthington & Higgs (2004) reported them to be efficient.Vieito, Murthy &Tripathi (2013) reported improved efficiency in G-20 countries especially after the global financial crisis.South African stock market was stated as weak form inefficient by Appiah-Kusi & Menyah (2003).

For Indian stock market, several studies have been conducted to determine its weak form efficiency. Chaudhuri (1991) applied serial correlation and run test over a period of 1988-1990 and found Indian market to be weak form inefficient. Poshakwale (1996) applied serial correlation, run and KS test on data from 1987-1994 to report that Indian market was efficient in weak form. Pant & Bishnoi (n.d.) reported negatively about weak form efficiency of Indian market after using Unit root, autocorrelation and variance ratio tests over data from 1996-2000. Verma (2005) found that Indian market is weak form efficient for a period from 1996-2001 through Serial Correlation test. Cooray & Wickremasinghe (2005) applied pair-wise correlation, autocorrelation, cointegration and granger causality tests from 1996-2005 and reported inefficiency. Gupta & Basu (2007) also found similar results on employing Phillips-Perron, augmented Dickey-Fuller (ADF) and KPSS unit root tests on data from 1991-2006. Asiri (2008) found contradictory results from previous two studies when he applied ARIMA, autocorrelation and Unit Root test on a study period of 1990-2000. Mishra & Pradhan (2009) reported evidence of weak form inefficiency of Indian capital market from 2001-2009 using Phillips-Perronand augmented Dickey-Fuller (ADF) unit root tests. Sadiqui & Gupta (2010) found similar results as the previous study on applying Runs test, K-S test, autocorrelation, auto-regression and ARIMA for a study period of 2000-2008. Mishra (2010) also found Indian capital market to be inefficient from 1991-2009 using Unit Root test and GARCH Model.

Thus while majority of studies found developed markets to be weak form efficient, opposite can be stated for emerging markets including India as most studies have found them to be weak form inefficient. This provides rationale for policy makers in these nations to take up necessary reforms and for investors to earn abnormal returns using arbitrage opportunities provided by these market inefficiencies.

While majority of research, including all studies discussed above, have focused on determining weak form efficiency for the stock market at macro level, some studies have been conducted in recent times incorporating sectoral level analysis (see Cheong et al., 2008; Rawashdeh & Squalli, 2005; Benjelloun & Squalli, 2008; Asiri & Alzeera, 2013; Lye & Hooy,2012; Lim, 2008; Özer, 2001; Elshareif et al., 2012). Hence we see that there is a dearth of existing literature on testing weak form efficiency of different sectors in stock markets while it is non-existent in case of India. Also barring a couple, none of these papers have attempted to analyse the impact of global financial crisis on weakform efficiency of different sectors. Hence there is a need to evaluate sectoral efficiency in India, especially after the global financial crisis which has impacted adversely the banking and realty sectors in India.

DATA AND METHODOLOGY

Data

The daily closing index values of 11 leading sectoral indices of National Stock Exchange (NSE) are used for analysing 11 sectors of Indian economy. These indices were CNX Auto, CNX Bank, CNX Energy, CNX Finance, CNX FMCG, CNX IT, CNX Media, CNX Metal, CNX Pharma, CNX PSU Bank,and CNX Realty. CNX 500 index of NSE was taken as the proxy for Market (MKT) Index. Daily closing data was collected from the website of NSE India for the period of study which ranged from January 01, 2004 to January 27, 2014 covering more than a decade of time and involving around 2500 observations.

Choice of starting date, i.e., January 01, 2004 was influenced by the fact that CNX Auto, CNX Finance, CNX Metal, and CNX PSU Bank were launched from this date. However data for CNX Media were available only from December 30, 2005 while data for CNX Realty were available from December 29, 2006 as these indices were launched on these dates.

Though the data were collected primarily for testing sectoral efficiency in Indian Stock Market, but in order to incorporate in the study the effect of global financial crisis on sectoral efficiency, the entire study period and data were divided into two sub-parts: Pre-Crisis period (January 01, 2004 to August 08, 2007) and Post Crisis period (August 09, 2007 to January 27, 2014). Rationale for the time frame of these sub-periods is the fact that there is a general acceptance among the global financial community that global financial crisis originated in the US on August 09, 2007.

For analysis, following two sets of data series ware developed out of the daily closing index values:

i. Natural Log of Closing Index Value Series, and
ii. Natural Log Return of Closing Index Value Series through the equation $R_t = Log\ I_t - Log\ I_{(t-1)}$

Methodology

In order to cover the problem and its analysis in entirety a comprehensive methodology was adopted. First the descriptive statistics of log return series was computed for all 12 indices (11 sectoral indices and 1 market index). This comprised mean, std. deviation (S.D.), coefficient of variation (C.V.) and measures of kkewness and kurtosis. Thereafter the log return of sectoral indices were regressed on log returns of market index to obtain parameters of characteristic line, i.e., α, β, $T(\alpha)$ and $T(\beta)$. Growth Rate for all sectoral and market indices were obtained by regressing index values on time. Further a comparative index of correlation was developed. Comparative Index of Correlation = [(Correlation Post

Crisis)/ (Correlation Pre-Crisis)].Finally to check whether the series were random walk or stationary, Unit root tests [(Augmented Dickey Fuller (ADF), *Phillips-Perron* (PP) and *Kwiatkowski-Phillips-Schmidt-Shin* (*KPSS*)] and Variance ratio tests [Chow Denning Joint Test, LoMackinlay Test and Wright (2000) Test based on Ranks and Signs] were conducted.

Unit Root Tests

(I) Augmented Dickey Fuller (ADF) Test[1]

Given an observed time series $Y_1, Y_2, ..., Y_N$ Augmented Dickey and Fuller test considers three differential-form autoregressive equations to detect the presence of a unit root- without drift or trend, with drift and with drift and trend as shown in (1), (2) and (3) respectively.

$$(1) \quad \Delta Y_t = \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-j} \right) + e_t$$

$$(2) \quad \Delta Y_t = \alpha + \gamma Y_{t-1} + \sum \left(\delta_j \Delta Y_{t-j} \right) + e_t$$

$$(3) \quad \Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-1} \right) + e_t$$

where

- α is an intercept constant called a *drift*,
- β is the coefficient on a time trend,
- γ is the coefficient presenting process root, i.e. the focus of testing,
- p is the lag order of the first-differences autoregressive process,
- e_t is an independent identically distributes residual term.

The difference between the three equations concerns the presence of the deterministic elements α (a drift term) and βt (a linear time trend).

The focus of testing is whether the coefficient γ equals to zero, what means that the original $Y_1, Y_2, ..., Y_N$ process has a unit root; hence, the null hypothesis of $\gamma = 0$ (random walk process) is tested against the alternative hypothesis $\gamma < 0$ of stationarity.

The ADF test ensures that the null hypothesis is accepted unless there is strong evidence against it to reject in favour of the alternate stationarity hypothesis. ADF testing technique involves Ordinary Least Squares (OLS) method to find the coefficients of the model chosen. To estimate the significance of the coefficients in focus, the modified T (Student)-statistic (known as Dickey-Fuller statistic) is computed and compared with the relevant critical value: if the test statistic is less than the critical value then the null hypothesis is rejected. Each version of the test has its own critical value which depends on the size of the sample.

(II) Phillips–Perron (PP) Test[2]

ADF test takes care of the possible serial correlation in the error terms by adding the lagged difference terms of the regress and. Phillips-Perron test uses non parametric statistical methods to take care of the serial correlation in error term without adding lagged difference terms. Phillips and Perron's test statistics can be viewed as Dickey-Fuller statistics that have been made robust to serial correlation by using the Newey-West (1987) heteroskedasticity- and autocorrelation-consistent covariance matrix estimator.

