Indian Journal of Accounting (IJA)
ISSN : 0972-1479 (Print) 2395-6127 (Online) Vol. 50 (2), December, 2018, pp. 01-16

VOLATILITY OF SELECT SECTORAL INDICES OF INDIAN STOCK MARKET: A STUDY

Prof. A. Sudhakar*
P.S.Viswanadh**

ABSTRACT

The present paper is aimed to analyze the Risk, Return and develop a volatility model of select sectoral indices of Indian stock market from April, 2006 to March 2016. Descriptive statistics such as mean, median, standard deviation, skewness, kurtosis, Jarque-Bera statistics have been applied to analyze the risk and return characteristics of sectoral indices. Augmented Dickey-Fuller model (ADF) test, Philp-Perron tests were used to test the stationarity characteristics, L-Jung box Q Statistics have been used to test the Auto correlation problems of day wise values of select sectoral indices. GARCH, TGARCH and EGARCH methods have been used to estimate the volatility models. It was found that Auto, Bank and IT sectors have provided betters returnwhereas Energy Index provided moderate returns to the investors in the chosen study period. The study also found that negative news caused more volatility as compared to positive news on the select indices.

KEYWORDS: *Sectoral Indices, Volatility, Stationarity, Auto Correlation, Heteroscadasticity.*

Introduction

Financial experts believe that the stock markets are one of the best investment options for superior returns when compared to other investment avenues. Majority of the people believe that equity markets are like a gambling house. Knowing the fact that, investment in stock markets are risky, investors in aim of higher returns prefer to invest in equities. The major reason behind the difference of opinions could be, the volatility instinct prevailing in these markets. Globally, various researchers have made empirical studies to test the volatility prevailing in various markets, and found that markets are more volatile in the recent times due to presence of global participants, high expectations from the investors and reactions in the equity market.

It is known that the risk and return of any investment is inter related, and the same concept can also been applied to the stock markets. The Indian Stock Market' volatility exhibits similar characteristics to those establish earlier in many of the major developed and emerging stock markets. Hence, one can interpret that the volatility is individual driven, meaning that when an investor has time to observe the market's ups and downs, volatility may not show much impact on their returns. Stock market Volatility is instability in the value of index, significant instability lead to risk of investments. In the recent past many investors have experienced significant volatility, lead to positive as well as negative results on their investments. As investors' fundamental expectations about stocks change, stock prices can move quickly, especially in today's internet driven world. Most of the volatile situations in the market place is simply a result of the over valuations fundamentals.

G Dean, Faculty of Commerce, Department of Commerce, Dr. B.R. Ambedkar Open University, Hyderabad, Telangana, India.

** Assistant Professor, School of Management Studies, Sreenidhi Institute of Science and Technology, Yamnampet, Ghatkesar, Hyderabad, Telangana, India.

Need for the Study

Higher volatility leads to irrational or speculative behavior of the investors and traders, consequently these will create problems such as trading mechanism imperfections, reduced confidence on markets, confusion among policy markets to set appropriate guidelines. In this regard the study focused on analyzing the volatility prevailing in the Indian Stock Market with respect to select sectoral indices.

Review of Literature

(Walid, Chaker, Masood, & Fry, 2011) employed Markov-Switching EGARCH model to find the dynamic relation between stock price volatility and exchange rate variations of four developing countries from the year 1994 to 2009. It was found that foreign exchange rate variations have a notable impact on the probability of shift across regimes.

(Corradi, Distaso, & Mele, 2013) analyzed relation between business cycle and stock market volatility and concluded that volatility risk-premiums are strongly countercyclical, even greater than stock volatility, and moderately explain the large swings of the VIX index.

(Kumari & Mahakud, 2014) empirically examines the issue with two stage estimation techniques such as Conditional volatility and multivariate VAR. is extracted by employing uni-variate ARCH models. Further, multivariate VAR model along with impulse response function, block erogeneity and variance decomposition are carried out to examine the relationship among stock market volatility and macroeconomic volatility and found that there is linkage between volatility in macroeconomic factors and equity market volatility.

(Dimpfl & Jank, 2016) have studied the dynamics of stock market volatility and retail investors' attention to the stock market. The volatility is measured by internet search queries related to the leading stock market index. They found a strong co-movement of the Dow Jones' realized volatility and the quantity of search queries for its name.

(Dhananjhay G 2017) has studied the volatility and co-movement of NIFTY 50 and six sectoral indices of Indian stock market. The volatility and co-movement has been studied with the help of GARCH, GJR-GATCH, EGARCH, Johansen Co-integration and Granger causality tests, and found that there exists co-movement betweenNIFTY-50 and sectoral indices of Indian stock markets.

Research Gap

The NSE (NSE) is one of the leading stock exchange in India and the fourth largest stock exchange in the world in terms of equity trading volume in 2015, according to World Federation of Exchanges (WFE).It began its operations in 1994 and is ranked as the largest stock exchange in India in terms of total and average daily turnover of equity shares every year since 1995, based on annual reports of SEBI. Earlier, many researchers have made enormous studies on volatility analysis of CNX NIFTY, and not much attention given to volatility of sectoral indices. Hence the researcher thought to make a study on volatility of select sectoral indices. The following table exhibits various sectoral indices and their weights on NIFTY.

Table 1: Weight-Age of Various Sectors in NIFTY

S. No.	Name of the Sector	Weigh in NIFTY
1	Banking and Financial Services	31.81
2	IT	15.5
3	Energy	11.1
4	Auto	9.43
5	FMCG	8.02
6	Pharma	7.21
7	Cigarettes	6.04
8	Others	10.89

Source: NSE Website

Based on the above table, the researcher has chosen the first four sectoral indices such as Auto, Bankex, Informational Technology (IT), and Energy. Ten years day wise closing prices of select sectoral indices were considered from April-2006 to March 2016 for the study.

Objectives of the Study

- To analyze the risk return of select sectoral indices of Indian stock market.
- To find the best model for measuring the volatility of select sectoral indices of Indian stock market.

Hypothesis

S. No	Hypothesis Set	Test Conducted
1	**H_0:** Day wise return series of select sectoral indices are not stationary **H_1:** Day wise return series of select sectoral indices are stationary.	Augmented Dickey Fuller Test (ADF), PhilpPerron test
2	**H_0:** There is no auto correlation in the returns of select sectoral indices. **H_1:** There is auto correlation in the return of series of select sectoral indices.	Ljung Box Q Test
3	**H_0:** There is no heteroskedasticity effect on the return series of select sectoral indices. **H_1:** There is heteroskedasticity effect on the return series of select sectoral indices.	GARCH, TGARCH and EGARCH

Tools and Techniques Used for the Study

In order to evaluate the volatility and return relationship, descriptive statistics such as returns, range, mean, standard deviation, covariance, Skewness and Kurtosis. Year wise risk and return were also calculated to measure the performance of indices through the period. Econometric data testing models such as unit root test and auto correlation test were measured to test the data to fit volatility testing models such as ARCH, GARCH, T-GARCH, and E-GARCH. The analysis has been organized into four sections such as analysis of Auto Index, Bankex, Energy Index and IT Index. Further, descriptive statics for daily returns, stationary test, auto correlation test and volatility modeling has been studied for each of the index. The detailed analysis is as follows:

- **Descriptive Statistical Analysis of Daily Returns of Auto Index**

The following table represents the descriptive statistics of return series of Auto Index of NSE for the period of ten years from April 2006 to March 2016.

