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The Dynamic linkage among Sectoral Indices: Evidence from Indian Stock Market

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Abstract

The sectoral indices will act as a benchmarking indicator for observing the performance stocks from a particular sector. An in depth examination on causal impact of a sector on the other sectors and the market index can assist the investors and portfolio managers to a great extent in addressing some key issues relating to portfolio revision. In this study we explore the co-movements of twelve NSE sectoral indices and Nifty on a daily basis from January 2012 to December 2016. The Granger causality test produced the evidence of strong bidirectional linkage between private banking sector and nifty. With respect to IT and FMCG sectors a significant unidirectional causal affiliation was reported with Nifty. The cross sectoral examination results confirmed that irrespective of shareholding pattern a strong bidirectional relation can be observed with banking stocks.

Keywords: Sectoral indices, Descriptive statistics, Unit root test, Granger Causality test

1. Introduction

Investment decision in stock market is always subject to a close inspection on risk return characteristics. The investors would prefer stocks of those sectors which provide maximum return with minimum level of risk. Modern portfolio theory suggests that investors should construct a portfolio of multiple assets in order to get maximum return at a given level of risk (Markowitz, 1952). In the

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practical context analysis of risk- return aspects each company seems to be tedious due to the requirement of large input data and enormous time. With reference to the above constraints investors usually resorts to index models for portfolio selection. Index models propose that the relationship between a pair of securities can indirectly be measured by comparing each security to a common factor of 'market performance index' (Sharpe, 1963). For instance if we are taking National stock exchange of India; the investors will come across more than seven thousand companies from diversified sectors. In this context individual risk-return assessment of each stock seems to be impracticable. At this point the portfolio selection can be employed by observing the performance of benchmarking indices from various sectors. NSE has created sectoral indices for benchmarking the performance companies from different sectors. Such benchmarking indices can greatly assist the investors in their portfolio creation process.

Sectoral linkage has become a debated topic in the portfolio creation process. The investors tend to create a portfolio by allocating capital to stocks from different sectors. Their allocation is purely subject to the performance and anticipated growth of concerned sector. The effect of random walk can also influence in the stock selection process. It refers that the investors tend to invest with some stocks based on favorable information from the concerned sector. And they keep on revising their portfolio in accordance with new piece of information (Fama, 1965). As far as investors are concerned the performance of various sectors can be observed from the respective sectoral indices and timely portfolio revision can be undertaken based on index movements. The price movements of stocks in one sector might have an influence on stocks in another sector. Understanding this linkage between various sectors would greatly assist the investors in portfolio revision process. The real motivation behind this study was to observe the linkage among various sectors in Indian stock market and to suggest some tips to the investors for portfolio revision process.

2. Literature Review

A survey on existing literature was carried out to examine the established linkage among various sectors and market indices.

Kaur, Bordoloi and Rajesh (2009) conducted an in depth study on inter sector linkage in India. A strong bi-variate long-run relationship between manufacturing, agriculture and service sector was observed. A long run equilibrium was found between service sectors like 'trade, hotels, transport & communication' and manufacturing sectors. A long run association is also found with banking and manufacturing sectors.

Choudhuri and Chatterjee (2015) examined the linkage between Indian service sector, industrial sector and agricultural sector by using econometric data modeling techniques. It is found that industrial sector is positively impacted by financing, insurance, real estate and banking sector as well as by community, social and personal services.In a similar line of research Uddin (2015) examined the casual relationship between agriculture, industry and service sector for economic growth in Bangladesh. Unidirectional granger causality from services sector to agriculture and industry sector to services sectors was reported.

A research work by Apergis and Lambrinidis (2011) found the evidence of long term relationship between real estate market with US and UK stock markets. A study on Istanbul Stock Market (ISE) reports bidirectional causality in the longrun for all sector indices except Banking- Holding and Holding-Commerce Index pairs. For the short-run causality channels, banking granger causes Chemistry, Holding and Communication. The granger causality test also confirmed that banking sector is the most influential sector in ISE (Vardar, Tunc and Aydogan, 2012). Mustafa (2012) used granger causality test to prove the long run relationship between market index (TASI) and finance index (TFIN). However the study states that evidence of such linkage is absent in short run. In another research conducted at Turkish economy states that the movement of technology index transmitted to the economy immediately. But the movement of financial sector will reflect very slowly to the market index (Yuksel and Bayrak, 2012).

A study by Sharabathi (2013) look into the relationship between various sectors and Amman Stock exchange. The results reveals that the financial services sector including banking have a prominent influence of the major stock market index. Cao, Long and Yang (2013) performed correlation analysis of sectoral indices in China. The results reveal that financial, industrial and energy sectors have high correlation with the major market index. But information technology, telecommunication services, and utilities have a low correlation with the market index.