The Phillips-Perron test involves fitting the regression

$$y_i = \alpha + \rho y_{i-1} + \in_i$$

where we may exclude the constant or include a trend term. There are two statistics, Z_ρ and Z_τ, calculated as

$$Z_\pi = n(\hat{\rho}_n - 1) - \frac{1}{2} \frac{n^2 \hat{\sigma}^2}{s_n^2} \left(\hat{\lambda}_n^2 - \hat{\gamma}_{0,n} \right)$$

$$Z_\tau = \sqrt{\frac{\hat{\gamma}_{0,n}}{\hat{\lambda}_n^2}} \frac{\hat{\rho}_n - 1}{\hat{\sigma}} - \frac{1}{2} \left(\hat{\lambda}_n^2 - \hat{\gamma}_{0,n} \right) \frac{1}{\hat{\lambda}_n} \frac{n\hat{\sigma}}{s_n}$$

$$\hat{\gamma}_{j,n} = \frac{1}{n} \sum \hat{u}_i \hat{u}_{i-j}$$

$$\hat{\lambda}_n^2 = \hat{\gamma}_{0,n} + 2 \sum_{j=1}^{q} \left(1 - \frac{j}{q+1} \right) \hat{y}_{j,n}$$

$$s_n^2 = \frac{1}{n-k} \sum_{i=1}^{n} \hat{u}_i^2$$

where u_i is the OLS residual, k is the number of covariates in the regression, q is the number of Newey-West lags to use in calculating $\hat{\lambda}_n^2$, and $\hat{\sigma}$ is the OLS standard error of $\hat{\rho}$.

(III) Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test[3]

Unlike unit root tests, Kwiatkowski *et al.* provide straightforward test of the null hypothesis of trend stationarity against the alternative of a unit root. For this, they consider

1. Adapted from www.rtmath.net/documentation/doc_finmath
2. Adapted from http://staff.bath.ac.uk/hssjrh/Phillips%20Perron.pdf

three-component representation of the observed time series $Y_1, Y_2, ..., Y_N$ as the sum of a deterministic time trend, a random walk and a stationary residual:

$$Y_t = \beta\, t + (r_t + \alpha) + e_t$$

where :

- $r_t = r_{t-1} + u_t$ is a random walk, the initial value $r_0 = \alpha$ serves as an intercept,
- t is the time index,
- u_t are independent identically distributed $\left(0, \sigma_u^2\right)$.

The simplified version of the model without the time trend component is also used to test level stationarity. The null and the alternative hypotheses are formulated as follows:

$H_0 : Y_t$ is trend or (level) stationary OR $\sigma_u^2 = 0$

$H_1 : Y_t$ is a unit root process.

Variance Ratio Tests[4]

(I) Lo & MacKinlay Test (1988)

Lo & MacKinlay (1988) variance ratio test, is based on the assumption that the variance of a random walk series increases linearly with time. Specifically, the variance estimated from the q period returns should be q times as large as the variance estimated from one period returns. The VR test is provided in Equation (1). The null hypothesis is VR(q) =1 and the alternate hypothesis is VR(q) 1. The standard normal statistics for the variance ratio test under the assumptions of homosckedasticity [Z(q)] and heteroscedasticityZ'(q)) are those constructed by Loand MacKinlay (1988).

Lo & MacKinlay (1988) compute an overlapping variance-ratio test on a time-series. The time-series should be in level form; e.g., to test that stock returns vary randomly around a constant mean, the log price series is a random walk with drift in the null hypothesis. The log price series would then be included in the variable list. If the assumption of homoskedastic errors in the process generating the differenced series is not reasonable, the robust option may be used to calculate avariance ratio test statistic robust to arbitrary heteroskedasticity.

(II) Chow and Denning Test

To analyze the independence of successive price changes, single variance ratio tests (Lo & MacKinlay, 1988) as well as multiple variance ratio tests (Chow & Denning, 1993) are used.

However, as stated by Chow & Denning (1993), the single variance ratio tests (both parametric and non-parametric ones) fail to control the joint-size and are associated with a large probability of Type-1 error.

To avoid this limitation, Chow & Denning (1993) created the multiple variance ratios(MVR) where a set of variance ratios are tested against one.

The null hypothesis in this model is:

$$V(q_i) = 1 \qquad for \qquad i = 1, ..., n$$

and the alternative hypothesis is,

$$V(q_i) \neq 1 \qquad \text{for some i}$$

The Chow and Dennings test statistics are,

$$MV_1 = \sqrt{T} \max_{1<i<n}$$

where,

$$Z(q) = \frac{VR(1) - 1}{\sqrt{v(q)}} \sim N(0,1)$$

$$v(q) = [2(wq - 1)(q - 1)] / 3q(nq)$$

The null hypothesis is rejected at the level of significance if MV1 is greater than $(1 - [\alpha^* / 2])^{th}$ percentile of the standard normal distribution, where $\alpha^* = 1 - (1 - \alpha)^{1/n}$.

The heteroskedasticity-robust version can be described as

$$MV_2 = \sqrt{T} \max_{1<i<n} | Z^*(q_i) |$$

where,

$$z^*(q) = \frac{VR(q) - 1}{\sqrt{v^*(q)}} \sim N(0,1)$$

$$v^*(q) = \sum_{k=1}^{q-1} \left[\frac{2(q-k)}{q} \right]^2 \phi(k)$$

and,

$$\phi(k) = \frac{\sum_{t=k+1}^{nq} (x_t - x_{t-1} - \hat{\mu})^2 (x_{t-k} - x_{t-k-1} - \hat{u})^2}{\left[\sum_{t=1}^{nq} (x_t - x_{t-1} - \hat{u})^2 \right]^2}$$

MV2 has the same critical values as MV1. As such, the Chow and Dennings test is based on the following inequality,

$$PR\left\{ \max \left(| Z(q_q) |, ..., Z(q_m |) \right) \leq SMM(\alpha; m; T) \geq 1 - \alpha \right\}$$

3. Adapted from www.rtmath.net/documentation/doc_finmath
4. Adapted from Vieito, Murthy and Tripathi (2013)

where,

$$SMM(\alpha; m; T) \geq 1-\alpha$$

is the upper α point of Standardized Maximum Modulus (SMM) distribution with m (number of aggregation intervals) and T (sample size) degrees of freedom. The Chow and Denning (1993) tests control the MV ratio test by comparing the values of standardized test statistics-either Z(q) or Z*(q)-with SMM critical value. If the maximum absolute value of Z(q) is higher than SMM critical value, the random walk hypothesis is rejected.

(III) Wrights' (2000) Ranks and Signs Based Multiple Variance Ratio Tests

Wright (2000) proposes the use of signs and ranks of differences in place of the differences proposed in the Lo & MacKinlay (1988) tests. The author demonstrates that this nonparametric variation ratio test based on ranks (R1 and R2) and signs (S1) is more powerful than those suggested by Lo and MacKinlay and it is much better when the distribution of the returns is non-normal. The rank statistics is computed based on,

$$R_1(k) = \left(\frac{\frac{1}{Tk}\sum_{t=k}^{T}\left(r_{1t}+\cdots+r_{1r-j+}\right)^2}{\frac{1}{T}\sum_{t=1}^{T} r_{1t}^2} - 1 \right) * \phi(k)^{-1/2}$$

and,

$$R_2(k) = \left(\frac{\frac{1}{TK}\sum_{t=k}^{T}\left(r_{2t}+\cdots+r_{2t-j+1}\right)^2}{\frac{1}{T}\sum_{t=1}^{T} r_{2t}^2} \right) * \phi k^{-1/2}$$

and,

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

$$r_{2t} = \Phi^{-1}\left(r(y_t)/(T+1)\right)$$

T = observations of the first difference of a variable { y_1, y_2, y_3, ..., y_T}

Φ = asymptotic variance

$r(y_t)$ = the rank of y_t among y_1, y_2, y_3, ..., y_n

Φ^{-1} = inverse of the standard normal cumulative distribution function.

This ways, the test based on the signs of first difference is:

$$S_1(k) = \left(\frac{\frac{1}{TK}\sum_{t=k}^{T}\left(S_t+\cdots+S_{t-k+1}\right)^2}{\frac{1}{T}\sum_{t=1}^{T} S_t^2} - 1 \right) x\,\phi(k)^{-1/2}$$

where Φ_t = asymptotic variance

$$s_t = 2u(y_t, 0)$$

$$s_t(\overline{u}) = 2u(y, \overline{u})$$

and

$$u(x,q) = \begin{cases} 0.5 & if\ x_t > 0 \\ -0.5 & otherwise \end{cases}$$

EMPIRICAL ANALYSIS AND ECONOMIC INTERPRETATION

Table 1 (refer Appendix) gives a snapshot of the descriptive characteristics of the data series. During the total period all the sectors generated a positive return except IT (-0.04%) and Realty (-0.11%). The highest return was generated by FMCG sector (0.07%). While the relative risk was highest for IT sector. During pre-crisis period only IT gave negative return (-0.17%). Highest return was given by Media which was also significant at 5% level. Realty sector was the most risky.