Table 2: Descriptive Statistics of Daily Returns of Auto Index for Ten Years

Name of the Technique	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Value	0.063639	0.094144	15.03268	-9.8008	1.529161	0.023231	9.180251	3945.501	0.000000

Source: Compiled data

The above table shows the descriptive statistics of Auto Index daily returns. Mean value represents the average daily returns i.e., 0.063 per cent, median 0.094144, standard deviation is 1.529161. The coefficient of skewness (0.023231)is found to be positive for the returns which imply that the return distribution of the index traded in the market in a given period has very minimum probability of earning less than the mean return value, meaning that the returns of index will closely move with average, which is not supporting the earlier studies conducted by Karmakar (2007) Joshi (2010) in NSE and Shanghai Stock Exchange, Bordoloi and Shankar (2008) in BSE and NSE, Karachi and Dhaka Stock Exchange, Kumar and Dhankar (2009) in Bombay and Abdalla (2012) in the Saudi Stock Market on the Indian Stock Market, mentioned that the returns are higher than the mean returns. The coefficient of Kurtosis higher than 3 indicates that, the distribution is highly leptokurtic as compared to normal distribution for all the returns. A risk-averse investor always prefers a minimum kurtosis value since the distribution with minimum kurtosis value will not have much deviation from the mean value. Jarque-Bera statistic (3945.501) and its respective probability value indicate that the distribution is not normal as supported by Karmakar (2007).

The following table represents the Annual Return offered by Auto Index and its respective risk.

Table 3: Year Wise Risk and Return Analysis of Auto Index

Year	Risk	Return
2006-07	1.837683	-11.6888
2007-08	1.625133	1.58343
2008-09	2.057907	-27.8775
2009-10	1.969432	138.2424
2010-11	1.267782	20.43686
2011-12	1.240508	8.367786
2012-13	1.069991	0.196855
2013-14	1.225002	38.33611
2014-15	1.100415	48.3146
2015-16	1.354395	-7.1538

Source: Compiled data

The above table represents that, the returns of Auto index are high in the year 2009-10 (138.2424) followed by 2014-15 (48.3146), 2013-14 (38.33611) and 2010-11 (20.43686). The annual returns for the Auto Index are negative in the year 2008-09 (-27.8775), 2006-07 (-11.6888) and 2015-16 (-7.1538). The annual returns of Auto Index are high in the year 2008-09 (2.057907), 2009-10 (1.969432) and 2006-07 (1.837683) due to US subprime lending crisis leading to world financial crisis. The above table also indicates that, the negative returns or high positive returns leads to greater risk for the investors.

- **Test of Stationarity for Daily returns of Auto Index**

The following table represents the test of unit root for Auto Index. The basic purpose of the unit root test is to observe whether the data is stationary or not, meaning that the mean and variance values of the data were stable or not. Minimum variations in the mean and variance of the data series are more desirable for performing the analysis. The unit root has been tested with Augmented Dickey fuller (ADF), and Philips Perron (PP) tests. If the data is found to be non-stationary at level (raw data), then the data has to be transformed to first difference and the test must be conducted. Even after considering the first difference, if the data found to be non-stationary, then it has to be transformed to second difference. In order to test the stationarity, to compare the t-statistic value with the critical values at 1 per cent, 5 per cent and 10 per cent depending on the requirement of the study. When the absolute t-statistic value is greater than the respective critical value, then the data can be considered as stationary and vice-versa.

Table 4: Test of Stationarity for Auto Index

Name of the Test	t- Statistic for Level Data	Probability
ADF test	-43.76644*	0.0000
PP	-43.76651*	0.0000

*Critical values at 1%, 5% and 10% are -3.43278, -2.8625 and 2.5677 respectively.

Source: Compiled data

The above table indicates that the level data series is stationary at one per cent level of significance, since the absolute t-statistic value is greater than critical value at 1 per cent (43.76644>3.43278). The probability value also represents that the Auto Index daily return series mean and variances over the period are similar since these values are less than 1 per cent. The findings are opposing the earlier studies of Nisha (2014), Srinivasan and Ibrahim (2010), Karmakar (2005) and Kaur (2004). Hence the available data has scope for further analysis.

- **Autocorrelation and Ljung-Box Q-statistic for Auto Index**

Autocorrelation (AC), also known as serial correlation, is the correlation with its own lag values or the past data. Informally, it is the similarity between observations as a function of the time lag between them. The analysis of autocorrelation is a mathematical tool for finding repeated patterns in the data. It is widely used technique in the field of finance in order to determine the repeated patterns of equity stocks and indices prices, economic data with equal time intervals etc,.

Table 5: Test of Auto Correlation for Auto Index

Lag	AC	Q-Stat	Probability	Lag	AC	Q-Stat	Probability
1	0.128	40.43	0.000	19	0.007	63.89	0.000
2	0.016	41.08	0.000	20	-0.04	68.78	0.000
3	-0.03	42.95	0.000	21	-0.01	69.12	0.000
4	-0.02	43.64	0.000	22	-0.02	70.18	0.000
5	-0.02	44.77	0.000	23	-0.01	70.54	0.000
6	-0.01	45.02	0.000	24	0.024	72.03	0.000
7	0.04	49.03	0.000	25	0.02	72.99	0.000
8	0.004	49.08	0.000	26	0.021	74.1	0.000
9	0.01	49.31	0.000	27	0.01	74.33	0.000
10	0.036	52.54	0.000	28	-0.02	75.58	0.000
11	0.01	52.79	0.000	29	-0.02	76.47	0.000
12	0.03	54.98	0.000	30	0.013	76.91	0.000
13	0.018	55.8	0.000	31	-0.01	76.98	0.000
14	0.014	56.28	0.000	32	-0.01	77.13	0.000
15	0.015	56.85	0.000	33	0.016	77.8	0.000
16	-0	56.86	0.000	34	0.039	81.72	0.000
17	0.049	62.84	0.000	35	-0.01	81.9	0.000
18	0.019	63.76	0.000	36	-0.02	82.66	0.000

Source: Compiled data

The above table shows the test of Auto Correlation for Auto Index. The independent and identically distributed hypothesis was rejected for Auto Index return series as the probability values are less than 1 per cent which indicates the select series returns exhibited dependencies are based on past behavior. The results of autocorrelation and Ljung-Box (LB) Q-statistic are also supported by previous findings of Nisha(2010), Bordoloi and Shankar (2008) showed in BSE and NSE, Abdalla (2012) in the Saudi Stock Market & Mittal and Jain (2009) showed in BSE and NSE.