Sharma (2014) examined the causal relation between five major sectoral indices and nifty and found a noteworthy unidirectional relation between bank-auto and metal-IT sectors. It is also reported to have a unidirectional causal relation between the metal sector and nifty. Another study on NSE Nifty and its correlation with sectoral indices concluded that Niftycan influence the performance of all sectoral indices. It is observed that the influential power of IT and FMCG sectors are comparatively more than that of other sectors (Nagendra, Haritha and Ravi, 2014). A contrary view can also be observed with another study as the results signify that there exist difference between the performance and connection

between NSE sectoral indices (Shanmugasundaram and Benedict, 2013). In another study Rajamohan and Muthukamu (2014) claims that the performance of banking sector stocks can influence the performance of stocks in other sectors.

Samsi, Yousof and Chiong (2012) observed a strong causal relationship between the banking sector and reality sector in Malaysia. They employed granger causality test to explore this relation. In Chinese market also a causal relation between reality and banking sector was observed (Li,Pan, He, 2016).

Ahmed (2016) examined the dynamic linkage of sectoral indices in Egyptian stock market. The granger causality test results produced the evidence of bidirectional causal relationship between construction & chemicals, financial services & chemicals and financial services &Real estate sectors. After splitting major international markets in to two zones; Kouki, Harrathi, Haque (2011) studied the impact of volatility spillover effect among sectoral indices. Granger causality test produced the evidence of high integration between sectors like the banking; real estate and oil, with the financial service and industrial.

A study conducted by Bi and Yousuf (2014) employed granger causality test for checking the linkage between power sector stocks with nifty. The study reports that, for most of the stocks, there was bi-directional causality exists from the daily returns of both index and the selected stocks. A similar line of result was also observed with a study by Arouri and Rault (2010) as the result produced the evidence of strong bidirectional linkage between oil stocks and Saudi Arabian stock market.

Saeed (2012) employed a study to explore the impact of macroeconomic factors on sectoral indices at Karachi Stock Exchange. The study reveals that Exchange Rate and Oil prices have significant impact on specific sectors like Oil and Gas sector, Automobile and Cable and Electronics. In another research Tripathi ,Parashar and Jaiswal (2014) studied the long-term relationship between various macro economic variables like USD fluctuations, crude oil rate, foreign institutional investment, current account balance, FOREX reserves on sectoral indices .They have taken automobile, banking, energy, FMCG and IT sectors. The results reveal that amongstall macroeconomic variables only Foreign Institutional Investment (FII) affects all sectoral indices however rest of the macroeconomic variables selectively affect different sectoral indices in India.

Qiao, Xia nd Lee (2016) examined the sectoral network linkage in Chinese market. The study revealed that Industrial Index and Consumer Discretionary Index, Capital goods and Information Technology as well as Construction, Chemicals and Real-estate have long been the central nodes and are highly

correlated to other indices.Shehrawat and Giri (2017) examined the relationship between Indian stock market and economic growth from a sectoral perspective, the results indicates that there is causality running from the GDP of electricity, gas and water sector and inflation to electricity, gas and water index in India, which shows that a change in GDP of electricity, gas and water sector and change in inflation causes a change in electricity, gas and water index. In another study Freytag and Fricke (2017) sectoral linkage of financial services of Nigerian and Kenyan economies. The study justified the strong interconnection between financial services and information technology sectors. In a generalized context Singh (2016) provides evidence of strong long run linkage between agriculture-industry and service sectors in India. But in short run context this relation is weak.

We can also examine the response of sectoral indices against some market contingencies. Arif and Suleman (2017) tested the impact of terrorist attacks on different industries listed in the Karachi Stock exchange's KSE-100 index. It was noted that various industries responded differently to terrorism. Some industries experienced decrease in price, while others recorded an increase. The financial, tobacco and health and care sectors experienced a rise in prices. In contrast, oil and gas, auto and parts, industrial and telecom sectors experienced a fall in prices.

From the above review of literature, we observed several research works explaining the causal impact of sectoral indices on the major index and vice versa. Some literatures check the causal impact among various sectors. But it can also be noted that such works were carried out in international context. In Indian scenario a research in this line hang about totally untapped. This research gap really motivated me to carry out a study by exploring the dynamic linkage among sectoral indices in Indian context.

3. Aim and Scope

This study was carried out with the following objectives

i. To examine the dynamic linkage of various sectoral stocks through benchmarking indices.

ii. To study the causal impact and the extent of influence of various sectors on Indian stock market.