In the postcrisis period in India only four out of ten sectors viz., Media, Metal, PSU Bank, and Realty gave negative returns. Market and Energy were marginally positive. Energy sector was most risky followed by PSU Bank. This is indicative of the fact that global financial crisis did not have much impact across various sectors in India. The relative risk as captured by coefficient of variation shows that IT sector was most risky (C.V. of -1.44) and FMCG was least risky in the total period. In pre-crisis period Realty sector was most risky (C.V. of 0.20) while finance sector was least risky. In post crisis period the most risky and least risky sectors were Energy and FMCG respectively. This may be due to the fact that in post crisis period oil prices fluctuated widely thereby increasing volatility substantially in energy stocks. Overall FMCG sector turned out to be least risky and hence has been the most defensive sector during the study period.

A look at Skewness values across sectors suggest that most of the sector's returns are negatively skewed. Further, the value of kurtosis happened to be more than 3 across all sectors in both sub periods as well as the total period. This suggests that even sectoral return distributions are 'fat tailed' and not normally distributed.

When we compared sectoral returns with market return, we find that while in the pre-crisis period only three sectors viz., Finance, Media and Metal provided higher return than that of the market, there were six sectors viz., Auto Bank, Finance, FMCG, IT, and Pharma which generated higher daily mean return than the market return in post crisis period. Thus active investment strategy would have yielded better returns

during the recent financial crisis period, as against passive management.

Table 2 (refer Appendix) provides the empirical results regarding estimated parameters of the characteristic line. It must be noted that none of the sector in any period had beta coefficient more than 1. Therefore all the sectors were 'defensive sectors' (having beta less than one) during the study period. IT had lowest beta in all the three periods followed by FMCG sector. As expected Energy and Finance sectors were most responsive to market changes amongst the sample sectors.

IT sector recorded a negative growth rate in pre-crisis period while Market grew at a maximum rate of 0.97%. In the post crisis period six sectors grew at a higher rate than market while Energy, Media, Metal, and Realty recorded negative growth. An examination of growth index reveals that overall growth rate in various sectors declined in post-crisis period.

Table 3 (refer Appendix) gives Comparative Index of Correlation. All the sectors were positively correlated with each other as well as with the Market index. Most of the bi-variate correlations were similar for pre and post crisis period. Significant increases could be observed in the case of bi-variate correlations of IT and Realty sectors with other sectors except in IT-Media and Realty-Pharma. Significant declines in bi-variate correlations after crisis could be seen in cases of IT-Media, PSU Bank-Pharma, Auto-FMCG, Media-FMCG, Auto-Pharma, and FMCG-Pharma.

Tables 4, 5 and 6 (refer Appendix) give the result of Augmented Dickey Fuller (ADF), *Phillips-Perron* (PP)and *Kwiatkowski-Phillips-Schmidt-Shin* (*KPSS*) unit root tests respectively applied on 11 sectoral and 1 market index for total period, pre-crisis period and post crisis period. All the three tests results support the random walk hypothesis in sectoral data at level in India. Further at first difference all the return series tend to become stationary or mean reverting in nature.

Tables 7, 8 and 9 (refer Appendix) give the results of different variance ratio tests [Chow Denning Joint Test, Lo & Mackinlay Test, Wright (2000) Test based on Ranks and Signs] conducted on total period, pre-crisis period and postcrisis period respectively.

Table 10 provides a snapshot of results of all 3 unit root tests [Augmented Dickey Fuller (ADF), *Phillips-Perron* (PP) and *Kwiatkowski-Phillips-Schmidt-Shin* (*KPSS*)] and 4 Variance ratio tests [Chow Denning Joint Test, Lo & Mackinlay Test, Wright (2000) Test based on Ranks and Wright (2000) Test based on Signs] conductedon all time periods (total period, pre-crisis period and postcrisis period).

These results reveals that during the total period Energy, Finance, FMCG, IT, Metal, Market, were by and large efficient. Autowas mostly inefficient. We have mixed results for Bank, Media, Pharma, PSU Bank, and Realty.

During the pre-crisis period all the sectors and market were efficient as per majority of test results. None of them were inefficient as per majority of test results.

In the postcrisis period, Auto, Energy, Finance, FMCG, IT, Media, Pharma, and Market seem to be efficient in accordance with test results while Bank, Metal, PSU Bank, and Realty indices have shown mixed results.

Thus post crisis a number of sectors especially Bank, Metal, and Realty witnessed decline in efficiency and increase in sector volatility. This is contrary to general belief that crisis make market more efficient due to greater vigil and control (Vietio, Murthy & Tripathi, 2013). What may be true at the overall market level may not hold true for its various components, i.e., sectors in the economy.

CONCLUSION AND IMPLICATIONS

This paper examined the issue of sectoral efficiency in Indian stock market which has remained unexplored so far. We have analysed 11 sectoral indices of NSE representing Auto, Bank, Energy, Finance, FMCG, IT, Media, Metal, Pharma, PSU Banks, and Realty sectors of Indian economy. We took CNX 500 index of NSE as proxy for the Market Index. The study period spans from Jan 2004 to Jan 2014 subdivided into a pre-global financial crisis (January 01, 2004 to August 08, 2007) and a post global financial crisis period (August 09, 2007-January 27, 2014). The analysis is done using unit root tests [Augmented Dickey Fuller (ADF), *Phillips-Perron* (PP) and *Kwiatkowski-Phillips-Schmidt-Shin* (*KPSS*)] and Variance ratio tests [Chow Denning Joint Test, Lo & Mackinlay Test and Wright (2000) Test based on Ranks and Signs].

Our results indicated that although the overall market was weak form efficient in total period as well as pre-crisis and postcrisis periods, the efficiency at sectoral level showed a different picture. While majority of the sectors were weak form efficient in pre-crisis period, efficiency declined in case of Bank, Metal, PSU Bank, and Realty sectors during postcrisis period. This is contrary to general belief that post crisis regulation and control leads to improved efficiency. Our results suggest that what is true at macro level may not hold true at micro level. These findings have important policy implications for policy makers, market regulators and investors at large. Arbitrage opportunities seem to be present in Bank, Metal, Realty, and PSU Bank sectors after this financial crisis. These arbitrage opportunities can be exploited to reap abnormal returns in Indian stock market. Further FMCG sector is found to be the most defensive sector in Indian stock market. Hence small investors may hold stocks of FMCG companies to get optimal value for their money. The regulators need to implement sector

specific reforms to improve sectoral efficiency in the Indian stock market.

REFERENCES

Abrosimova, N., Dissanaike, G., & Linowski, D. (2002). Testing weak-form efficiency of the Russian stock market, EFA Berlin meetings Presented Paper. Retrieved from http://ssrn.com/abstract=302287.

Al-Loughani, N., & Chappell, D. (1997). On the validity of the weak form efficient market hypothesis applied to London Stock Exchange. *Applied Financial Economics,* 7, 173-176.

Appiah-Kusi, J., & Menyah, K. (2003). Return predictability in African stock markets. *Review of Financial Economics,* 12(3), 247-271.

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).

Atkins, A., & Dyl, E. (1993). Reports of the death of the efficient markets hypothesis are greatly exaggerated. *Applied Financial Economics*, 3(2), 95-100.

Batool, A. (2008). Testing weak-form efficiency in the Bahrain stock market. *International Journal of Emerging Markets,*3(1), 38-53.

Batten, J., & llis, C. (1996). Technical trading system performance in the Australian share market: Some empirical evidence. *Asia Pacific Journal of Management,* 12(1), 87-99.

Benjelloun, H., & Squalli, J. (2008). Do general indexes mask sectoral efficiencies? A multiple variance ratio assessment of Middle Eastern equity markets. *International Journal of Managerial Finance,* 4(2), 136-151.

Bos, J. (1994). Stock market efficiency. The evidence from FTA indices of eleven major stock markets. *De Economist,* 142(4), 454-473.

Buguk, C., & Brorsen, B.(2003). Testing weak-form market efficiency: Evidence from the Istanbul stock exchange. *International Review of Financial Analysis,* 12(5), 579-590.

Cahow, K. V., & Denning, K. (1993). A simple multiple variance ratio test. *Journal of Econometrics,* 58(3), 385-401.

Campbell, J., Lo, A., & MacKinlay, A. (1997). *The econometrics of financial markets* (2nd Edn.). Princeton University Press.

Chan, K., & Gup, B. (1992). An empirical analysis of stock prices in major Asian markets and the United States. *The Financial Review,* 27(2), 289-307.

Chan, K., Benton, F., & Ming, S. (1997). International stock market efficiency and integration: A study of eighteen nations. *Journal of Business Finance and Accounting*, 24(6), 803–813.

