EXAMINING THE LINKAGE BETWEEN SECTORAL INDICES OF NSE AND VOLATILITY INDEX: AN EMPIRICAL STUDY

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ABSTRACT

Volatility index introduced by the National Stock Exchange of India (NSE) in 2008, called the India VIX (IVIX), is a measure of market's expectation of volatility over the near term. The present study attempts to analyze and examine the relationship between IVIX and Sectoral Indices of NSE. The authors have relied on Graphical analysis, Descriptive statistics, ADF test, Correlation and Regression performed on a time series data set ranging from 01/04/2009 up to31/03/2015 to derive and detect the linkage. This research has supported and at the same time contradicted with the past literature. However,present study clearly documents the same with some contardictions as revealed in the analysis part. One important observation found as a part of the analysis is that the Nifty Energy index seems to be immune to the volatility shocks while the Nifty Finance has a positive impact on IVIX and the same is confirmed by the multiple regression analysis.

KEY WORDS: IVIX, Sectoral Indices, Implied Volatility, Volatility Index

I. INTRODUCTION

Research in the context of market volatility has gained notable attention among the stakeholders of stock market prices in India and world alike(Shaikh & Padhi, 2014); (Claessen & Mittnik, 2002);(Dimpfl & Jank, 2016).Stock market prices exhibit dramatic movements, and prices changes may be too drastic compared to what is justified by fundamentals(Schwert, 1989).The stock market crashes are becoming the norm of the day for almost all the economies of the world. The Sensex and Nifty are certainly not immune to the fluctuations in prices which most of the times seem to be unwarranted as far as the fundamentals are concerned.Stock markets over the period of time have depicted considerable movements both upwards as well as downwards. The recent plunging of Sensex and Nifty on 28th August, 2015 has left policy makers, researchers and investors high and dry with the supposition that stocks seem to be highly capricious.

In order to conceptualize and measure implied volatility of stock markets, concept of volatility index (VIX) was introduced by (Whaley R. E., 2008)and the same is calculated by Chicago Board of Options Exchange (CBOE) based on

S&P 500 options. Literature has clearly documented a negative relation between VIX and stock market prices(Shaikh & Padhi, 2014)(Whaley R. E., 2000).A surge in volatility as represented by Volatility Index (VIX) has a negative impact on stock market prices with clear evidence that VIX acts as "Investor fear gauge" thereby suggesting that negative shocks in volatility has more profound impact of prices(Shaikh & Padhi, 2014). The Chicago Board of Options Exchange (CBOE) has over the period of time come up with a number of volatility measures with different underlying assets like CBOE NASDAQ Volatility Index (VXN), CBOE S&P 100 Volatility Index (VXO), CBOE DJIA Volatility Index (VXD), CBOE Russell 2000 Volatility Index(RVX), CBOE Short-Term Volatility Index (VXST), CBOE 3-Month Volatility Index (VXV), CBOE Mid-Term Volatility Index(VXMT).Different Stock market exchanges of the globe have also come up with their respective volatility indices, for example, NSE of India (IVIX), China (VXFXI) etc.

In India, the first Volatility index was introduced by the National Stock Exchange of India (NSE) in 2008, called the India VIX (IVIX). Volatility Index is a measure of market's expectation of volatility over the near term and is computed by the similar methodology as adopted by Chicago Board of Options Exchange (CBOE) for the computation of VIX. Both call and put option prices based on Nifty index are used for computing the IVIX. IVIX depicts the expected market volatility over the next 30 calendar days. i.e. higher the India VIX values, higher the expected volatility and vice-versa.