The outcome of this study can greatly assist investors, portfolio managers, policy makers, and researchers to a great extent. From investors point of view deep understanding on sectoral connections would enable them wisely select stocks

and also help them to set some preconditions for portfolio revision.Moreover the risk attributed to their investment can be diversified by channeling capital from one sector to another. Policy makers like RBI, SEBI, and government can observe how various sectors are connected together. It is sure that their policy decisions pertaining to one sector can influence other sectors also. In this line they can take necessary precautionary measures while implementing some crucial policy decisions. Knowledge on causal relation among various sectors will help portfolio managers, mutual funds to maintain NAV of their fund through timely revision. In theoretical perspective 'any news related to a particular sector can positively or negatively influence the stocks of the concerned sector'. But a profound awareness on interconnection between sectors will force the portfolio managers to think 'how positive or negative news pertaining to one sector can influence other sectors'. Outcomes of this study will also offer abundant opportunity for future researchers by opening a scope to do more detailed research on some specific sectors.

4. Research Methodology

This study was developed on the basis of daily time series data of NSE sectoral indices from 1st January 2012 to 31st December 2016. The work extensively covers twelve sectoral indices viz. Automobile, Banking, Energy, FMCG, Financial Services, Information Technology, Media, Metal, Pharmaceuticals, PSU Banks, Private Banks and Reality. Along with the above sectoral indices this study also considers movement of NSE-Nifty index for the aforesaid period. The daily closing price observations of all sectoral indices have been collected from www.nseindia.com.

Initially daily returns of sectoral indices and Nifty was computed in Microsoft excel by using the following formula;

$$R = (P1-P0)/P0*100 \quad \ldots\ldots(1)$$

In the above equation; R denotes return, P1 stands for current day's price and P0 stands for price of the previous day. The formula generated 1237 daily returns data each for sectoral indices and Nifty. EViews 9 statistical package were used for data analysis. Necessary pre tests like Augmented Dickey Fuller (ADF) test, Phillips - Perron (PP) test were employed for checking the presence of unit root.

4.1. Augmented Dickey Fuller (ADF) Test

Testing unit root has become a concern for econometric modeling and forecasting. This research followed the statistical model suggested by Dickey

and Fuller (1979, 1981) and by Dickey (1984) for checking stationarity of the collected time series data. This empirical analysis is conducted based on the assumption that the time series data's used for mathematical modeling are not stationary. Stationary time series are those which the statistical properties will remain constant over a period of time. If the series is stationary it is understood that its statistical properties will be the same in the future as they have been in the past. It is also interesting to check whether the shocks in the collected data have permanent or transitory effect. This study used an improved version of the Dickey–Fuller test for a larger and more complicated set of time series models.

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad \text{.....(2)}$$

Where Yt represents time series to be tested, á is a constant, â the coefficient on a time trend and p the lag order of the autoregressive process and et is the white noise error term. Imposing the constraints á = 0 and â = 0 corresponds to modeling a random walk and using the constraint â = 0 corresponds to modeling a random walk with a drift. The test is usually carried out on the assumption that "the time series data is not stationary". If the test statistics is found to be negative number the chance for rejection of null hypotheses is higher.

4.2. Phillip - Perron (PP) Test

Phillip Perron test is a unit root test in statistics developed by Phillip and Perron (1988). The major advantage of Philips-Perron test is that it is non-parametric, i.e. it does not require selecting the level of serial correlation as in ADF. PP test also takes the same estimation scheme as in ADF test, but corrects the test statistic to conduct for autocorrelations and heteroscedasticity.

$$\tilde{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2 f_0^{1/2} s} \quad \text{.....(3)}$$

Where á^ is the estimate, and t á t ratio ofá, se á^ is coefficient standard error, and 's' is the standard error of the test regression. In addition, ã0 is a consistent estimate of the error variance; k is the number of regressors. The remaining term, f0, is an estimator of the residual spectrum at frequency zero. The PP test is carried out with null hypothesis that the variable contains a unit root, and the alternative is that the variable was generated by a stationary process.

4.3. Granger Causality Test

Granger causality test investigates the ability to predict the future values of a time series using prior values of another time series. This statistical hypothesis

test was first proposed in 1969 by Clive Granger. In economics this is a widely used tool for measuring the usefulness of a time series data in forecasting another time series. The essential pre-condition for applying Granger Causality test is to ascertain the stationarity of the variables in the pair. A time series is said to Granger-cause of another if it can be shown, usually through a series of t-tests and F-tests on lagged values; and values of the former provide statistically significant information about future values of the later. Another requirement for the Granger Causality test is to find out the appropriate lag length for each pair of variables. For this purpose, the researcher used the automatic lag order selection method.