Chan, K. C., Gup, B. E., & Pan, M. P. (1997). International stock market efficiency and integration: A study of eighteen nations. *Journal of Business Finance and Accounting,* 24(6), 803-813.

Chaudhuri, S. K. (1991). *Short-run share price behaviour: New evidence on weak form of market efficiency,* 16(4), 17-21.

Cheong, C. W. (2008). A sectoral efficiency analysis of Malaysian stock exchange under structural break. *American Journal of Applied Sciences,* 5(10), 1291-1295.

Choudhry, T. (1994). Stochastic trends and stock prices: An international enquiry. Applied *Financial Economics,* 4, 383-390.

Chow, K., & Denning, K. (1993). A simple multiple variance ratio test. *Journal of Econometrics,* 58, 385-401.

Chung, H. (2006). Testing weak-form efficiency of the Chinese stock market. Working Paper, Department of Business Administration, Lappeenranta University of Technology.

Cooray, A., & Wickremasinghe, G. The efficiency of emerging stock markets: Empirical evidence from the south asian region. *The Journal of Developing Areas,* 41(1).

Diviš, K.,&Teplý, P. (2005). Information efficiency of central Europe stock exchanges. Finance a Uver.*Czech Journal of Economics and Finance,* 55(9-10), 471-482.

Dorina, L., & Simina, U. (2007). Testing efficiency of the stock market of emerging economies. Faculty of economics and business administration. Working Paper, Babes-Bolyai University.

Elshareif, E., Tan, H., & Wong, M. (2012). Unexpected Volatility Shifts and Efficiency of Emerging Stock Market: The case of Malaysia. *Business Management Dynamics,*1(10), 58-66.

Fama, E. (1965). The behaviour of stock market prices. *Journal of Business,* 38, 34-105.

Fama, E. (1970). Efficient capital market: A review of theory and empirical work. *Journal of Finance,* 25(2), 383–347.

Gan, C., Lee, M., Hwa, A. Y. H., & Zhang, J. (2005). Revisiting share market efficiency: Evidence from New Zealand, Australia, US and Japan stock indices. *American Journal of Applied Sciences,* 2(5), 996-1002.

Gillete, L., & Hardle, W. (2005). *An empirical test of German stock market efficiency*. Master Thesis Dissertation, Center for Applied Statistics and Economics, Institute for Statistics and Econometrics, Humoldt-Uniersitat Zu Berlin.

Gu, A. (2004). Increasing market efficiency: Evidence from the NASDAQ. *American Business Review,* 22(2), 20-25.

Gupta, R., & Basu, P. (2007). Weak form efficiency in indian stock markets. *International Business and Economics Research Journal,* 6(3), (2007). 57-64.

Hasanov, M. (2009). A note on efficiency of Australian and New Zealand stock markets. Applied Economics, 41(2), 269-273.

Jarret, J. (2008). Random walk, capital market efficiency and predicting stock returns for Hong Kong exchange and clearing limited. *Management Research News,* 31(2), 142-148.

Jarret, J., & Kyper, E. (2005). Daily variation, capital market efficiency and predicting stock market returns. *Management Research New,* 28(8), 34-47.

Ko, K., & Lee, S. (1991). A comparative analysis of the daily behaviour of stock returns: Japan, the US and the Asian NICs. *Journal of Business Finance and Accounting*, 18, 219-234.

Laurence, M., Cai, F., & Qian, S. (1997). Weak-form efficiency and causality tests in Chinese stock markets. *Multinational Finance Journal,*1, 291-307.

Lee, U. (1992). Do stock prices follow random walk? Some International Evidence. *International Review of Economics and Finance,* 1(4), 315-327.

Li, X. (2003). China: Further evidence on the evolution of stock markets in transition economies. *Scottish Journal of Political Economy,* 50(3), 341-358.

Lim, K. P., & Brooks, R. (2011). The Evolution of stock market efficiency over time: A survey of the empirical literature. *Journal of Economic Surveys,* 25(1).

Lim, K. P. (2008). Sectoral efficiency of the malaysian stock market and the impact of the Asian financial crisis. *Studies in Economics and Financ*e, 25, 196-208.

Lima, E. J. A., & Tabak, B. M. (2004). Tests of the random walk hypothesis for equity markets: Evidence from China, Hong Kong and Singapore. *Applied Economics Letters,* 11, 255-258.

Liu, X., Song, H., & Romilly, P. (1997). Are Chinese stock markets efficient? A cointegration and causality analysis. *Applied Economics Letters,* 4, 511-515.

Lo, A., & MacKinlay, C. (1988). Stock market prices do not follow random walks: Evidence from a simple specification test. *Review of Financial Studies,* 1, 41-66.

Long, D. M., Payne, J. D., & Feng, C. (1999). Information transmission in the Shanghai equity market. *Journal of Financial Research,* 22, 29-45.

Lye, *C.,* & Hooy, C. (2012). Multifractality and efficiency: Evidence from Malaysian sectoral indices. Int. *Journal of Economics and Management,* 6(2), 278-294.

Ma, S. (2004). The efficiency of China's stock market. Aldershot: Ashgate.

Markowitz, H. (2012). Mean-variance approximation to the geometric mean. *Annals of Financial Economics*, 7(1), 1250001.

Milionis, A., & Moschos, D. (2000). On the validity of the weak-form efficient markets hypothesis applied to the London stock exchange: Comment. *Applied Economics Letters*, 7, 419-421.

Mishra, P. K. (2010). Indian capital market-Revisiting market efficiency. Retrieved from http://ssrn.com/abstract=1339901.

Mishra, P. K., & Pradhan, B. B. (2009). Capital market efficiency and financial innovation. *The Research Network*, 4(1).

Mookerjee, R., & Yu, Q. (1999). An empirical analysis of the equity markets in China. *Review of Financial Economics,* 8, 41-60.

Nurunnabi, M. (2012). Testing weak-form efficiency of emerging economies: A critical review of Literature. *Journal of Business Economics and Management,* 13(1), 167-188.

Ojah, K., & Kamera, D. (1999). Random walks and market efficiency tests of Latin American emerging equity markets: A revisit. *The Financial Review,* 34(2) 57-72.

Özer, H. (2001). The distributional properties and weak efficiency in istanbul stock exchange: A sectoral analysis. Masters Thesis, Department of Economics, Bilkent University, Ankara.

Pant, B., & Bishnoi, T. R. Testing Random Walk Hypothesis for Indian Stock Market Indices. Retrieved from http://www.utiicm.com/Cmc/PDFs/2002/bhanu_pant.pdf

Poshakwale, S. (1996). Evidence on weak form efficiency and day of the week effect in the Indian stock market. *Finance India,*10(3), 605-616.

Rawashdeh, M., & Squalli, J. (2005). A sectoral efficiency analysis of the amman stock exchange. Working Paper No. 05-04, Economic and Policy Research Unit, Zayed University.

Richardson, M., & Smith, T. (1991). Tests of financial models in the presence of overlapping observations. *Review of Financial Studies,* 4, 227-254.

Sadiqui, S., & Gupta, P. K. (2010). Weak form of market efficiency- evidences from selected NSE indices. Retrieved from http://ssrn.com/abstract=1355103.

Samuelson, P. A. (1998). Summing upon business cycles: Opening address. *In beyond shocks: What causes business cycles*, edited by Jeffrey C. Fuhrer and Scott Schuh. Boston: Federal Reserve Bank of Boston,

Tripathi, V., & Aggarwal, S. (2009). The overreaction effect in indian stock market. *Asian Journal of Business and Accounting, 2(1&2)*, 93-114.

Verma, A. (2005). The study of the weak form informational efficiency in Bombay stock market. *Finance India,* 19(4), 1421.

Vieito, J. P., Murthy, K. V., & Tripathi,V. (2013). Market efficiency in G-20 countries: The paradox of financial crisis. *Annals of Financial Economics,* 8(1), 1-27.

Virmani, V. (2004). Unit Root Tests: Results from some recent tests applied to select Indian macroeconomic variables. Retrieved from http://www.iimahd.ernet.in/publications/data/2004-02-04vineet.pdf

Worthington, A., & Higgs, H. (2004). Random walks and market efficiency in European equity markets. *Global Journal of Finance and Economics,* (1), 59-78.

Worthington, A., & Higgs, H. (2004). Tests of random walks and market efficiency in Latin American stock markets: An empirical note. Working Paper No. 157, School of Economics and Finance.

Worthington, A., & Higgs, H. (2009). Efficiency in the Australian stock market, 1875-2006: A note on extreme long-run random walk behaviour. *Applied Economics Letters,* 16(3), 301-306.