II. REVIEW OF LITERATURE

The Capital Asset Pricing Model (CAPM) clearly indicates that as the element of risk increases there is a profound negative impact on returns. Accordingly, as the Volatility index (sometimes referred as fear gauge) increases, the stock market prices go down.As already pointed out that the concept of Volatility index was put forward by Whaley but it was (Fleming, Ostdiek, & Whaley, 1995)who laid the foundation of implied volatility and its computation. Besides, their study also confirmed an inter-temporal relationship (negative) between implied volatility and stock market returns.This research opened the gates for more empirical research on implied volatility index across the world.(Whaley R. E., 2000)analyzed the weekly changes in VIX and S&P100 returns and results revealed significant negative contemporaneous relation with significant asymmetry between changes in VIX and stock index returns. Subsequent review of literature also established asymmetric negative relation between expected market volatility and stock returns (Schwert, 1989); (Fleming, Ostdiek, & Whaley, 1995); (Bates, 2000); (Poteshman, 2001); (Pan, 2002); (Sarwar, 2012);

(Shaikh & Padhi, 2014); (Shaikh & Padhi, 2016);(Konstantinidi & Skiadopoulos, 2016); (Giot, 2005). In the Indian context as the Volatility Index was introduced very recently in 2008, only a few studies have been focused on the same.

In this context, (Kumar, 2012)studied and analyzedthe IVIX interms of its statistical properties and its relationship with Indian stock market and its predictive power for forecasting future variance. By relying on quartile regression and VAR techniques, the study concluded that the IVIX returns show a negative asymmetric relationship with Indian stock market.However, a study on cross-sectional relationship of IVIX with stock beta, market to book value, value of equity and market capitalization, using three factor multiple regression, has established that the IVIX has a positive and significant relationship with the returns of value-weighted high-low returns(Bagchi, 2012).Shaikh and Padhi(2014)using daily closing prices of India VIX and underlying S&P CNX Nifty Index data for a period between 11/01/2007 and 04/30/2013 attempted to investigate the contemporaneous inter-temporal relationship between implied volatility index and stock returns. The study while adopting (Fleming, Ostdiek, & Whaley, 1995)model concluded that there is a negative asymmetric relationship between Indian VIX and S&P CNX Nifty, thereby supporting the past literature.

III. OBJECTIVE

The present study has been undertaken with the following objective

- To analyze and examine the relationship between IVIX and Sectoral Indices of NSE.

IV. RESARCH METHODS, ANALYSISANDDISCUSSION

The present study has been conducted to examine the relationship between Indian-VIX and various sectoral indices of NSE like Nifty Auto, Nifty Finance, Nifty Energy, Nifty Bank Nifty IT and Nifty Media representing the crucial aspects of Indian economy. For the purpose of this study and realizing the afore-mentioned objective, daily closing prices of sectoral indices along with relevant readings of India VIX are taken into consideration ranging over a period of six years (01/04/2009-31/03/2015). A total of 1490 observations across each index have been taken up from the NSE website.[1]

Fig.1.1 & 1.2 Graphs depicting relationship between sectoral Indices of NSE and IVIX (for log transformed returns of sectoral indices and change in IVIX).The time series data of Sectoral indices and India VIX over a time period ranging from 01/04/2009-31/03/2015 is plotted using a time series graph in order to

[1]http://www.nseindia.com/products/content/equities/indices /historical_index_data.htm.

derive the relationship among the variables taken up for the study. The red line depicts the IVIX and has clearly revealed high level fluctuations as far as volatility is concerned in the Indian Stock market. The graphical analysis indicates that the sectoral indices seem to move in the same direction thereby indicating a positive correlation among them. However, the graph clearly indicates an inverse relationship between sectoral indices and IVIX. The graph further elaborates that the implied volatility levels being highest in the year 2009 and then easing out in 2010-11 and now depicting a decreasing trend towards 2014-15 with some huge fluctuations in 2013 and 2014. As the Indian economy has affected by the economic slowdown due to sub-prime crisis which in turn contributed towards the higher levels of volatility in 2009 and the recovery phase that started towards the 2010 period has led to decline in the levels of implied volatility demonstrated by the IVIX.

Fig 1.3 gives us a clearer picture about the behavior of indices taken up for the study. While all the sectoral indices follow a similar direction (Upwards), the Indian VIX has a negative slope and the direction being completely antagonistic to that of sectoral indices. This once again clearly shows us inverse relationship between IVIX and Sectoral Indices of NSE.