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \ldots + \beta_l x_{-l} + \epsilon_t$$
$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \ldots + \beta_l y_{-l} + u_t \quad \ldots\ldots\ldots(4\&5)$$

For the above 'x' is independent time series; and 'y' is dependent time series. In the above equation á denotes a constant, â is the coefficient and '? 'representing the error term. The null hypothesis is that 'x' does not Granger-cause 'y' in the first regression and that 'y' does not Granger-cause 'x' in the second regression. For instance 'y' is said to be Granger-caused by 'x' ; if'x' helps in the prediction of 'y', or equivalently if the coefficients on the lagged 'x' 's are statistically significant.

5 Empirical Analysis and Discussions

The descriptive statistics of average mean returns, median, standard deviations, skewness and kurtosis etc. of sectoral indices and nifty were exhibited in Table.1. Normality of the selected time series data was also checked by means of employing Jarque-Bera test.

Table 1: About Here

From Table 1 it can be inferred that Private Banks generated the maximum average daily of 0.095 percent throughout the study period. An average daily return of 0.05 percent observed for NSE benchmarking index Nifty. Automobile, Banking, FMCG, Financial Services, Media and Pharmaceutical sectors were outperformed nifty with mean returns of 0.088 percent, 0.077 percent, and 0.064 percent, 0.073 percent, 0.079 percent and 0.071 percent respectively. The least mean return was generated by reality sector with 0.017 percent. In terms of risk Nifty accomplished the better position with the lowest standard deviation of 0.98 percent. This indicates that the stock listed with nifty exhibited lesser volatility than that of stock listed with sectoral indices. Moreover the reported spread between maximum and minimum daily return of Nifty were 3.81 percent and -

5.92 percent respectivelyfor the study period. From sectoral indices the lesser volatility was reported for Pharmaceutical stocks (1.08 percent). This points that pharmaceutical stock can be considered as a heaven for risk averse investors. During the study period pharmaceutical sector generated a maximum daily return of 5.11 percent and with a minimum daily return of -6.99 percent. FMCG sector reported to have a volatility of 1.09 percent. Reality sector exhibited the highest volatility of 2.23 percent; signaling towards the risk in reality stocks. The above fact also pointing that the investors need to take adequate precautions while selecting stocks from reality sector.

The return series for Automobile, Energy, FMCG, IT, Media, Pharmaceutical, and Reality sectors reported to have negative skewness -0.16 percent, -0.29 percent, -0.22 percent, -0.78 percent, -0.16 percent , -0.51 percent and -0. 27 percent respectively suggesting that these distributions have long left tail. The return distributions of other sectoral indices exhibited a positive skewness during the study period. The obtained positive kurtosis values for the time series data indicate that the distributions have heavier tails and a sharper peak than the normal distribution.

Jarque- Bera test was employed to check the normality of the return series. The test was carried on the assumption that the return series data is normally distributed. Table 1 gives clear evidence of Jarque-Beratest results. It is clear that the probability values obtained for all return series in Jarque–Bera test is statistically significant at 5 percentage level of significance (p -values $0.00 < 0.05$). This leads to rejection of null hypotheses by accepting the fact that the return series are not normally distributed (Null hypothesis is rejected). These facts are supporting to the findings that the sample data do not have the skewness and kurtosis matching to a normal distribution.

Unit root of the returns data were examined by using Augmented Dickey Fuller (ADF) test and Phillips Perron (PP) tests. Table 2 will provide the details of test results. These tests were conducted with a null hypothesis that the time series data is not stationary.

Table 2: About Here

ADF test showsthat the obtained test statistics of sectoral indices and Nifty falling within the critical values of -3.435, -2.863 and -2.567 at corresponding significance levels of one percent, five percent and ten percent respectively. If the result of test statistics is falling within critical values leads to rejection of null hypotheses. In the above case null hypotheses is rejected; in other words it

can be inferred that the time series data is stationary. Moreover the probability values obtained (p.values of 0.000) for the test statistics are much below the significance level of 0.01, 0.05 and 0.1.

The Phillip–Perron test results also agree with the findings of ADF test. The obtained t- values of sectoral indices and Nifty falling within the corresponding critical values of -3.435,-2.863,-2.567 at one percent, five percent and ten percent level of significance. This spot towards rejection of null hypotheses. The obtained probability values of PP test are also duly falling within the corresponding significance levels of one percent, five percent and ten percent (0.000<0.01,0.000<0.05, 0.000<0.1).

Granger causality test was used for exploring the causal relationship between sectoral indices and Nifty. Table 3 will exhibit the result of Granger causality test. The lag order selection criteria suggested two lag periods for performing Granger causality test.