Wright, J. (2000). Alternative variance-ratio tests using ranks and signs. *Journal of Business and Economic Statistics,* 18, 1-9. www.rtmath.net/documentation/doc_finmath. http://staff.bath.ac.uk/hssjrh/Phillips%20Perron.pdf.

APPENDIX

Table 1: Descriptive Statistics

	Total Period					Pre Crisis					Post Crisis				
Sectors	**Mean (%)**	**S.D. (%)**	**C.V. (%)**	**Skewness**	**Kurtosis**	**Mean (%)**	**S.D. (%)**	**C.V. (%)**	**Skewness**	**Kurtosis**	**Mean (%)**	**S.D. (%)**	**C.V. (%)**	**Skewness**	**Kurtosis**
Auto	0.06	1.60	25.02	-0.20	5.01	0.07	1.64	22.11	-0.57	3.12	0.06	1.58	27.13	0.03	6.25
Bank	0.05	2.15	39.33	-0.13	5.33	0.11	1.99	18.72	-0.85	7.88	0.03	2.24	86.89	0.17	4.36
Energy	0.03	1.78	63.16	-0.58	9.65	0.07	1.70	23.60	-1.50	12.20	0.00	1.82	519.66	-0.15	8.59
Finance	0.06	2.07	34.63	-0.08	6.06	0.12	1.83	15.59	-0.85	8.83	0.03	2.20	79.90	0.19	5.06
FMCG	0.07	1.40	20.23	-0.42	5.48	0.06	1.46	22.76	-0.71	7.67	0.07	1.37	18.97	-0.22	3.89
IT	-0.04	5.05	-144.33	-40.48	1888.33	-0.17	8.04	-46.48	-27.99	821.45	0.04	1.90	44.47	-0.10	4.77
Media	0.03	1.89	71.46	-0.17	4.52	0.2057*	1.92	9.34	-0.32	2.72	-0.02	1.88	-103.20	-0.14	5.07
Metal	0.03	2.47	74.11	0.19	9.75	0.12	2.58	21.75	0.63	17.20	-0.01	2.40	-161.31	-0.13	4.07
Pharma	0.06	1.27	22.50	-0.50	7.12	0.04	1.30	34.75	-0.82	4.19	0.07	1.24	18.67	-0.29	9.08
PSU Bank	0.03	2.28	71.91	-0.23	4.59	0.10	2.26	23.34	-0.90	7.05	-0.01	2.29	-458.28	0.13	3.43
Realty	-0.11	3.18	-29.95	-0.40	6.08	0.03	2.77	106.87	-0.24	0.59	-0.12	3.21	-27.12	-0.40	6.31
MKT	0.04	1.59	36.32	-0.48	9.06	0.10	1.50	15.58	-1.44	10.20	0.01	1.64	112.28	-0.07	8.61
Note: * Significant at 5% Level.															

Table 2: Estimated Parameters of Characteristic Line

	Total Period					Pre Crisis					Post Crisis					Growth Index
Sectors	**α**	**β**	**T(α)**	**T(β)**	**Growth Rate**	**α**	**β**	**T(α)**	**T(β)**	**Growth Rate**	**α**	**β**	**T(α)**	**T(β)**	**Growth Rate**	**Post/Pre**
Auto	0.00	0.84	1.50	77.26	0.90	0.00	0.88	-0.76	54.21	0.92	0.00	0.82	2.08	57.96	0.85	0.92
Bank	0.00	0.88	0.07	91.36	0.90	0.00	0.85	-0.17	48.24	0.93	0.00	0.89	0.32	78.06	0.67	0.72
Energy	0.00	0.91	-1.10	110.21	0.76	0.00	0.92	-1.19	69.04	0.93	0.00	0.91	-0.59	86.45	-0.16	-0.18
Finance	0.00	0.91	0.42	106.35	0.90	0.00	0.88	0.41	55.87	0.95	0.00	0.92	0.44	91.49	0.66	0.69
FMCG	0.00	0.72	2.14	51.18	0.97	0.00	0.76	-0.20	35.17	0.90	0.00	0.69	2.59	38.51	0.97	1.08
IT	0.00	0.32	-0.83	16.88	0.36	0.00	0.28	-1.24	8.82	-0.13	0.00	0.68	0.90	36.89	0.74	-5.72
Media	0.00	0.76	-0.09	52.65	-0.04	0.00	0.76	1.68	23.63	0.95	0.00	0.76	-1.02	47.14	-0.03	-0.03
Metal	0.00	0.85	-0.99	80.20	0.64	0.00	0.81	-0.39	41.57	0.94	0.00	0.87	-1.15	71.47	-0.30	-0.32
Pharma	0.00	0.73	1.77	53.15	0.95	0.00	0.79	-1.06	37.92	0.92	0.00	0.70	2.66	39.37	0.93	1.00
PSU Bank	0.00	0.82	-0.74	71.89	0.80	0.00	0.84	-0.68	45.75	0.84	0.00	0.81	-0.65	56.06	0.32	0.38
Realty	0.00	0.83	-3.29	62.21	-0.84	0.00	0.62	-0.47	9.49	0.41	0.00	0.84	-3.31	62.86	-0.81	-1.98
MKT	-	-	-	-	0.83	-	-	-	-	0.97	-	-	-	-	0.44	0.45

Table 3: Correlation Index (Post Crisis/Pre Crisis)

	AUTO	BANK	ENERGY	FINANCE	FMCG	IT	MEDIA	METAL	PHARMA	PSU BANK	REALTY	MKT
AUTO	1.00											
BANK	1.00	1.00										
ENERGY	0.93	1.02	1.00									
FINANCE	0.99	1.00	1.02	1.00								
FMCG	0.85	0.97	0.92	0.95	1.00							
IT	2.14	2.14	2.23	2.21	2.34	1.00						
MEDIA	0.93	1.09	1.01	1.03	0.85	0.71	1.00					
METAL	1.03	1.14	1.11	1.13	0.89	2.87	1.13	1.00				
PHARMA	0.86	0.89	0.95	0.88	0.87	2.38	0.89	0.92	1.00			
PSUBANK	0.93	0.95	0.93	0.95	0.91	1.83	1.07	1.05	0.81	1.00		
REALTY	1.22	1.41	1.52	1.34	1.37	1.28	1.23	1.65	0.89	1.31	1.00	
MKT	0.94	1.05	0.99	1.04	0.91	2.40	1.00	1.08	0.89	0.97	1.37	1.00

Note: All bi-variate correlations are significant at 1%.

Table 4: Augmented Dickey Fuller (ADF) Unit Root Test Results

	Total Period				**Pre Crisis**				**Post Crisis**			
	Log of Index		**Log Return of Index**		**Log of Index**		**Log Return of Index**		**Log of Index**		**Log Return of Index**	
Sectors	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**
Auto	-0.96	0.77	-43.99	0.00	-0.89	0.79	-27.57	0.00	-0.76	0.83	-34.22	0.00
Bank	-1.75	0.40	-43.59	0.00	-0.47	0.89	-22.05	0.00	-1.87	0.35	-35.25	0.00
Energy	-1.68	0.44	-46.49	0.00	-0.06	0.95	-23.22	0.00	-2.68	0.08	-37.79	0.00
Finance	-1.56	0.50	-35.04	0.00	0.00	0.96	-22.43	0.00	-1.81	0.38	-35.38	0.00
FMCG	-0.25	0.93	-48.96	0.00	-0.42	0.90	-29.07	0.00	-0.40	0.91	-39.39	0.00
IT	-3.52	0.01	-50.34	0.00	-2.90	0.05	-30.28	0.00	-0.37	0.91	-38.95	0.00
Media	-2.05	0.27	-39.75	0.00	-1.06	0.73	-17.67	0.00	-1.89	0.34	-35.66	0.00
Metal	-1.63	0.47	-45.45	0.00	0.02	0.96	-28.14	0.00	-1.48	0.54	-35.60	0.00
Pharma	-0.03	0.95	-47.01	0.00	-1.17	0.69	-15.73	0.00	-0.17	0.94	-39.15	0.00
PSU Bank	-2.01	0.28	-43.29	0.00	-0.84	0.81	-22.00	0.00	-1.91	0.33	-34.85	0.00
Realty	-1.17	0.69	-37.28	0.00	-1.10	0.72	-10.36	0.00	-1.33	0.62	-35.75	0.00
MKT	-1.58	0.49	-44.70	0.00	0.14	0.97	-23.07	0.00	-1.73	0.41	-36.01	0.00