- **Volatility Analysis of Auto Index with GARCH Models**

The following table - 6 represents the results of GARCH (1,1), T-GARCH (1,1), E-GARCH(1,1), models for return series of Auto Index for a period of ten years from April 2006 to March 2016. C1, C2, C3, C4, C5 and C6 represents constant of mean equation coefficient, constant of variance equation coefficient, ARCH coefficient, TGARCH coefficient, EGARCH coefficient and GARCH coefficients respectively. Q statistics represents the significance of squared residuals at select lag lengths, ARCH LM statistics represents the presence of ARCH effect in the model.

In the following table GARCH model estimates that lagged conditional variance (C3) or ARCH term and lagged squared residuals (C6) or GARCH term has an explanatory power on current volatility of Auto Index since the probability values of C3 and C6coefficients' are less than 1 per cent. The coefficient of C3 (0.082876) is lesser than C6 (0.895544) indicates that there was more impact of past volatility on the present volatility in comparison to effect of past shocks or news on the volatility of Auto Index residuals or conditional volatility. The persistence coefficients or the sum of ARCH and GARCH coefficients in the GARCH (1,1) model is 0.97842 is very close to 1 which is desirable to have a mean reverting variance process, indicating that volatility shocks were quite continual and took longer time to scatter. It is an indication of covariance stationary model with high degree of continual and long memory on variance in the residuals. These results are similar to the findings made by Kour(2004) where the sum of ARCH and GARCH coefficients were near to one indicating long persistence of shocks in volatility.

Standard GARCH (1,1) model assumed that the volatility is symmetric meaning that the impact of favorable and unfavorable news has same effect on the model. In the real market situations this assumption is repeatedly violated particularly in the equity markets. Impact of unfavorable news is generally more than good news in the equity markets due to leverage effect. Negative news will initially reduce the worth of market capitalization of a firm leads to higher proportion of debt capital out of total amount capital of a firm. It leads to greater risk of equity investments which again leads to increased supply and diminishing in the value of stocks. This phenomenon is called as leverage effect or asymmetric behavior of stock prices. In order to tackle the leverage effect on volatility of stock returns, one can use TGARCH and EGARCH models. The major difference between these models is that, the TGARCH coefficients must be positive and significant, whereas EGARCH coefficient can be a significant negative coefficient.

Table 6: GARCH (1,1), TGARCH and EGARCH Models for Auto Index Returns

Variable	GARCH		TGARCH		EGARCH	
	Test Statistic	P value	Test Statistic	P value	Test Statistic	P value
Mean Equation						
C1	0.098499	0.0003	0.074784	0.0063	0.070170	0.0091
Variance Equation						
C2	0.055466	0.00	0.056323	0.00	-0.098575	0.00
C3	0.082876	0.00	0.044854	0.00	0.151124	0.00
C4	NA*	NA*	0.071550	0.00	NA*	NA*
C5	NA*	NA*	NA*	NA*	-0.059155	0.00
C6	0.895544	0.00	0.896491	0.00	0.975692	0.00
R-squared	-0.000520		-0.000053		-0.000018	
Adj.R-squared	-0.000520		-0.000053		-0.000018	
Log likely hood	-4378.245		-4364.805		-4356.059	
AIC	3.535494		3.525457		3.518402	
SIC	3.544878		3.537187		3.530132	
Durban-Weston Stat	1.743828		1.744642		1.744703	
Residual Diagnostic Test						
Q Statistics	2.4116	0.992	2.4255	0.992	1.9313	0.997
ARCH LM Test						
F-statistic	0.635740	0.4253	0.48287	0.8261	0.181212	0.6704
Observed R-square	0.636090	0.4251	0.048325	0.8260	0.181345	0.6702

Source: Compiled Data
*Not Applicable

The asymmetric TGARCH and EGARCH models estimated for the returns of the Auto Index indicate that all coefficients of the models are statistically significant at 1 percent level, the coefficient terms of TGARCH (0.071550), EGARCH (-0.059155) also follows the positive and negative sign conditions, indicating that there is a leverage effect on the returns of Auto Index. The guideline to choose the best model among TGARCH and EGARCH is that the model whose value of Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) is minimum that could be a better model. These two models indicate the variance in the predictive ability of the model. TGARCH model exhibited AIC and SIC as 3.525457 and 3.537187 whereas EGARCH exhibited the values as 3.518402 and 3.530132 respectively. These values indicate that EGARCH model predictive ability is superior as compared to TGARCH model, henceEGARCH model is selected. Karmakar (2007), Bordoloi and Shankar (2008) and Pandey (2005) supports the results. The estimated model must be free from Auto Correlation and ARCH effect in order to consider the appropriate model for the present study. The Auto correlation can be performed by using residual diagnostic check or Q Test. The Null hypothesis statement of Q test is that the estimated model is free from Auto correlation. When the probability value of residual diagnostics is more than 5 percent then we can conclude that the estimated model is free from Auto Correlation. Similarly F statistic and observed R squared probability values are more than 5 percent, when one can consider that the model is from ARCH effect. In the above table the probability values of Q statistics for GARCH, TGARCH and EGARCH models are 99.2, 99.2 and 99.7 percent, F statistic and observed R squared probability values are for GARCH (42.53%, 42.51%), TGARCH (82.61%, 82.6%) and EGARCH (67.04%, 67.02%) indicating that these three models are free from Auto Correlation and ARCH effect.

- **Descriptive statistical analysis of Daily returns of Bankex**

The following table represents the descriptive statistics of return series of Bankex of NSE for the period of ten years from April 2006 to March 2016.

Table 7: Descriptive Statistics of Daily Returns of Bankex

Name of Technique	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Value	0.070767	0.068353	18.81458	-12.618	2.062317	0.293226	8.090190	2711.815	0.000000

Source: Compiled Data

The above table shows the descriptive statistics of Bankex daily returns. Mean value represents the average daily returns i.e., 0.070767 per cent, median 0.068353, standard deviation is 2.062317. The coefficient of skewness (0.293226)is found to be positive for the returns which imply that the return distribution of the index traded in the market for a given period have very minimum probability of earning less than the mean return value, meaning that the returns of index will closely move with average, which is not supporting the earlier studies conducted by Karmakar (2007) Joshi (2010) in NSE and Shanghai Stock Exchange, Bordoloi and Shankar (2008) in BSE and NSE, Karachi and Dhaka Stock Exchange, Kumar and Dhankar (2009) in Bombay and Abdalla (2012) in the Saudi Stock Market on the Indian Stock Market, mentioned that the returns are higher than the mean returns. The coefficient of Kurtosis (8.090190) higher than 3 indicates that, the distribution is highly leptokurtic as compared to normal distribution for all the returns. A risk-averse investor always prefers a minimum kurtosis value since the distribution with minimum kurtosis value will not have much deviations from the mean value. Jarque-Bera statistic (2711.815) and its respective probability value (0.00)indicate that the distribution is not normal as suggesting lack of symmetric nature in the equity returns. The results are supported by previous findings of Srinivasan and Ibrahim (2010) in BSE, Mahajan and Singh (2008) in BSE,Leon (2008) in regional stock exchange BRVM and Pandey (2005) in NSE. The following table represents the Annual Return offered by Bankex and its respective risk.