Table 1 recapitulates the descriptive statistics of select sectoral indices (returns) and change in IVIX. The table clearly reveals that the mean return of all the sectoral indices being positive. While, among the selected indices taken up for the study, Nifty AUTO has the highest mean return for the selected time period while Nifty Energy has yielded the least mean return as given in the table above. The mean of changes in VIX is negative standing at -0.014730 which in other words reveals that the volatility is following a decreasing trend that complements the graphical analysis with the maximum positive change being 6.21 and the highest negative change being -12.47250. What is also important to note that standard deviation from mean is highest in case of IVIX compared to sectoral indices that once again depict its fluctuating nature. The descriptive statistics is also crucial in the sense that it helps us to identify whether a given distribution has the characteristics of normal distribution or not. In none of the indices, the mean and median coincide which clearly indicates that none of the distribution follows the properties of a normal distribution. Another important analysis pertains to skewness and kurtosis of the distributions. In the table, it is very much clear that the coefficient of skewness for CIVIX and RIT is negative with values being -0.533057 and -0.181728 respectively indicating that both of these distributions are negatively skewed. A value of coefficient of skewness for all the other indices indicates that all such indices are positively skewed. The coefficient of kurtosis for all the distributions is very high compared to want is warranted for a normal distribution thereby exhibiting leptokurtic behaviour.

In all, descriptive statistics reveals that the behaviour of all the indices including IVIX is totally different compared to a normal distribution. For any distribution to be random, the first and foremost pre-condition is that the data should be normal. Thus, the descriptive statistics confirms that none of the indices follows a normal distribution and hence do not behave in a random manner.

Table 2 reveals the empirical results of Augmented Dickey Fuller test. The ADF test has been done to find out whether a unit root exist in the return series and to check whether the return time series are non-stationary. Non-stationarity in the return series is a necessary condition for the random walk to hold true. The null hypothesis in this case is that the time series data is non-stationary and doesn't exhibit any pattern or relation with other variables. The probability of accepting the null hypothesis i.e. sectoral indices of NSE and IVIX is zero in all the cases. Also, in all the cases the ADF t-statistic is highly negative compared to the respective critical levels @ 5%. Hence, the null hypothesis of the time series data being non-stationary once again stands refuted. The stationary of time series data makes it aptfor further analysis and research.

Table 3 depicts the results of correlation analysis. The correlation matrix clearly reveals that the sectoral indices exhibit very high positive correlation with one another, for example, Nifty Auto shows significantly high positive correlation with Nifty Bank (0.950026), Nifty Finance (0.96348), Nifty FMCG (0.891888), Nifty IT (0.949014) and Nifty Media (0.813141). What is very important to note is that the Nifty Energy index exhibits the least correlation with other indices. It is also very much clear here that the Indian VIX shows significantly high negative correlation with the sectoral indices except the Nifty Energy with which it depicts marginal negative correlation. Investors and other stakeholders of sectoral indices can take a clue from this research as a potential increase in implied volatility in Indian markets would mean a profound negative impact on the equity indices.

Table 4 shows the results of multiple regression analysis. The model has been employed to detect the influence on Implied Volatility index by the sectoral indices for a time series data ranging from 01/04/2009-31/03/2015 (daily prices).The P values for all the indices except Nifty Finance stand significant at less than 5%.Since the intercept value is very high (i.e. 49.071) all the regression coefficients are found out to be marginally negative except Auto (.0076499)and Nifty Energy (0.00072172). The multiple adjusted R^2 Standsat 52.92 which in other words clearly demonstrates the fact that the sectoral indices do have a significant impact on the volatility index.