Table 3: About Here

The test is performed on the hypothecation that 'x' does not Granger-cause 'y' in the first regression and that 'y' does not Granger-cause 'x' in the second regression. From table 3 it is observed that automobile sector can granger cause to financial services, media, pharmaceutical and Pvt. bank sectors as the obtained probability values (0.02.0.00, 0.04 and 0.04) falling within five percent significance level. But this relation is found to be unidirectional. FMCG can Granger cause to automobile, media, reality and nifty. (p.values of 0.02, 0.00, 0.03 and 0.03). The banking sector can Granger cause to financial services, media, pharmaceutical, PSU banks and Pvt. Banks with probability values of 0.02.0.00.0.00.0.01 and 0.03 respectively. Metal industry is found to have unidirectional causal relation with financial services, media and pharmaceutical sectors with significant probability values of 0.03,0.00 and 0.00 respectively.

Interestingly it is found that the sectoral movements of FMCG, IT and Pvt. Banks can influence the movement of benchmarking index nifty with corresponding probability values of 0.03, 0.03 and 0.00. This results will add to the existing literature of Vardar,Tunc and Aydogan (2012), Sharabathi (2013), Cao, Long and Yang (2013)by confirming the well established causal relation between financial sectors including banking and major market index. The Causal relation of IT stocks to the main market index was also reported in Turkish market (Yukasl and Bayrack, 2012). In Indian context of the study result will also agree with

the findings of Nagenra, Harita and Ravi (2014) as they produced early evidence on the influence by IT and FMCG sectors on nifty index.

Granger causality test also shows that nifty movements can notably influence media, pharmaceutical and Pvt. Banks only with consequent probabilities of 0.00, 0.00 and 0.02. These findings will strongly disagree with the study results of Sharma (2014) as they found that nifty movements can influence all sectoral indices.

In addition to this no linkage was observed between energy sector and nifty. This study result will stand as a contradiction to the findings of Arouri and Rault (2010), Bi, Yousaf (2014) as they found strong bidirectional causal relation with energy sector and major market index.

From the Granger causality test a strong bidirectional relationship can be observed with Bank-Pvt. Bank, Bank-PSU Bank and Pvt. Bank–PSU Bank as the obtained p.values of causality test falling very much within the significance limit of five percent. These results spot that the banking stocks are inter connected together. The surprising fact is that only a unidirectional relation was observed with financial services sector and bank. The causal relation between nifty- private banks is bidirectional pointing that the up and down movements of private banking stocks can influence the major market index. The above study results are not fully agreeing with the claims of study by Rajamahan and Muthukamu (2014); as they acknowledged that banking sector can influence all other sectoral stocks.

The media sector is found to be influenced by all sectors as it is reported to have a significant causal impact of other sectors (obtained p values are 0.00 in all cases). Despite this fact strong bidirectional relationship was observed between media-energy, media- financial services, media- private banks and media-reality sectors.

The test further observed a strong bidirectional linkage between reality-private banking sectors with significant probability values of 0.01 and 0.04 respectively. This finding will agree with the contributions of Samsi, Yousof, Cheong (2012), Li, Pan, He (2016) as they observed a strong early interconnection between banking and reality sectors.

6. Concluding observations

Knowledge on sectoral interconnection can play a vital role in portfolio reallocation. This research work intended in analyzing the linkage between

various sectors via some benchmarking indices. With a close inspection of data from twelve different sectors and the major market index; this study has generated some eye-catching results. The descriptive statistics of the data highlighted the nature of performance of various sectors and market index. It is found that during the study period private banks generated the utmost average returns. Besides private banks; the sectors like automobile, banking, financial services, FMCG, media and pharmaceutical sectors produced a better return that of the benchmarking index nifty. The above results show that the investors have a great scope of investment in such sectors. Risk adverse investors can opt for shares from pharmaceutical and FMCG sectors as these sectors exhibited lesser volatility throughout the time of study. Further ADF and PP tests prove that the time series data used for this study is stationary.

Granger causality test employed for detecting the linkage between various sectors and nifty. It is found to have a unidirectional linage between FMCG and IT sectors with nifty. It shows that any movement in the above sectors can cause significant variation in nifty index. And this relation is bidirectional with private banks and nifty, strongly points that any variation in nifty can affect private banks and vice versa. Hence it can be inferred that a close observation on the FMCG, IT and private banking sectors will facilitate the market participants in identifying the direction of nifty movements. Nifty is used as a benchmark for economic performance in India and consequently these results will enable the policy makers to bring some drastic changes through proper market intervention. A strong bidirectional relation was observed among banks, PSU banks and private banks. This refers that irrespective of the shareholding pattern, we can find a powerful linkage among stocks in banking sector. Surprisingly it is found that the media sector is affected by the fluctuation from all sectors. A significant unidirectional relation can be identified with automobile sector to financial services, media, pharmaceutical and private banking sectors. So the investors can keep in their mind that any variation in automobile sector will subsequently influence the financial services, private banks, media and pharmaceutical sectors. The test results also produced the evidence of bidirectional linkage among media-energy, media- financial services, media- private banks, media-reality, and reality-private banking sectors. The bidirectional linkage tips that any fluctuation in stock price of one sector may consequently affect the other sector.