Table 8: Year Wise Risk and Return Analysis of Bankex

Year	Risk	Return in Percent
30-Mar-07	2.109086	12.3718
31-Mar-08	2.426186	34.18286
31-Mar-09	3.480152	-37.4525
31-Mar-10	2.37968	124.6162
31-Mar-11	1.526463	23.11483
30-Mar-12	1.514457	-11.8903
28-Mar-13	1.218186	10.25196
31-Mar-14	1.930248	11.52242
31-Mar-15	1.340558	44.62923
31-Mar-16	1.463381	-13.3001

Source: Compiled Data

The above table represents that, the returns of Bankex are high in the year 2009-10 (124.6162) followed by 2014-15(44.62923), 2007-08(34.18286)and 2010-11 (23.11483). The annual returns for the Bankex are negative in the year 2008-09 (-37.4525), 2015-16(-13.3001) and 2013-14(-11.8903). The annual risk of Bankex are high in the year 2008-09 (3.480152), 2007-08 (2.426186), 2009-10 (2.37968) and 2006-07 (2.109086). The above table also indicates that, the negative returns or high positive returns leads to greater risk for the investors.

- **Test of Stationarity for daily returns of Bankex**

The following table represents the test of unit root for Bankex.

Table 9: Test of Stationarity for Bankex

Name of the Test	t- statistic for level data	Probability
ADF test	-43.91689*	0.0000
PP	-43.64679*	0.0000

*Critical values at 1%, 5% and 10% are -3.43278, -2.8625 and 2.5677 respectively.
Source: Compiled data

The above table indicates that the level data series is stationary at one per cent level of significance, since the absolute t-statistic value is greater than critical value at 1 per cent (43.91689>3.43278) critical value. The probability value also represents that the Bankex Index daily return series mean and variances over the period are similar since these values are less than 1 per cent. The findings are opposing the earlier studies of Mehta and Sharma (2011) and Joshi (2010). Therefore the data can be used for the further analysis.

- **Autocorrelation and Ljung-Box Q-statistic for Bankex**

The results of thirty six orders sample autocorrelation coefficients and Ljung- Box statistics return series of the Bankex for the total period of ten years from April 2006 to March 2016 are presented in Table 10.

Table 10: Test of Auto Correlation for Bankex

Lag	AC	PAC	Q-Stat	Probability	Lag	AC	PAC	Q-Stat	Probability
1	0.124	0.124	38.445	0.000	19	-0.018	-0.014	70.021	0.000
2	-0.02	-0.036	39.443	0.000	20	-0.034	-0.029	72.997	0.000
3	-0.006	0.001	39.548	0.000	21	0.003	0.015	73.021	0.000
4	-0.026	-0.026	41.193	0.000	22	0.027	0.026	74.866	0.000
5	-0.053	-0.048	48.244	0.000	23	-0.013	-0.022	75.288	0.000
6	-0.05	-0.039	54.356	0.000	24	-0.011	-0.011	75.572	0.000
7	0.007	0.015	54.461	0.000	25	0.014	0.008	76.054	0.000
8	0.044	0.039	59.218	0.000	26	0.051	0.046	82.475	0.000
9	0.029	0.018	61.367	0.000	27	-0.013	-0.021	82.891	0.000
10	0.002	-0.006	61.379	0.000	28	0.022	0.031	84.08	0.000
11	0.021	0.02	62.495	0.000	29	-0.014	-0.025	84.587	0.000
12	0.012	0.007	62.827	0.000	30	0	0.006	84.587	0.000
13	-0.012	-0.008	63.177	0.000	31	0	0.003	84.587	0.000
14	0.021	0.03	64.296	0.000	32	-0.001	0.003	84.591	0.000
15	0.017	0.012	65.007	0.000	33	0.012	0.009	84.98	0.000
16	0.025	0.023	66.591	0.000	34	0.013	0.009	85.394	0.000
17	0.032	0.028	69.17	0.000	35	-0.03	-0.032	87.638	0.000
18	-0.006	-0.012	69.249	0.000	36	-0.002	0.006	87.649	0.000

Source: Compiled Data

The above table shows the test of Auto Correlation. The independent and identically distributed hypothesis was rejected for Bankex return series as the probability values are less than 1 per cent, which indicates that the select series returns exhibited dependencies are based on past behavior. The results of autocorrelation and Ljung-Box (LB) Q-statistic are also supported by previous findings of Nisha (2010), Bordoloi and Shankar (2008) in BSE and NSE, Abdalla (2012) in the Saudi Stock Market & Mittal and Jain (2009) in BSE and NSE.

- **Volatility Analysis of Bankexwith GARCH Models**

Table 11 represents the results of GARCH (1,1), T-GARCH (1,1), E-GARCH(1,1), models for return series of Bankex for the total period of ten years from April 2006 to March 2016. In table 11, GARCH model estimates that lagged conditional variance (C3) or ARCH term and lagged squared residuals (C6) or GARCH term had an explanatory power on current volatility of Bankex since the probability values of C3 and C6coefficients' are less than 1 per cent. The coefficient of C3 (0.063110) is lesser than C6 (0.927367) indicates that there was more impact of past volatility on the present volatility in comparison to effect of past shocks or news on the volatility of Bankex residuals or conditional volatility. The persistence coefficients or the sum of ARCH and GARCH coefficients in the GARCH (1,1) model is 0.990978is very close to 1 which is desirable to have a mean reverting variance process, indicating that volatility shocks were quite continual and took longer time to scatter. It is an indication of covariance stationary model with high degree of continual and long memory on variance in the residuals. These results are similar to the findings made by Kour(2004) and mentioned that the sum of ARCH and GARCH coefficients are near to one, indicating long persistence of shocks in volatility.