Table 5: Phillips–Perron **(PP) Unit Root Test Results**

	Total Period				**Pre Crisis**				**Post Crisis**			
	Log of Index		**Log Return of Index**		**Log of Index**		**Log Return of Index**		**Log of Index**		**Log Return of Index**	
Sectors	**Adj. t-Statistic**	**Prob.**	**Adj. t-Statistic**	**Prob.**	**Adj. t-Statistic**	**Prob.**	**Adj. t-Statistic**	**Prob.**	**Adj. t-Statistic**	**Prob.**	**Adj. t-Statistic**	**Prob.**
Auto	-0.93	0.78	-43.85	0.00	-0.90	0.79	-27.48	0.00	-0.71	0.84	-34.10	0.00
Bank	-1.69	0.43	-43.26	0.00	-0.50	0.89	-25.14	0.00	-1.72	0.42	-35.07	0.00
Energy	-1.76	0.40	-46.49	0.00	-0.24	0.93	-26.76	0.00	-2.68	0.08	-37.73	0.00
Finance	-1.59	0.49	-43.58	0.00	-0.05	0.95	-25.47	0.00	-1.66	0.45	-35.19	0.00
FMCG	-0.26	0.93	-48.95	0.00	-0.48	0.89	-29.12	0.00	-0.36	0.91	-39.42	0.00
IT	-3.50	0.01	-50.35	0.00	-2.89	0.05	-30.28	0.00	-0.30	0.92	-38.96	0.00
Media	-2.06	0.26	-39.78	0.00	-1.12	0.71	-17.68	0.00	-1.90	0.33	-35.69	0.00
Metal	-1.64	0.46	-45.40	0.00	0.01	0.96	-28.09	0.00	-1.43	0.57	-35.60	0.00
Pharma	-0.06	0.95	-47.05	0.00	-1.15	0.70	-26.41	0.00	-0.17	0.94	-39.15	0.00
PSU Bank	-2.02	0.28	-43.02	0.00	-0.96	0.77	-25.55	0.00	-1.79	0.38	-34.68	0.00
Realty	-1.20	0.68	-37.35	0.00	-1.20	0.68	-10.42	0.00	-1.39	0.59	-35.82	0.00
MKT	-1.66	0.45	-44.61	0.00	-0.13	0.94	-26.16	0.00	-1.53	0.52	-35.93	0.00

Table 6: *Kwiatkowski–Phillips–Schmidt–Shin* **(***KPSS***) Unit Root Test Results**

	Total Period						Pre Crisis						Post Crisis					
	Log of Index			Log Return of Index			Log of Index			Log Return of Index			Log of Index			Log Return of Index		
Sectors	**LM-Statistic**	**t-Statistic**	**Prob.**	**LM-Statistic**	**t-Statistic**	**Prob.**	**LM-Statistic**	**t-Statistic**	**Prob.**	**LM-Statistic**	**t-Statistic**	**Prob.**	**LM-Statistic**	**t-Statistic**	**Prob.**	**LM-Statistic**	**t-Statistic**	**Prob.**
Auto	5.09	732.07	0.00	0.07	2.00	0.05	3.41	652.86	0.00	0.13	1.36	0.17	3.86	740.77	0.00	0.12	1.48	0.14
Bank	5.16	889.75	0.00	0.08	1.27	0.20	3.30	792.86	0.00	0.06	1.61	0.11	2.69	1256.75	0.00	0.06	0.46	0.65
Energy	4.12	1244.15	0.00	0.12	0.79	0.43	3.39	1004.21	0.00	0.13	1.27	0.20	0.36	2562.95	0.00	0.06	0.08	0.94
Finance	5.16	737.83	0.00	0.09	1.45	0.15	3.43	631.38	0.00	0.10	1.93	0.05	2.59	1141.46	0.00	0.06	0.50	0.62
FMCG	5.68	775.48	0.00	0.06	2.48	0.01	3.30	742.23	0.00	0.19	1.32	0.19	4.78	892.68	0.00	0.06	2.11	0.03
IT	1.24	903.82	0.00	0.27	-0.35	0.73	0.48	405.09	0.00	0.24	-0.65	0.52	3.00	1006.41	0.00	0.25	0.90	0.37
Media	0.28	1226.78	0.00	0.13	0.63	0.53	2.26	584.31	0.00	0.04	2.14	0.03	0.32	1085.20	0.00	0.23	-0.39	0.70
Metal	3.24	690.87	0.00	0.20	0.68	0.50	3.32	517.31	0.00	0.18	1.38	0.17	0.77	951.82	0.00	0.12	-0.25	0.80
Pharma	5.66	951.12	0.00	0.08	2.23	0.03	3.35	1273.50	0.00	0.05	0.86	0.39	4.41	960.38	0.00	0.10	2.15	0.03
PSU Bank	4.49	878.47	0.00	0.17	0.70	0.49	2.78	868.25	0.00	0.06	1.29	0.20	1.23	1148.13	0.00	0.13	-0.09	0.93
Realty	3.80	392.24	0.00	0.05	-1.40	0.16	0.53	591.49	0.00	0.26	0.11	0.91	3.24	386.74	0.00	0.07	-1.48	0.14
MKT	4.35	1037.16	0.00	0.11	1.38	0.17	3.58	700.09	0.00	0.10	1.92	0.05	1.31	1617.82	0.00	0.08	0.36	0.72

Table 7: Variance Ratio Test Results (Total Period)

	Chow Denning Joint Test		Lo Mackinlay Test					Wright (2000) Test based on Ranks						Wright (2000) Test based on Signs					
Sectors	**Max IZI**		**Lags**	**2**	**5**	**10**	**20**	**Max IZI**	**Wald**	**2**	**5**	**10**	**20**	**Max IZI**	**Wald**	**2**	**5**	**10**	**20**
	(at period *)							**(at period *)**	**(Chi Square)**					**(at period *)**	**(Chi Square)**				
Auto	**Value(2*)**	3.91	**Var.Ratio**	1.13	1.17	1.17	1.32	**Value(2*)**	48.49	1.10	1.13	1.11	1.15	**Value(2*)**	45.84	1.08	1.12	1.14	1.20
	Probability	0.00	**Z Statistic**	3.91	2.55	1.76	2.36	**Probability**	0.02	5.12	3.07	1.61	1.49	**Probability**	0.04	4.05	2.73	2.01	2.01
Bank	**Value(2*)**	3.76	**Var.Ratio**	1.14	1.16	1.06	1.13	**Value(2*)**	73.59	1.12	1.18	1.12	1.15	**Value(2*)**	52.69	1.09	1.16	1.12	1.12
	Probability	0.01	**Z Statistic**	3.76	2.17	0.62	0.92	**Probability**	0.00	6.26	4.15	1.81	1.48	**Probability**	0.01	4.53	3.61	1.85	1.18
Energy	**Value(2*)**	1.75	**Var.Ratio**	1.07	1.05	1.00	1.06	**Value(2*)**	55.14	1.04	1.04	1.01	1.01	**Value(18*)**	37.83	1.01	1.05	1.06	1.11
	Probability	0.91	**Z Statistic**	1.75	0.54	-0.03	0.37	**Probability**	0.00	2.08	0.92	0.14	0.10	**Probability**	0.12	0.54	1.05	0.91	1.07
Finance	**Value(2*)**	3.55	**Var.Ratio**	1.13	1.14	1.04	1.12	**Value(2*)**	68.67	1.12	1.18	1.12	1.15	**Value(2*)**	40.10	1.08	1.17	1.17	1.23
	Probability	0.01	**Z Statistic**	3.55	1.91	0.39	0.80	**Probability**	0.00	6.03	4.11	1.81	1.52	**Probability**	0.10	4.13	3.80	2.49	2.31
FMCG	**Value(2*)**	0.61	**Var.Ratio**	1.02	1.01	1.00	1.03	**Value(2*)**	30.05	1.03	1.05	1.07	1.06	**Value(4*)**	22.97	1.04	1.10	1.15	1.19
	Probability	1.00	**Z Statistic**	0.61	0.14	0.04	0.23	**Probability**	0.41	1.62	1.11	0.97	0.63	**Probability**	0.79	2.06	2.29	2.20	1.91
IT	**Value(5*)**	1.61	**Var.Ratio**	1.00	0.97	0.94	0.97	**Value(2*)**	35.99	1.03	0.97	0.95	0.99	**Value(2*)**	34.47	1.05	1.04	1.04	1.12
	Probability	0.96	**Z Statistic**	-0.57	-1.61	-1.24	-0.29	**Probability**	0.17	1.29	-0.75	-0.77	-0.14	**Probability**	0.24	2.29	0.85	0.64	1.22
Media	**Value(29*)**	3.23	**Var.Ratio**	1.12	1.23	1.27	1.50	**Value(3*)**	55.21	1.10	1.18	1.16	1.26	**Value(3*)**	35.86	1.08	1.14	1.12	1.17
	Probability	0.03	**Z Statistic**	3.00	2.80	2.30	3.12	**Probability**	0.00	4.57	3.73	2.10	2.37	**Probability**	0.18	3.37	2.82	1.57	1.49
Metal	**Value(2*)**	2.81	**Var.Ratio**	1.10	1.13	1.15	1.30	**Value(2*)**	49.66	1.08	1.14	1.20	1.31	**Value(28*)**	38.47	1.06	1.12	1.20	1.37
	Probability	0.14	**Z Statistic**	2.81	1.82	1.49	2.07	**Probability**	0.01	4.13	3.30	2.94	3.13	**Probability**	0.12	2.85	2.84	2.97	3.69
Pharma	**Value(22*)**	1.96	**Var.Ratio**	1.06	1.13	1.17	1.29	**Value(2*)**	48.73	1.07	1.09	1.11	1.16	**Value(2*)**	51.21	1.08	1.17	1.23	1.35
	Probability	0.77	**Z Statistic**	1.47	1.62	1.48	1.94	**Probability**	0.01	3.29	2.16	1.57	1.57	**Probability**	0.02	4.21	3.95	3.41	3.48
PSU Bank	**Value(2*)**	3.80	**Var.Ratio**	1.14	1.19	1.12	1.19	**Value(2*)**	73.53	1.11	1.18	1.14	1.20	**Value(2*)**	49.26	1.09	1.18	1.19	1.26
	Probability	0.00	**Z Statistic**	3.80	2.56	1.17	1.41	**Probability**	0.00	5.61	4.16	2.03	2.06	**Probability**	0.02	4.70	4.13	2.84	2.60
Realty	**Value(4*)**	3.32	**Var.Ratio**	1.11	1.24	1.33	1.48	**Value(3*)**	79.45	1.15	1.30	1.39	1.48	**Value(4*)**	54.11	1.10	1.23	1.26	1.27
	Probability	0.03	**Z Statistic**	3.08	3.10	2.79	2.83	**Probability**	0.00	6.11	5.75	4.87	4.09	**Probability**	0.01	4.03	4.43	3.23	2.25
MKT	**Value(2*)**	2.69	**Var.Ratio**	1.11	1.14	1.14	1.28	**Value(2*)**	59.49	1.11	1.16	1.18	1.24	**Value(2*)**	67.02	1.11	1.21	1.30	1.48
	Probability	0.19	**Z Statistic**	2.69	1.68	1.14	1.72	**Probability**	0.00	5.39	3.74	2.62	2.44	**Probability**	0.00	5.37	4.89	4.45	4.87