Understanding this relation among various sectors will assist the portfolio managers and investors in portfolio revision process. After considering the significance and extent of linkage among various sectors investors can properly channelize their fund. For instance a strong bidirectional linkage can be observed with private banks and reality sectors. So the investors have a great awareness

that any up-down oscillation in private banking stocks can consequently affect reality stocks too and vice versa. Depending on this information they can take adequate precautions by purchasing or selling reality stocks in their portfolio based on fluctuation of private banking stocks.

7. Scope for Future Research

A couple of limitations associated with this study can also be highlighted. This study can produce only the evidence of long run relation among various sectors. In short run this linkage may drastically vary. The results of this study were derived on the basis of econometric perspective rather than asset pricing perspective. And most importantly the volatility shocks across sectors may go beyond the scope of this study. The above cited limitations in this study open an ample scope for future research works on some topics like;

a. Short run linkage of sectoral stocks with reference to benchmarking indices.

b. Cross relationship among sectoral indices across developing economies.

c. Linkage with volatility and return among sectoral stocks.

References

Ahmed, W.M.A. (2016). The Dynamic Linkage among Sectoral Indices: The case of Egyptian Stock market. International Journal of Economics and Finance, 8(4), 23-38.

Apergis,N and Lambrinidis,L. (2011). More Evidence on the Relationship between the Stock and the Real Estate Market. Briefing Notes in Economics, 85,1-18.

Arif, I. and Suleman, T. (2017). Terrorism and Stock Market Linkages: An Empirical Study from a Front-line State. Global Business Review, 18(2), 365-378.

Arouri, M.E.H. and Rault, C. (2010). Causal relationships between oil and stock prices: some new evidence from gulf oil-exporting countries. Economieinternationale, 2/2010 n° 122), 41-56.

Bi,Z., Yousaf, A and Bi, A. (2014). A study on the Power sector stocks with Nifty index using Granger Causality Test. AIMA Journal of Management & Research, 8 (3/4).1-17.

Cao,D., Long, W. and Yang,W. (2013). Sector Indices Correlation Analysis in China's Stock Market. Procedia Computer Science, 17 (1), 1241 – 1249.

Choudhuri,P.R. and Chatterjee,b. (2015). Inter-sectoral Linkage and Openness in India's Services Sector Growth. Money & Finance –ICRA Bulletin, November 2015,63-85.

Dickey DA, Fuller WA (1979). Distributions of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, 74(366), 427–431.

Dickey DA, Fuller WA (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, 49(4), 1057–1072.

Fama, E. (1965).The Behavior of Stock Market Prices. Journal of Business, 38, 34–105.

Freytag,A. and Fricke,S. (2017). Sectoral linkages of financial services as channels of economic development An input–output analysis of the Nigerian and Kenyan economies. Review of Development Finance, 7(1), 36-44.

Granger, C. W. J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. Econometrica, 37 (3), 424–438.

Kaur, G., Bordoloi, S. and Rajesh, R. (2009). An Empirical Investigation of the Inter-Sectoral Linkages in India. Reserve Bank of India Occasional Papers, 30(1), 29-72.

Kouki,I. , Harrathi,N. and Haque,M. (2011). A Volatility Spillover among Sector Index of International Stock Markets. Journal of Money, Investment and Banking, 22(1), 32-45.

Li, S., Pan, Q. and He, J. (2016). Impact of systemic risk in the real estate sector on banking return. SpringerPlus, 5, 1-9.

Markowitz, H. (1952). Portfolio Selection. The Journal of Finance, 7(1),77-91.

Mustafa,M.J. (2012). Short-Run and Long-Run Dynamics Linkages among the Saudi Arabia Stock Market Indices. ProsidingPersidanganKebangsaanEkonomi Malaysia, July 2012, 1624 – 1632.

Nagendra, M, Haritha, M. and Ravi,V. (2014). NSE NIFTY and its correlation with sectorialindexes. International Journal of Conceptions on Management and Social Sciences, 2(1),9-13.

Phillips, P. C. B. and P. Perron. (1988). Testing for a unit root in time series regression. Biometrica, 75(2), 335-346.

Qiao, H., Xia, Y. and Li, Y. (2016) Can Network Linkage Effects Determine Return? Evidence from Chinese Stock Market. PLoS ONE, 11(6), 1-25.

Rajamohan,S. and Muthukamu,M. (2014). Bank Nifty Index and Other Sectoral Indices of Nse- A Comparitive Study. PARIPEX - Indian Journal of Research, 3(4), 147-149.

Saeed, S. (2012). Macroeconomic Factors and Sectoral Indices: A Study of Karachi Stock Exchange (Pakistan). European Journal of Business and Management, 4(17), 132-152.