Table 11: GARCH (1,1), TGARCH and EGARCH Models for Bankex Returns

Variable	GARCH		TGARCH		EGARCH	
	Test Statistic	P value	Test Statistic	P value	Test Statistic	P value
Mean Equation						
C1	0.096060	0.0040	0.067628	0.0444	0.068376	0.0413
Variance Equation						
C2	0.040202	0.00	0.041377	0.00	-0.082220	0.00
C3	0.063110	0.00	0.025132	0.00	9.343729	0.00
C4	NA*	NA*	0.067540	0.00	NA*	NA*
C5	NA*	NA*	NA*	NA*	-0.047229	0.00
C6	0.927367	0.00	0.931607	0.00	0.987212	0.00
R-squared	-0.000150		-0.000002		-0.000001	
Adj.R-squared	-0.000150		-0.000002		-0.000001	
Log likely hood	-5006.252		-4989.516		2.062319	
AIC	4.042156		4.029461		4.028071	
SIC	4.051540		4.041190		4.039801	
Durbon-Weston Stat	1.750421		1.750681		1.750682	

Residual Diagnostic test						
Q Statistics	5.5791	0.849	4.7374	0.992	5.5101	0.855
ARCH LM Test						
F-statistic	0.366710	0.5449	0.945636	0.3309	1.785078	0.1816
Observed R-square	0.366952	0.5447	0.946039	0.3307	1.785233	0.1815

Source: Compiled Data
*Not Applicable

The asymmetric TGARCH and EGARCH models estimated for the returns of the Bankex indicate that all coefficients of the models are statistically significant at 1 percent level, the coefficient terms of TGARCH (0.067540), EGARCH (-0.047229) also showed positive and negative sign conditions, indicating that there is a leverage effect on the returns of Bankex. The guideline to choose the best model among TGARCH and EGARCH is that the model whose value of Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) is minimum that could be a better model. These two models indicate the variance in the predictive ability of the model. TGARCH model exhibited AIC and SIC as 4.029461 and 4.041190 whereas EGARCH exhibited the values as 4.028071and 4.039801 respectively. These values indicate that EGARCH model predictive ability is superior as compared to TGARCH model in this phenomenon. Karmakar (2007), Bordoloi and Shankar (2008) and Pandey (2005) supports the results. In the above table the probability values of Q statistics for GARCH, TGARCH and EGARCH models are 84.9, 99.2 and 85.5 percent, F statistic and observed R squared probability values are for GARCH (54.49%, 54.47%), TGARCH (33.09%, 33.07%) and EGARCH (18.16%, 18.15%) indicating that these three models are free from Auto Correlation and ARCH effect.

- **Descriptive Statistical Analysis of Daily Returns of Energy Index**

The following table represents the descriptive statistics of return series of Energy Index of NSE for the period of ten years from April 2006 to March 2016.

Table 12: Descriptive Statistics of Daily Returns of Energy Index

Name of Technique	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Value	0.031620	0.046806	16.69967	-13.524	1.693321	-0.00276	11.27280	7069.209	0.000000

Source: Compiled Data

The above table shows the descriptive statistics of Energy Index daily returns. Mean value represents the average daily returns i.e.,0.031620 per cent, median 0.046806, standard deviation is 1.693321. The coefficient of skewness (-0.002762)is found to be negative for the returns which imply that the return distribution of the index traded in the market for a given period have very minimum probability of earning more than the mean return value, meaning that the returns of index will closely move with average, which is supporting the earlier studies conducted by Karmakar (2007) Joshi (2010) in NSE and Shanghai Stock Exchange, Bordoloi and Shankar (2008) in BSE and NSE, Karachi and Dhaka Stock Exchange, Kumar and Dhankar (2009) in Bombay and Abdalla (2012) in the Saudi Stock Market on the Indian Stock Market, mentioned that the returns are higher than the mean returns. The coefficient of Kurtosis (11.27280) higher than 3 indicates that, the distribution is highly leptokurtic as compared to normal distribution for all the returns. A risk-averse investor always prefers a minimum kurtosis value since the distribution with minimum kurtosis value will not have much deviations from the mean value. Jarque-Bera statistic (7069.209) and its respective probability value (0.00) indicate that the distribution is not normal as suggesting lack of symmetric nature in the equity returns. The results are supported by previous findings of Srinivasan and Ibrahim (2010) in BSE, Mahajan and Singh (2008) in BSE, Leon (2008) in regional stock exchange BRVM and Pandey (2005) in NSE.

The following table represents the annual return offered by Energy Index and its respective risk.

Table 13: Year wise Risk and Return Analysis of Energy Index

Year	Risk	Return in percent
30-Mar-07	1.681326	7.738037
31-Mar-08	2.408089	50.98667
31-Mar-09	2.666868	-25.9861

31-Mar-10	1.821402	36.28211
31-Mar-11	1.095381	4.687307
30-Mar-12	1.237792	-19.7835
28-Mar-13	0.964521	0.120651
31-Mar-14	1.35184	9.662236
31-Mar-15	1.342049	-1.92082
31-Mar-16	1.364122	1.340647

Source: Compiled Data

The above table represents that, the returns of Energy index are high in the year 2007-08 (50.98667) followed by 2014-15(36.28211). The annual returns for the Energy Index are negative in the year 2008-09 (-25.9861), and in 2011-12(-19.7835). The annual risk of Energy Index are high in the year 2008-09 (2.666868), and in 2007-08 (2.408089), the overall return and risk of Energy index is moderate. This phenomenon is due to variations in the prices of crude oil and currency values. The above table also indicates that, the negative returns or high positive returns leads to greater risk for the investors.

- **Test of Stationarity for Daily returns of Energy Index**

The following table represents the test of unit root for Energy Index.

Table 14: Test of Stationarity of Energy Index

Name of the Test	t- Statistic for Level Data	Probability
ADF test	-47.25712*	0.0001
PP	-47.1933*	0.0001

*Critical values at 1%, 5% and 10% are -3.43278, -2.8625 and 2.5677 respectively.
Source: Compiled data

The above table indicates that the level data series is stationary at one per cent level of significance, since the absolute t-statistic value is greater than critical value at 1 per cent (47.25712>3.43278) critical value. The probability value also represents that the Energy Index daily return series mean and variances over the period are similar since these values are less than 1 per cent. The findings are opposing the earlier studies of Mehta and Sharma (2011) and Joshi (2010). Therefore the data can be used for the further analysis.

- **Autocorrelation and Ljung-Box Q-statistic for Energy Index**

The results of thirty six orders sample autocorrelation coefficients and Ljung- Box statistics return series of the Energy Index for the total period of ten years from April 2006 to March 2016 are presented in Table15.