V. CONCLUSIONANDDIRECTIONFOR FUTURERESARCH

The study attempted to examine the linkage between the sectoral indices of NSE and IVIX. The data ranging over a period of six years from 01/04/2009 up to 31/03/2015, collected from NSE website has been put to analysis by employing number of econometric tests like the Graphical analysis, Descriptive statistics, ADF test, Correlation and Regression analysis.The graphical analysis clearly indicated an inverse relationship between sectoral indices of NSE and IVIX and the same was also confirmed by the correlation and regression analysis. This research has both supported and at the same time contradicted with the past literature. Studies like (Fleming, Ostdiek, & Whaley, 1995); (Giot, 2005);(Shaikh & Padhi, 2014) have clearly documented an assymetrical negative relationship between Stock market returns and Volatilty Index. However our study clearly documents the same with some contardictions as revealed in the analysis part. One important observation found as a part of the analysis is that the Nifty Energy index seems to be immune to the volatility shocks while the Nifty Finance has a positive impact on IVIX and same confirmed by the multiple regression analysis.

The present study was conducted only on a few select sectoral indices on NSE using daily prices on a wholesome time period of six years. Future research should focus on examining all the sectoral indices and respective relationship with the Indian VIX and preferably the time series data should be grouped into different time periods depending on the stage of economy. Besides this a separate analysis of monthly and weekly data can lead to important results. Future research could also focus on developing an econometric model in order to derive one to one relationship between IVIX and other indices of NSE like Nifty 100, Nifty 200 etc. so as to generalize the results.

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FIGURES AND TABLES

Table 1:Descriptive Statistics of Sectoral Indices of NSE and CIVIX

	CIVIX	RFINAN	RAUTO	RBANK	RENERGY	RFMCG	RIT
Mean	-0.014730	0.000993	0.001246	0.000983	0.000149	0.000911	0.001090
Median	-0.040000	0.000854	0.001032	0.000991	-9.37E-05	0.001102	0.001021
Maximum	6.210000	0.178069	0.140046	0.172394	0.154433	0.083038	0.117203
Minimum	-12.47250	-0.087199	-0.051468	-0.085440	-0.059810	-0.047434	-0.124903
Std. Dev.	1.303114	0.016448	0.013625	0.017222	0.013533	0.011423	0.015009
Skewness	-0.533057	0.905926	0.766487	0.760033	0.929722	0.167086	-0.181728
Kurtosis	12.37602	13.44742	10.78627	10.81055	14.67235	6.495828	13.34127
Jarque-Bera	5528.298	6980.112	3909.760	3930.820	8673.127	765.6419	6647.512
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	-21.94750	1.479911	1.857136	1.463980	0.221958	1.357009	1.624783
Sum Sq. Dev.	2528.479	0.402805	0.276429	0.441643	0.272693	0.194277	0.335433
Observations	1490	1490	1490	1490	1490	1490	1490

Source: Computed data.

Table 2: Results of Augmented Dickey Fuller Test at level and 1stdifference.

Index	Level			First difference		
	ADF t-statistic	Critical Value @ 5%	Probability*	ADF t-statistic	Critical Value @ 5%	Probability*
CIVIX	-39.72994	-2.863275	0.0000	-22.26683	-2.863290	0.0000
FINANCE	-34.59987	-2.863275	0.0000	-17.75257	-2.863296	0.0000
AUTO	-34.47671	-2.863275	0.0000	-20.75955	-2.863290	0.0000
BANK	-33.91079	-2.863275	0.0000	17.49992	-2.863296	0.0000
ENERGY	-37.63737	-2.863275	0.0000	-19.41396	-2.863292	0.0000
FMCG	-38.80602	-2.863275	0.0000	-18.91779	-2.863292	0.0000
IT	-37.84088	-2.863275	0.0000	-17.11153	-2.863299	0.0000
MEDIA	-35.60685	-2.863275	0.0000	-20.15783	-2.863292	0.0000

*MacKinnon (1996) one-sided p-values

Source: Computed data

Table 3: Correlation Analysis.