Samsi,S.T., Yusof,Z. and Cheong,K.C. (2012). Linkages between the real sector and the financial sector: the case of Malaysia. Asian Academy of management Journal of Accounting and Finance, 8 (Supp. 1), 93–113.

Shanmugasundaram, G and Benedict, J. (2013). Volatility of the Indian sectoral indices - a study with reference to national stock exchange. International Journal of Marketing, Financial Services & Management Research, 2(8),1-11.

Sharabati, A.A.A. (2013). The relationship between Amman stock exchange (ASE) sector and ASE general index performance. European Journal of Accounting Auditing and Finance Research, 1(2), 67-96.

Sharma, A.K. (2014). Relationship between selected sectoral indices and Nifty. International Journal of Business and General Management, 3(3),117-124.

Sharpe, W.F. (1963). A Simplified Model for Portfolio Analysis. Management Science, 9, 277-293.

Sharpe, W.F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Condition of Risk. Journal of Finance, 19, 425-442.

Shehrawat ,M. and Giri,A.K. (2017). A Sectoral Analysis of the Role of Stock Market Development on Economic Growth: Empirical Evidence from Indian Economy. Global Business Review, 18(4), 911-923.

Singh,T. (2016). On the sectoral linkages and pattern of economic growth in India. Journal of Asia Pacific Economy, 21(2), 257-275.

Tripathi, L.K, Parashar,A. and Jaiswal,S. (2014). Impact of Macroeconomic Variables on Sectoral Indices in India. Pacific Business Review International. 6(12). 83-90.

Uddin,M.M.M (2015). Causal Relationship between Agriculture, Industry and Services Sector for GDP Growth in Bangladesh: An Econometric Investigation. Journal of Poverty, Investment and Development, 8(1),124-130.

Vardar, G., Tunc, G. and Aydogan, B. (2012). Long-Run and Short-Run Dynamics among the Sectoral Stock Indices: Evidence from Turkey. Asian Economic and Financial Review, 2(2), 347-357.

Yuksel, E and Bayrak, O.T. (2012). Cyclical Behavior of Stock Exchange Index by Sectors: A Case from Turkey. Procedia - Social and Behavioral Sciences, 62, 947-951.

Table 1: Descriptive Statistics of Daily Returns

Index	Mean	Median	Maximum	Minimum	Std.Dev	Skewness	Kurtosis	Jarque-Bera*	*p.value
Auto	0.088	0.123	5.98	-7.26	1.22	-0.16	4.97	205.79	*0.00*
Bank	0.077	0.059	9.46	-6.90	1.48	0.18	5.67	375.12	*0.00*
Energy	0.038	0.059	5.47	-8.31	1.23	-0.29	5.26	280.87	*0.00*
FMCG	0.064	0.121	5.38	-4.65	1.09	-0.22	5.33	289.95	*0.00*
FS	0.073	0.055	7.82	-6.55	1.38	0.04	5.27	266.33	*0.00*
IT	0.049	0.048	9.33	-11.74	1.24	-0.78	15.26	7887.39	*0.00*
Media	0.079	0.092	5.32	-8.05	1.42	-0.16	4.34	98.12	*0.00*
Metal	0.019	0.030	9.84	-7.05	1.68	0.13	4.82	174.74	*0.00*
Pharma	0.071	0.109	5.11	-6.99	1.08	-0.51	6.22	589.45	*0.00*
PSU Bank	0.032	0.020	9.90	-9.35	2.07	0.28	5.00	222.13	*0.00*
Pvt.Bank	0.095	0.068	10.25	-6.66	1.47	0.20	6.46	627.96	*0.00*
Reality	0.017	0.074	8.43	-11.60	2.23	-0.27	4.99	219.05	*0.00*
Nifty	0.050	0.047	3.81	-5.92	0.98	-0.24	5.00	218.91	*0.00*

Source: Data Analysis, *p.values at 5% level of significance

Table 2: Unit Root Tests

Indices	ADF Test		PP Test	
	T. Stat	p.value	T. Stat	p.value
Auto	-32.046	0.000	-31.933	0.000
Bank	-32.209	0.000	-32.130	0.000
Energy	-33.579	0.000	-33.558	0.000
FMCG	-34.102	0.000	-34.096	0.000
FS	-32.546	0.000	-32.473	0.000
IT	-33.406	0.000	-33.366	0.000
Media	-34.207	0.000	-34.254	0.000
Meta	-33.719	0.000	-33.759	0.000
Nifty	-32.648	0.000	-32.559	0.000
Pharma	-32.814	0.000	-32.814	0.000
PSU Bank	-32.833	0.000	-32.794	0.000
Pvt. Bank	-32.117	0.000	-32.056	0.000
Reality	-32.471	0.000	-32.458	0.000
Critical Values				
*At 1% level of significance **	*-3.435**		*-3.435**	
*At 5% level of significance ***	*-2.863***		*-2.863***	
*At 10 % level of significance****	*-2.567****		*-2.567****	