Table 8: Variance Ratio Test Results (Pre Crisis Period)

	Chow Denning Joint Test		Lo Mackinlay Test					Wright (2000) Test based on Ranks						Wright (2000) Test based on Signs					
Sectors	**Max IZI**		**Lags**	**2**	**5**	**10**	**20**	**Max IZI**	**Wald**	**2**	**5**	**10**	**20**	**Max IZI**	**Wald**	**2**	**5**	**10**	**20**
	(at period *)							**(at period *)**	**(Chi Square)**					**(at period *)**	**(Chi Square)**				
Auto	**Value(2*)**	1.48	**Var.Ratio**	1.09	1.04	1.01	1.04	**Value(2*)**	32.29	1.09	1.06	1.01	0.97	**Value(2*)**	35.96	1.05	1.04	1.03	1.16
	Probability	0.99	**Z Statistic**	1.48	0.37	0.05	0.15	**Probability**	0.33	2.66	0.80	0.06	-0.19	**Probability**	0.24	1.53	0.60	0.23	0.97
Bank	**Value(2*)**	1.87	**Var.Ratio**	1.16	1.13	1.00	1.07	**Value(2*)**	45.53	1.13	1.15	1.02	0.98	**Value(2*)**	39.33	1.12	1.18	1.13	1.18
	Probability	0.84	**Z Statistic**	1.87	0.78	0.00	0.28	**Probability**	0.04	4.03	2.03	0.16	-0.10	**Probability**	0.11	3.53	2.47	1.13	1.12
Energy	**Value(2*)**	1.16	**Var.Ratio**	1.11	1.05	1.01	1.03	**Value(2*)**	42.98	1.05	1.02	0.95	0.82	**Value(30*)**	36.28	1.06	1.14	1.20	1.34
	Probability	1.00	**Z Statistic**	1.16	0.29	0.06	0.11	**Probability**	0.06	1.61	0.31	-0.46	-1.06	**Probability**	0.31	1.66	1.96	1.82	2.04
Finance	**Value(2*)**	1.64	**Var.Ratio**	1.15	1.12	0.99	1.06	**Value(2*)**	50.41	1.14	1.16	1.04	0.99	**Value(2*)**	32.21	1.11	1.17	1.20	1.34
	Probability	0.95	**Z Statistic**	1.64	0.71	-0.02	0.21	**Probability**	0.01	4.10	2.21	0.35	-0.04	**Probability**	0.42	3.26	2.32	1.80	2.06
FMCG	**Value(20*)**	1.15	**Var.Ratio**	1.03	1.05	1.14	1.28	**Value(7*)**	28.40	1.07	1.13	1.21	1.24	**Value(2*)**	26.70	1.09	1.17	1.28	1.33
	Probability	1.00	**Z Statistic**	0.49	0.35	0.79	1.15	**Probability**	0.54	2.01	1.77	1.90	1.42	**Probability**	0.59	2.73	2.37	2.53	2.00
IT	**Value(9*)**	1.19	**Var.Ratio**	0.99	0.98	0.95	0.98	**Value(10*)**	31.63	1.01	0.90	0.80	0.75	**Value(2*)**	29.18	1.03	1.00	0.95	0.98
	Probability	1.00	**Z Statistic**	-0.86	-1.16	-1.02	-0.20	**Probability**	0.33	0.40	-1.42	-1.74	-1.54	**Probability**	0.46	0.86	0.06	-0.44	-0.12
Media	**Value(2*)**	1.52	**Var.Ratio**	1.12	1.22	1.23	1.35	**Value(30*)**	30.38	1.04	1.00	0.87	0.78	**Value(7*)**	18.29	1.02	0.95	0.93	1.00
	Probability	0.98	**Z Statistic**	1.52	1.34	0.92	1.01	**Probability**	0.41	0.88	-0.01	-0.76	-0.88	**Probability**	0.95	0.30	-0.49	-0.39	0.00
Metal	**Value(2*)**	1.08	**Var.Ratio**	1.07	1.01	1.00	1.01	**Value(2*)**	24.66	1.05	1.00	1.00	0.97	**Value(30*)**	25.02	1.04	1.04	1.10	1.27
	Probability	1.00	**Z Statistic**	1.08	0.11	0.00	0.03	**Probability**	0.71	1.65	0.06	0.01	-0.21	**Probability**	0.72	1.13	0.50	0.86	1.65
Pharma	**Value(8*)**	2.20	**Var.Ratio**	1.13	1.24	1.35	1.40	**Value(2*)**	51.08	1.13	1.20	1.27	1.25	**Value(14*)**	49.82	1.14	1.31	1.52	1.75
	Probability	0.56	**Z Statistic**	2.14	2.00	2.10	1.78	**Probability**	0.01	3.79	2.70	2.44	1.49	**Probability**	0.06	4.19	4.29	4.60	4.54
PSU Bank	**Value(2*)**	1.88	**Var.Ratio**	1.15	1.12	1.01	1.12	**Value(2*)**	39.90	1.11	1.14	1.05	1.05	**Value(2*)**	25.70	1.10	1.18	1.17	1.16
	Probability	0.84	**Z Statistic**	1.88	0.76	0.07	0.48	**Probability**	0.08	3.23	1.98	0.44	0.32	**Probability**	0.67	2.86	2.47	1.50	1.00
Realty	**Value(4*)**	2.28	**Var.Ratio**	1.17	1.39	1.54	1.79	**Value(2*)**	21.86	1.16	1.23	1.24	1.22	**Value(2*)**	23.93	1.11	1.14	1.06	1.09
	Probability	0.49	**Z Statistic**	2.04	2.06	1.91	1.99	**Probability**	0.86	1.94	1.27	0.87	0.53	**Probability**	0.76	1.31	0.80	0.22	0.22
MKT	**Value(2*)**	1.25	**Var.Ratio**	1.12	1.06	1.04	1.11	**Value(2*)**	56.04	1.08	1.01	0.94	0.80	**Value(30*)**	66.57	1.11	1.18	1.40	1.78
	Probability	1.00	**Z Statistic**	1.25	0.34	0.17	0.37	**Probability**	0.01	2.44	0.16	-0.54	-1.19	**Probability**	0.14	3.20	2.47	3.57	4.69