Table 15: Test of Auto Correlation for Energy Index

Lag	AC	PAC	Q-Stat	Prob	Lag	AC	PAC	Q-Stat	Prob
1	0.052	0.052	6.5924	0.01	19	-0.038	-0.019	74.911	0.000
2	-0.008	-0.01	6.74	0.034	20	-0.073	-0.062	88.306	0.000
3	-0.044	-0.043	11.589	0.009	21	-0.009	-0.017	88.513	0.000
4	-0.015	-0.01	12.126	0.016	22	-0.005	-0.017	88.569	0.000
5	-0.024	-0.023	13.549	0.019	23	-0.018	-0.031	89.384	0.000
6	-0.046	-0.046	18.826	0.004	24	0.012	0.003	89.755	0.000
7	0.044	0.048	23.728	0.001	25	0.02	0.022	90.772	0.000
8	0.051	0.044	30.204	0.000	26	0.016	0.014	91.403	0.000
9	0.021	0.013	31.322	0.000	27	-0.006	-0.002	91.494	0.000
10	-0.005	-0.003	31.376	0.001	28	0.004	0.007	91.541	0.000
11	-0.04	-0.036	35.265	0.000	29	-0.003	-0.007	91.564	0.000
12	-0.01	-0.004	35.517	0.000	30	0.025	0.024	93.176	0.000
13	0.03	0.037	37.732	0.000	31	-0.031	-0.034	95.532	0.000
14	0.089	0.087	57.622	0.000	32	-0.043	-0.032	100.22	0.000
15	0.02	0.008	58.572	0.000	33	0.014	0.024	100.7	0.000
16	0.024	0.021	60.017	0.000	34	0.02	0.029	101.75	0.000
17	0.02	0.021	61.023	0.000	35	-0.045	-0.044	106.89	0.000
18	-0.064	-0.061	71.366	0.000	36	-0.021	-0.01	108	0.000

Source: Compiled Data

The above table shows that the independent and identically distributed hypothesis is rejected for Energy Index return series since the probability values are less than 1 per cent, which indicates that the select series returns exhibited dependencies on its past behavior. The results of autocorrelation and

Ljung-Box (LB) Q-statistic are also supported by previous findings of Nisha (2010), Bordoloi and Shankar (2008) in BSE and NSE, Abdalla (2012) in the Saudi Stock Market & Mittal and Jain (2009) in BSE and NSE.

- **Volatility Analysis with GARCH Models**

The following table represents the results of GARCH (1,1), T-GARCH (1,1), E-GARCH(1,1), models for return series of Energy Index for the total period of ten years from April 2006 to March 2016. In the following table 16, GARCH model estimates that lagged conditional variance (C3) or ARCH term and lagged squared residuals (C6) or GARCH term which has an explanatory power on current volatility of Energy Index since the probability values of C3 and C6 coefficients' are less than 1 per cent. The coefficient of C3 (0.042054) is lesser than C6 (0.89795) indicates that there was more impact of past volatility on the present volatility in comparison to effect of past shocks or news on the volatility of Energy Index residuals or conditional volatility. The persistence coefficients or the sum of ARCH and GARCH coefficients in the GARCH (1,1) model is 0.940004is very close to 1 which is desirable to have a mean reverting variance process, indicating that volatility shocks were quite continual and took longer time to scatter. It is an indication of covariance stationary model with high degree of continual and long memory on variance in the residuals. These results are similar to the findings made by Kour (2004) and mentioned that the sum of ARCH and GARCH coefficients are near to one is an indicates long persistence of shocks in volatility.

Table 16: GARCH (1,1), TGARCH and EGARCH Models for Energy Index Returns

Variable	GARCH		TGARCH		EGARCH	
	Test Statistic	P value	Test Statistic	P value	Test Statistic	P value
Mean Equation						
C1	0.036484	0.1688	0.017103	0.5197	0.019306	0.4411
Variance Equation						
C2	0.042054	0.00	0.045541	0.00	-0.13365	0.00
C3	0.089580	0.00	0.63533	0.00	0.196531	0.00
C4	NA*	NA*	0.057794	0.00	NA*	NA*
C5	NA*	NA*	NA*	NA*	-0.046796	0.00
C6	0.89795	0.00	0.894048	0.00	0.979046	0.00
R-squared	-0.000008		-0.000074		-0.000053	
Adj.R-squared	-0.000008		-0.000074		-0.000053	
Log likely hood	-4472.939		-4466.726		1.693366	
AIC	3.611891		3.607685		3.604637	
SIC	3.621275		3.619415		3.616367	
Durbon-Weston Stat	1.896878		1.896754		1.896793	
Residual Diagnostic test						
Q Statistics	1.8442	0.997	2.0884	0.996	2.5120	0.991
ARCH LM Test						
F-statistic	0.0026	0.9593	0.032383	0.8572	0.037772	0.8459
Observed R-square	0.002603	0.9593	0.32408	0.8571	0.037802	0.8458

Source: Compiled Data *Not Applicable

The asymmetric TGARCH and EGARCH models estimated for the returns of the Bankex indicate that all coefficients of the models are statistically significant at 1 percent level, the coefficient terms of TGARCH (0.057794), EGARCH (-0.046796) also showed the positive and negative sign conditions, indicating that there is a leverage effect on the returns of Bankex. The guideline to choose the best model among TGARCH and EGARCH is that the model whose value of Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) is minimum that could be a better model. These two models indicate the variance in the predictive ability of the model. TGARCH model exhibited AIC and SIC as 3.607685 and 3.619415 whereas EGARCH exhibited the values as 3.604637 and 3.616367 respectively. These values indicate that EGARCH model predictive ability is superior as compared to TGARCH model in this phenomenon. Karmakar (2007), Bordoloi and Shankar (2008) and Pandey (2005) supports the results. In the above table the probability values of Q statistics for GARCH, TGARCH and EGARCH models are 99.7, 99.6 and 99.1 percent, F statistic and observed R squared probability values are for GARCH (95.93%, 95.93%), TGARCH (85.72%, 85.71%) and EGARCH (84.59%, 84.58%) indicating that these three models are free from Auto Correlation and ARCH effect.

- **Descriptive Statistical Analysis of Daily Returns of IT Index**

The following table represents the descriptive statistics of return series of IT Index of NSE for the period of ten years from April 2006 to March 2016.

Table 17: Descriptive Statistics of Daily Returns of IT Index

Name of Technique	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Value	0.052870	0.049207	12.43480	-11.742	1.751513	0.051664	7.797686	2378.648	0.000000

Source: Compiled Data

The above table shows the descriptive statistics of IT Index daily returns. Mean value represents the average daily returns i.e., 0.05287 per cent, median 0.049207, standard deviation is 1.751513. The coefficient of skewness (0.051664)is found to be positive for the returns which imply that the return distribution of the index traded in the market in a given period have very minimum probability of earning less than the mean return value, meaning that the returns of index will closely move with average, which is not supporting the earlier studies conducted by Karmakar (2007) Joshi (2010) in NSE and Shanghai Stock Exchange, Bordoloi and Shankar (2008) in BSE and NSE, Karachi and Dhaka Stock Exchange, Kumar and Dhankar (2009) in Bombay and Abdalla (2012) in the Saudi Stock Market on the Indian Stock Market, mentioned that the returns are higher than the mean returns. The coefficient of Kurtosis higher than 3 indicates that, the distribution is highly leptokurtic as compared to normal distribution for all the returns. A risk-averse investor always prefers a minimum kurtosis value since the distribution with minimum kurtosis value will not have much deviations from the mean value. Jarque-Bera statistic (2378.648) and its respective probability value indicate that the distribution is not normal as supported by Karmakar (2007). The following table represents the Annual Return offered by Bankex and its respective risk.