Source: Data Analysis, *p.values at 5% level of significance

Table 3: Granger Causality Test

Independent Variables (x) → / Dependant Variables (y) ↓	Auto	Bank	Energy	FMCG	FS	IT	Media	Metal	Pharma	PSU Bank	Pvt. Bank	Reality	Nifty
Auto		0.07	0.29	3.74	0.05	1.33	1.74	0.10	1.88	1.94	0.71	2.63	1.83
		*0.93**	*0.75**	***0.02****	*0.95**	*0.26**	*0.18**	*0.90**	*0.15**	*0.14**	*0.49**	*0.07**	*0.16**
Bank	2.69		0.91	2.64	0.28	1.16	5.04	2.45	1.27	9.27	3.66	4.10	1.71
	*0.07**		*0.40**	*0.07**	*0.76**	*0.31**	*0.01**	*0.09**	*0.28**	***0.00****	***0.03****	*0.02**	*0.18**
Energy	0.88	3.81		2.33	0.18	2.28	4.14	1.41	0.53	1.19	0.77	2.48	0.47
	*0.41**	*0.68**		*0.09**	*0.84**	*0.10**	***0.02****	*0.24**	*0.59**	*0.30**	*0.40**	*0.05**	*0.63**
FMCG	0.85	0.75	0.90		0.65	0.47	0.20	0.04	1.81	0.79	1.02	1.22	0.43
	*0.43**	*0.47**	*0.41**		*0.52**	*0.62**	*0.82**	*0.96**	*0.10**	*0.45**	*0.35**	*0.29**	*0.65**
FS	0.42	0.20	1.29	1.76		0.21	4.20	3.38	1.77	6.70	2.00	5.25	2.07
	0.02*	***0.02****	*0.27**	*0.17**		*0.81**	***0.02****	***0.03****	*0.17**	***0.00****	*0.15**	***0.00****	*0.13**
IT	1.49	2.73	0.33	0.09	2.73		1.66	1.16	1.54	0.96	3.32	0.33	1.47
	*0.23**	*0.07**	*0.72**	*0.92**	*0.07**		*0.19**	*0.31**	*0.22**	*0.38**	***0.04****	*0.72**	*0.23**
Media	65.15	29.27	33.91	2.59	32.39	17.05		35.33	38.67	29.49	29.61	43.79	60.09
	0.00*	***0.00****	***0.00****	***0.00****	***0.00****	***0.00****		***0.00****	***0.00****	***0.00****	***0.00****	***0.00****	***0.00****
Metal	1.53	1.37	0.02	3.51	0.93	1.92	5.26		0.26	0.59	2.11	0.59	1.13
	*0.22**	*0.25**	*0.98**	*0.03**	*0.39**	*0.15**	*0.01**		*0.79**	*0.55**	*0.12**	*0.55**	*0.32**
Pharma	3.25	6.08	4.76	1.77	5.88	0.84	0.56	5.99		1.92	7.07	3.59	6.70
	0.04*	***0.00****	***0.01****	*0.17**	***0.00****	*0.43**	*0.57**	***0.00****		*0.15**	***0.00****	***0.03****	***0.00****
PSU Bank	0.77	4.84	0.91	1.62	2.74	1.02	2.70	0.90	1.19		4.62	0.93	1.03
	*0.46**	***0.01****	*0.40**	*0.19**	*0.06**	*0.36**	*0.07**	*0.40**	*0.31**		***0.01****	*0.39**	*0.36**
Pvt.Bank	3.17	3.40	1.52	2.93	2.64	1.09	5.91	2.51	1.67	8.64		4.94	3.91
	0.04*	***0.03****	*0.22**	*0.05**	*0.07**	*0.34**	***0.00****	*0.08**	*0.19**	***0.00****		***0.01****	***0.02****
Reality	0.80	2.76	1.06	3.46	1.28	2.71	3.20	0.53	0.49	0.05	3.27		0.58
	*0.45**	*0.063**	*0.35**	***0.03****	*0.28**	*0.07**	***0.04****	*0.59**	*0.61**	*0.96**	***0.04****		*0.56**
Nifty	2.24	2.99	0.62	3.63	2.30	1.20	2.42	0.83	1.74	2.66	5.49	2.98	
	*0.11**	*0.05**	*0.54**	***0.03****	*0.10**	***0.03****	*0.09**	*0.44**	*0.18**	*0.07**	***0.00****	*0.05**	

Result of test statistics is shown against the name of each sectors ; * p. values at 5% level of significance