Table 9: Variance Ratio Test Results (Post Crisis Period)

	Chow Denning Joint Test		Lo Mackinlay Test					Wright (2000) Test based on Ranks						Wright (2000) Test based on Signs					
Sectors	Max IZI		Lags	2	5	10	20	Max IZI	Wald	2	5	10	20	Max IZI	Wald	2	5	10	20
	(at period *)							(at period *)	(Chi Square)					(at period *)	(Chi Square)				
Auto	Value(3*)	4.08	Var.Ratio	1.15	1.26	1.28	1.51	Value(2*)	40.78	1.11	1.17	1.15	1.21	Value(2*)	42.04	1.10	1.16	1.19	1.21
	Probability	0.00	Z Statistic	3.97	3.14	2.35	3.05	Probability	0.09	4.37	3.12	1.77	1.71	Probability	0.07	3.89	2.94	2.29	1.72
Bank	Value(2*)	3.51	Var.Ratio	1.13	1.17	1.09	1.16	Value(2*)	53.92	1.12	1.19	1.15	1.19	Value(2*)	39.55	1.07	1.15	1.12	1.07
	Probability	0.01	Z Statistic	3.51	2.27	0.80	0.97	Probability	0.00	4.67	3.45	1.81	1.52	Probability	0.10	2.99	2.67	1.45	0.55
Energy	Value(2*)	1.32	Var.Ratio	1.06	1.05	0.99	1.09	Value(3*)	47.47	1.03	1.03	1.00	1.02	Value(30*)	41.76	0.99	0.99	0.98	0.96
	Probability	1.00	Z Statistic	1.32	0.49	-0.06	0.43	Probability	0.02	1.19	0.59	-0.02	0.16	Probability	0.07	-0.60	-0.15	-0.24	-0.33
Finance	Value(2*)	3.33	Var.Ratio	1.12	1.15	1.06	1.15	Value(2*)	51.56	1.11	1.18	1.14	1.18	Value(4*)	37.00	1.07	1.16	1.15	1.16
	Probability	0.02	Z Statistic	3.33	1.90	0.50	0.83	Probability	0.01	4.34	3.26	1.61	1.42	Probability	0.17	2.69	3.00	1.74	1.27
FMCG	Value(30*)	1.00	Var.Ratio	1.02	0.99	0.92	0.91	Value(30*)	40.55	1.01	1.00	0.97	0.96	Value(3*)	30.53	1.01	1.06	1.07	1.11
	Probability	1.00	Z Statistic	0.40	-0.09	-0.61	-0.53	Probability	0.08	0.39	-0.08	-0.36	-0.33	Probability	0.44	0.50	1.05	0.81	0.86
IT	Value(30*)	0.83	Var.Ratio	1.03	0.93	0.96	1.07	Value(2*)	34.16	1.03	1.01	1.02	1.10	Value(2*)	27.54	1.06	1.06	1.09	1.19
	Probability	1.00	Z Statistic	0.73	-0.83	-0.34	0.41	Probability	0.24	1.30	0.10	0.24	0.80	Probability	0.59	2.25	1.01	1.12	1.57
Media	Value(30*)	3.00	Var.Ratio	1.11	1.23	1.26	1.49	Value(3*)	50.16	1.11	1.21	1.18	1.28	Value(3*)	38.74	1.09	1.19	1.16	1.21
	Probability	0.08	Z Statistic	2.56	2.41	1.94	2.73	Probability	0.01	4.53	3.86	2.14	2.23	Probability	0.13	3.59	3.42	1.94	1.68
Metal	Value(3*)	3.01	Var.Ratio	1.12	1.20	1.25	1.48	Value(3*)	55.96	1.09	1.20	1.25	1.39	Value(25*)	44.98	1.07	1.17	1.25	1.41
	Probability	0.07	Z Statistic	2.86	2.39	1.97	2.62	Probability	0.00	3.63	3.62	3.02	3.18	Probability	0.03	2.69	3.14	3.01	3.34
Pharma	Value(30*)	1.35	Var.Ratio	1.02	1.07	1.06	1.24	Value(2*)	42.53	1.03	1.03	1.00	1.09	Value(2*)	33.47	1.05	1.09	1.06	1.11
	Probability	1.00	Z Statistic	0.39	0.64	0.40	1.19	Probability	0.05	1.13	0.60	0.04	0.73	Probability	0.28	2.10	1.70	0.77	0.90
PSU Bank	Value(2*)	3.62	Var.Ratio	1.14	1.23	1.18	1.24	Value(2*)	61.35	1.11	1.20	1.16	1.25	Value(2*)	47.18	1.09	1.18	1.20	1.30
	Probability	0.01	Z Statistic	3.62	2.98	1.58	1.54	Probability	0.00	4.49	3.56	1.94	2.02	Probability	0.02	3.71	3.29	2.36	2.44
Realty	Value(4*)	3.06	Var.Ratio	1.11	1.24	1.32	1.47	Value(3*)	77.86	1.14	1.31	1.40	1.50	Value(4*)	53.25	1.09	1.24	1.28	1.28
	Probability	0.06	Z Statistic	2.84	2.86	2.59	2.67	Probability	0.00	5.77	5.60	4.79	4.06	Probability	0.01	3.79	4.38	3.29	2.23
MKT	Value(2*)	2.59	Var.Ratio	1.11	1.18	1.18	1.36	Value(3*)	53.88	1.11	1.21	1.23	1.33	Value(3*)	43.81	1.10	1.24	1.26	1.33
	Probability	0.24	Z Statistic	2.59	1.97	1.31	1.83	Probability	0.00	4.57	3.92	2.72	2.62	Probability	0.03	4.19	4.38	3.06	2.70

Table 10: Summary Results of Unit Root and Variance Ratio Tests on All Samples

	Total Period							Pre Crisis							Post Crisis						
	Unit Root Tests			Variance Ratio Tests				Unit Root Tests			Variance Ratio Tests				Unit Root Tests			Variance Ratio Tests			
Sectors	ADF	PP	KPSS	Chow Denning	Lo Mackinlay	Wright Ranks	Wright Signs	ADF	PP	KPSS	Chow Denning	Lo Mackinlay	Wright Ranks	Wright Signs	ADF	PP	KPSS	Chow Denning	Lo Mackinlay	Wright Ranks	Wright Signs
Auto	E	E	IE	IE	IE	IE	IE	E	E	E	E	E	E	E	E	E	E	IE	IE	E	E
Bank	E	E	E	IE	E	IE	IE	E	E	E	E	E	IE	E	E	E	E	IE	IE	IE	E
Energy	E	E	E	E	E	IE	E	E	E	E	E	E	E	E	E	E	E	E	E	IE	E
Finance	E	E	E	IE	E	IE	E	E	E	E	E	E	IE	E	E	E	E	IE	E	IE	E
FMCG	E	E	IE	E	E	E	E	E	E	E	E	E	E	E	E	E	IE	E	E	E	E
IT	IE	IE	E	E	E	E	E	IE	IE	E	E	E	E	E	E	E	E	E	E	E	E
Media	E	E	E	IE	IE	IE	E	E	E	IE	E	E	E	E	E	E	E	E	IE	IE	E
Metal	E	E	E	E	IE	IE	E	E	E	E	E	E	E	E	E	E	E	E	IE	IE	IE
Pharma	E	E	IE	E	E	IE	IE	E	E	E	E	E	IE	E	E	E	IE	E	E	E	E
PSU Bank	E	E	E	IE	IE	IE	IE	E	E	E	E	E	E	E	E	E	E	IE	IE	IE	IE
Realty	E	E	E	IE	IE	IE	IE	E	E	E	E	IE	E	E	E	E	E	E	IE	IE	IE
MKT	E	E	E	E	E	IE	IE	E	E	E	E	E	IE	E	E	E	E	E	E	IE	IE
E: Random Walk or Weak Form Efficient; IE: Weak Form Inefficient																					