Table 18: Year wise Risk and Return Analysis of IT Index

Year	Risk	Return in percent
30-Mar-07	1.924772	16.14747
31-Mar-08	2.005995	-25.0078
31-Mar-09	2.854525	-36.9035
31-Mar-10	2.047434	146.069
31-Mar-11	1.249839	19.45354
30-Mar-12	1.458289	-8.3525
28-Mar-13	1.296912	10.24817
31-Mar-14	1.459056	27.99493
31-Mar-15	1.178566	28.00127
31-Mar-16	1.138376	-5.37893

Source: Compiled Data

The above table represents that, the returns of IT index are high in the year 2009-10 (146.069) followed by 2014-15(28.00127), and in 2013-14 (27.99493). The annual returns for the IT Index are negative in the year 2008-09 (-36.9035), and in 2007-08(-25.0078). The annual risk of IT Index are high in the year 2008-09 (2.854525), 2009-10 (2.047434), and in 2007-08 (2.005995). The overall return and risk of IT index is moderate due to existing volatile conditions in the global economy. The above table also indicates that, the negative returns or high positive returns leads to greater risk for the investors.

- **Test of Stationarity for Daily Returns of IT Index**

The following table represents the test of unit root for IT Index.

Table 19: Test of Stationarity of IT Index

Name of the Test	t- Statistic for Level Data	Probability
ADF test	-48.67804*	0.0001
PP	-48.72757*	0.0001

*Critical values at 1%, 5% and 10% are -3.43278, -2.8625 and 2.5677 respectively.
Source: Compiled Data

The above table indicates that the level data series is stationary at one per cent level of significance, since the absolute t-statistic value is greater than critical value at 1 per cent

(48.67804>3.43278) critical value. The probability value also represents that the IT Index daily return series mean and variances over the period are similar since these values are less than 1 per cent. The findings are opposing the earlier studies of Mehta and Sharma (2011) and Joshi (2010). Therefore the data can be used for the further analysis.

- **Autocorrelation and Ljung-Box Q-statistic for IT Index**

The results of thirty six orders sample autocorrelation coefficients and Ljung- Box statistics return series of the IT Index for the total period of ten years from April 2006 to March 2016 are presented in table 20.

Table 20: Test of Autocorrelation for IT Index

Lag	AC	PAC	Q-Stat	Probability	Lag	AC	PAC	Q-Stat	Probability
1	0.022	0.022	1.1965	0.274	19	0.048	0.056	40.913	0.002
2	-0.059	-0.059	9.7972	0.007	20	-0.037	-0.033	44.393	0.001
3	-0.048	-0.045	15.417	0.001	21	-0.02	-0.008	45.366	0.002
4	-0.025	-0.027	16.98	0.002	22	-0.002	-0.006	45.378	0.002
5	0.034	0.03	19.858	0.001	23	-0.029	-0.033	47.466	0.002
6	0.009	0.003	20.068	0.003	24	-0.01	-0.018	47.739	0.003
7	0.009	0.01	20.248	0.005	25	0.029	0.023	49.917	0.002
8	0.027	0.03	22.043	0.005	26	0.026	0.02	51.627	0.002
9	0.003	0.005	22.068	0.009	27	0.027	0.024	53.433	0.002
10	0.007	0.01	22.189	0.014	28	0.013	0.02	53.829	0.002
11	0.001	0.003	22.19	0.023	29	-0.031	-0.025	56.168	0.002
12	0.008	0.01	22.334	0.034	30	-0.006	0.001	56.245	0.003
13	-0.008	-0.009	22.484	0.048	31	-0.034	-0.037	59.148	0.002
14	0.007	0.008	22.591	0.067	32	-0.002	-0.004	59.163	0.002
15	0.002	0	22.597	0.093	33	0.026	0.016	60.842	0.002
16	0.004	0.004	22.647	0.124	34	0.042	0.033	65.19	0.001
17	0.07	0.07	35.062	0.006	35	-0.009	-0.011	65.383	0.001
18	0.009	0.007	35.248	0.009	36	-0.009	-0.008	65.579	0.002

Source: Compiled Data

The above table shows the test of Auto Correlation for IT Index. The independent and identically distributed hypothesis was rejected for ITIndex return series since the probability values are less than 1 per cent, indicates that the select series returns exhibited dependencies are based on past behavior. The results of autocorrelation and Ljung-Box (LB) Q-statistic are also supported by previous findings of Nisha (2010), Bordoloi and Shankar (2008) in BSE and NSE, Abdalla (2012) in the Saudi Stock Market & Mittal and Jain (2009) in BSE and NSE.

- **Volatility Analysis of IT Index with GARCH Models**

The following table 21, represents the results of GARCH (1,1), T-GARCH (1,1), E-GARCH(1,1), models for return series of IT Index for the total period of ten years from April 2006 to March 2016. GARCH model estimates that lagged conditional variance (C3) or ARCH term and lagged squared residuals (C6) or GARCH term which has an explanatory power on current volatility of IT Index since the probability values of C3 and C6 coefficients' are less than 1 per cent. The coefficient of C3 (0.158293) is lesser than C6 (0.781815) indicates that there was more impact of past volatility on the present volatility in comparison to effect of past shocks or news on the volatility of IT Index residuals or conditional volatility. The persistence coefficients or the sum of ARCH and GARCH coefficients in the GARCH (1,1) model is 0.940108is very close to 1 which is desirable to have a mean reverting variance process, indicating that volatility shocks were quite continual and took longer time to scatter. It is an indication of covariance stationary model with high degree of continual and long memory on variance in the residuals. These results are similar to the findings made by Kour (2004) and mentioned that the sum of ARCH and GARCH coefficients are near to one indicates long persistence of shocks in volatility.

Table 21: GARCH (1,1), TGARCH and EGARCH Models for IT Index Returns

Variable	GARCH		TGARCH		EGARCH	
	Test Statistic	P value	Test Statistic	P value	Test Statistic	P value
Mean Equation						
C1	0.103543	0.0002	0.088002	0.0022	0.098345	0.0005
Variance Equation						
C2	0.192393	0.00	0.194266	0.00	-0.132921	
C3	0.158293	0.00	0.126222	0.00	0.249958	0.00
C4	NA*	NA*	0.072287	0.04	NA*	NA*
C5	NA*	NA*	NA*	NA*	-0.049750	0.00
C6	0.781815	0.00	0.777928	0.00	0.941525	0.00
R-squared	-0.000837		-0.000402		-0.000674	
Adj.R-squared	-0.000837		-0.000402		-0.000674	
Log likely hood	-4622.266		1.7518266		-4613.577	
AIC	3.732365		3.730640		3.726161	
SIC	3.741749		3.742370		3.737891	
Durbon-Weston Stat	1.954427		1.955276		1.954745	
Residual Diagnostic test						
Q Statistics	3.7966	0.956	4.7086	0.910	3.7966	0.956
ARCH LM Test						
F-statistic	0.046918	0.8285	0.037418	0.8466	0.271703	0.6022
Observed R-square	0.046955	0.8284	0.037448	0.8466	0.271892	0.6021