INDEX	AUTO	BANK	ENERGY	FINANCE	FMCG	IT	IVIX	MEDIA
AUTO	1							
BANK	0.950	1						
ENERGY	0.188	0.339	1					
FINANCE	0.963	0.997	0.305	1				
FMCG	0.892	0.793	-0.127	0.829	1			
IT	0.949	0.870	0.198	0.888	0.849	1		
IVIX	-0.615	-0.656	-0.140	-0.663	-0.612	-0.604	1	
MEDIA	0.813	0.858	0.509	0.861	0.674	0.802	-0.620	1

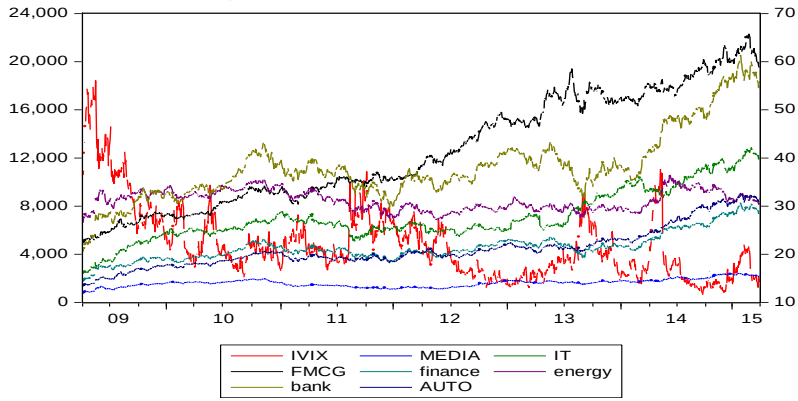
Source: Computed data

Table 4: Multiple Regression Matrix

Dependent variable: IVIX				
N (Number of observations):	1490	Multiple R:	0.72904	
Multiple R^2:	0.5315	Multiple Adjusted R^2.:		
	Coefficient	**Standard error**	**t-statistic**	**Prob.**
Constant	49.071	2.1227	23.117	0.0000
AUTO	0.0076499	0.0005633	13.581	0.0000
BANK	-0.0028956	0.00094441	-3.066	0.0022
ENERGY	0.00072172	0.00030591	2.3593	0.0184
FINANCE	-0.00077004	0.0026477	-0.29084	0.7712
FMCG	-0.00089758	0.00011309	-7.937	0.0000
IT	-0.0019181	0.00023009	-8.3364	0.0000

Source: Computed data.

Figure I & II Graphical analysis of India VIX and Sectoral Indices of NSE



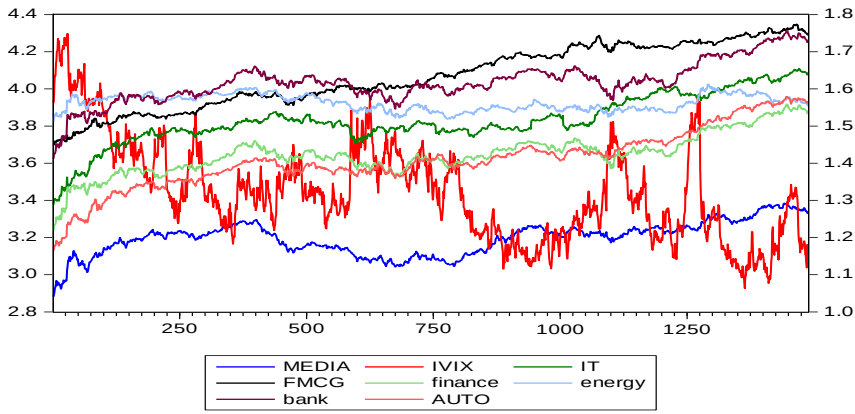
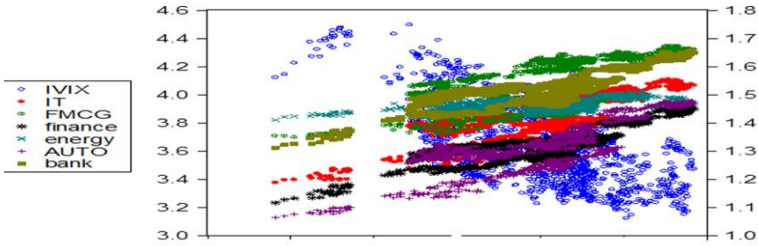


Figure 3 Scatter-plot showing the behavior of India VIX and Sectoral Indices of NSE.



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