Source: Compiled Data *Not Applicable

The asymmetric TGARCH and EGARCH models estimated for the returns of the IT Index indicating that all coefficients of the models are statistically significant at 1 percent level, the coefficient terms of TGARCH (0.072287), EGARCH (-0.049750) also showed positive and negative sign conditions, indicating that there is a leverage effect on the returns of IT Index. The guideline to choose the best model among TGARCH and EGARCH is that the model whose value of Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) is minimum that could be a better model. These two models indicate the variance in the predictive ability of the model. TGARCH model exhibited AIC and SIC as 3.730640 and 3.742370 whereas EGARCH exhibited the values as 3.726161 and 3.737891 respectively. These values indicate that EGARCH model predictive ability is superior as compared to TGARCH model in this phenomenon. Karmakar (2007), Bordoloi and Shankar (2008) and Pandey (2005) supports the results. In the above table the probability values of Q statistics for GARCH, TGARCH and EGARCH models are 95.6, 91.0 and 95.6 percent, F statistic and observed R squared probability values are for GARCH (82.85%, 82.84%), TGARCH (84.66%, 84.66%) and EGARCH (60.22%, 60.21%) indicating that these three models are free from Auto Correlation and ARCH effect.

Findings

The major findings of the research study are as follows:

- The average daily returns and risk of Auto Index are 0.063 per cent and 1.52 per cent. The probability of getting lower returns than the average return is also low since the coefficient of skewness is positive. High variations were found in the risk of Auto index. In the year 2009-10 the returns were high, negative returns were found in different years during the studyperiod. This phenomenon is due to high correction in the previous period and favorable expectations about the industry growth rate. In the year 2015-16 index has generated negative returns due to high inflation rates.
- The average daily returns and risk of Bankex are 0.07 per cent and2.062 per cent. The probability of getting lower return than the average return is also low since the coefficient of skewness is positive. There is much variations in the risk of Bankex index through the period of ten years where as the returns were high in the year 2009-10 and negative in different years

during the study period. This phenomenon is due to high correction in the previous period and strong fundamental in the Indian banking industry. Due to high inflation the rates of interest have been increased by banks with RBI instructions in this regard the banking stocks have faced losses in the year 2015-16.

- The average daily returns and risk of Energy Index are 0.031 per cent and 1.69 per cent. The probability of getting lower return than the average return is high since the coefficient of skewness is negative. There is much variations in the risk of Energy index during the period of ten years where as the returns were high in the year 2007-08 and negative in the year 2008-09 and 2011-12. This phenomenon is due to ongoing high production of crude oil by Iraq in the beginning of 2007-08 financial year. Later the crude oil production has been reduced and there exists oil price shocks to the market lead the energy index to face losses in the year 2008-09.
- The average daily returns and risk of IT Index are 0.052 per cent, 1.75 per cent and the probability of getting lower return than the average return is low since the coefficient of skewness is positive. There is much variations in the risk of IT index during the period of ten years where as the returns were high in the year 2009-10 and negative in the year 2007-08, 2008-09 and 2015-16. This phenomenon is due to US subprime crisis. The index have provided highest positive returns in the year 2009-10 due to huge losses in the stock prices in previous years. In the year 2015-16 IT index has witnessed negative returns due to downfall in estimated earnings.
- ADF and PP tests reveals that the Auto, Bank, Energy and IT indices are free from non-stationary problem at level data where as it suffers from Auto correlation problem since the Ljung-Box Q-statastic probability values are less than 0.05 for different lag series. In this regard, it is felt that there is need to apply ARCH models to analyze the volatility of select indices.
- ARCH family models such as GARCH, TGARCH and EGARCH have been constructed and found that EGARCH model is best fit model to forecast the volatility of select indices. It is also found that the model is free from ARCH effect.
- The other important finding of EGARCH model is that the returns of Auto, Bank, Energy and IT Indices reacted differently to that of positive and negative information. Negative information have showed more effect and the index experienced high volatility than that of positive information. This may be due to leverage effect on stock prices.

Conclusion

The study concludes that Auto, Bank and IT sectors have provided better returns during the study period where as Energy Index has provided only moderate returns to the investors. The variations in the stock prices were high during the period of the study i.e., from the year 2006 to 08 the indices have provided less returns and from 2010 to 2014 all these indices have offer considerable returns, where as in 2015 and 16 years the returns are negative. The composite index NIFTY has offered comfortable returns to the investors with minimum risk due to shifting of risk from one sector to another sector in the market. The ARCH models reveal that the investor are reacting more quickly for negative information than positive information prevailing in the market and the negative trends were continuing for long period due to leverage effect. In order to understand and make effective investment decisions, one has to make a study on the factors contributing the volatility in the markets.

References

- Corradi, V., Distaso, W., & Mele, A. (2013). Macroeconomic determinants of stock volatility and volatility premiums. Journal of Monetary Economics, 60(2), 203–220. https://doi.org/10.1016/j.jmoneco.2012.10.019
- Dimpfl, T., & Jank, S. (2016). Can Internet Search Queries Help to Predict Stock Market Volatility? European Financial Management, 22(2), 171–192. https://doi.org/10.1111/eufm.12058
- Kumari, J., & Mahakud, J. (2014). Relationship Between Conditional Volatility of Domestic Macroeconomic Factors and Conditional Stock Market Volatility: Some Further Evidence from India. Asia-Pacific Financial Markets, 22(1), 87–111. https://doi.org/10.1007/s10690-014-9194-7
- Walid, C., Chaker, A., Masood, O., & Fry, J. (2011). Stock market volatility and exchange rates in emerging countries: A Markov-state switching approach. Emerging Markets Review, 12(3),

272–292. https://doi.org/10.1016/j.ememar.2011.04.003

- Kour, M., Chaudhary, K., Singh, S., & Kaur, B. (2016). International Journal of Innovative Studies in Sociology and Humanities (IJISSH) www.ijissh.org A STUDY ON IMPACT OF GST AFTER ITS IMPLEMENTATION, (November).
- Bhowmik, D. (2013). STOCK MARKET VOLATILITY : AN EVALUATION, 3(10), 1–18.
- Garg, A., & Bodla, B. S. (2015). Impact of the Foreign Institutional Investments on Stock Market : Evidence from India. Indian Economic Review, 46(2), 303–322.
- Karmakar, M. (2006). Stock Market Volatility in the Long Run. Economic and Political Weekly, 41(18), 1796–1802.
- Karmakar, M. (2007). Asymmetric Volatility and Risk-return Relationship in the Indian Stock Market. South Asia Economic Journal, 8(1), 99–116. https://doi.org/10.1177/139156140600800106
- Literature, R. O. F. (n.d.). Review of literature, 46–82.
- Mittal, A. K., & Goyal, N. (2012). modeling the volatility of indian stock market. International Journal of Research in IT & Management, 2(1), 2231–4334. Retrieved from http://www.mairec.org

❍☯❍