Examining Contemporaneous Relationship Between Return of Nifty Index and India VIX

Prasenjit Chakrabarti*

Abstract

The study examines the contemporaneous relationship between Nifty returns and India VIX returns. Literature documents that the relationship between them is negative and asymmetric. Building on this, the study considers the linear and quadratic effect of stock index return (CNX Nifty) and examines the changes in implied volatility index (India VIX). The study finds both linear and quadratic CNX Nifty index returns are significant for changes in the level of India VIX. Findings suggest that India VIX provides insurance both for downside market movement and size of the downside movement.

Keywords: Asymmetric Return, Implied Volatility, India VIX, CNX Nifty

Introduction

Nature of the relationship between stock return and expected level of volatility is a fundamental query in finance literature. Since, the volatility cannot be observed in the market directly, implied volatility is used by many practitioners and academicians as a measure of forward looking volatility. CBOE is the first exchange to introduce implied volatility measure in 1993. In India, *India VIX* is introduced in March 2008. Introduction of implied volatility index (VIX) helps the market players to gauge expected volatility in short term. Implied volatility index reflects investors' consensus estimate of future stock market return volatility (Banerjee et *al.* 2007). Whaley (2009) while discussing the purposes of implied volatility index (VIX) in the market, says that VIX will provide the benchmark for investors' expected short term volatility and volatility derivatives can be written on the VIX index.

The relation between the stock market return and VIX return is well established in literature. VIX is termed as investors *fear gauge* or *fear index* (Whaley, 2000). VIX can be thought as an indicator that reflects insurance premium of a portfolio. According to Whaley (2009), if expected market volatility increases (decreases) investors demand higher (lower) rates of return on stocks making stock prices to fall (rise). So, it is expected that rate of change of in VIX should be proportional to the rate of the return on equity market and relationship should be negative. Moreover, VIX is calculated by out-of-the-money options on the CNX Nifty 50 index. Intuitively, high VIX level signifies increase in demand to buy *put option* on index. This increased demand to buy index *put-options* affects the level of VIX. Thus VIX is expected to rise at a higher absolute rate when the stock market falls than when it rises. So the implied volatility index reflects the risk averseness among investors.

Many empirical studies across different equity markets have proven the negative and asymmetric relationship between spot market and VIX index return. Whaley (2000) documented negative and asymmetric relationship between VIX and S&P 100 and established VIX as investors fear gauge. Giot (2005) reported negative and asymmetric relationship between VXO and S&P 100. Moreover, paper revealed that extreme high level of VIX implies oversold market. The paper also examined the size effect of stock index return on implied volatility index in U.S. market and reported no significant relationship. Dash, S., & Moran, M. T. (2005) examined the portfolio return relationship between hedge fund and VIX and reported negative and asymmetric relationship. Badshah, I. U. (2009) studied the relationship of VIX, VXN, VDAX and VSTOXX and corresponding stock indices returns. The paper reported pronounced negative

* Fellow Programme in Management (Finance and Accounting), Indian Institute of Management Indore, Madhya Pradesh, India. E-mail: f13prasenjitc@iimidr.ac.in

and asymmetric relationship for each of these volatility indices corresponding to its stock market returns. The paper also reported degree of asymmetric return-volatility relationship for these indices. (VIX, VSTOXX, VDAX and VXN in the order highest to lowest asymmetry). Dowling, S., & Muthuswamy, J. (2005) reported negative relationship between volatility index return and Australian stock index return but reported no asymmetric relationship between them. Sarwar, G. (2012) documented strong negative and asymmetric relationship exist between VIX and S&P 100, 500 and 600 returns. The study also reported strength of the VIX return relationship depends on the mean and the volatility regime of VIX. Thenmozhi M. and Chandra A. (2013) reported negative and asymmetric relationship between India VIX and CNX Nifty return. The study supported use of India VIX as investor *fear gauge* .Study also revealed that India VIX can be used to capture stock market volatility better than the traditional class of volatility models including the ARCH/GARCH.

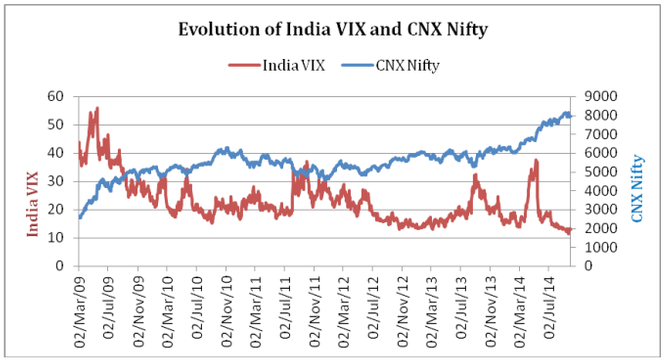
In the current study, we examine the relationship between the CNX Nifty index returns and changes in India VIX. We include daily linear and quadratic CNX Nifty return to understand its effect on India VIX level changes. The linear term helps to understand the directional movement of India VIX returns corresponding to Nifty returns. Another motive of our study is to understand whether size of Nifty returns affects the returns of India VIX. Thus, we include quadratic term to understand the size effect of Nifty return on the changes of India VIX level.

The design of our discussion is as follows, section 2 describes data for the period of 2nd March, 2009 to 30th September, 2014. Section 3 discusses the research design and methodology. The empirical results are described in section 4. Section 5 contains the conclusion.

The Data

To explore the relationship between CNX Nifty and implied volatility index return, we use daily closing index prices of CNX Nifty and daily closing implied volatility index. We obtain data directly from NSE website. India VIX data is available in NSE website from March, 2009. We keep our analysis period from 2nd March 2009 to 30th September, 2014. Figureure below (Figure-1) depicts the co-movement of India VIX with CNX Nifty index.

Figure 1. Historical Fluctuations of India VIX and CNX Nifty Index from 2nd March 2009 to 30th September 2014.



Primary observation reveals an inverse relationship between India VIX level and CNX Nifty index prices. Moreover, high levels of India VIX are observed during March 2009 to September 2009 period, which may be explained by the then global recession and financial turmoil. Refer Figureure below (Figure-2) for a snapshot of daily changes in the levels India VIX and daily return CNX Nifty index from 2nd March 2009 to 30th September 2014.

Figure 2. Evolution of daily changes in the levels India VIX and daily return CNX Nifty index from 2nd March 2009 to 30th September 2014. Data

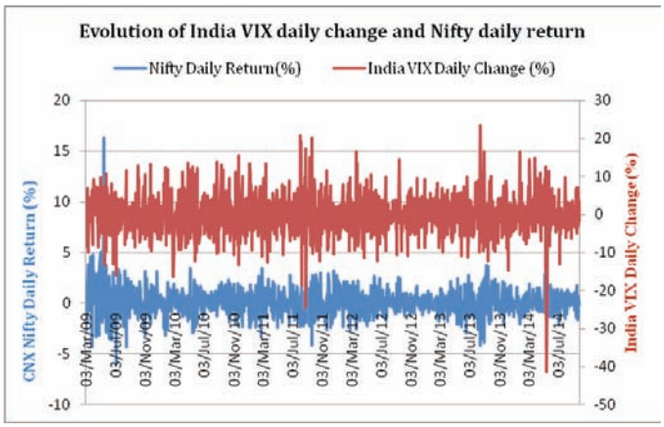


Exhibit-1 below shows some descriptive statistics of the India VIX index levels and CNX Nifty Index price levels. If we observe the CNX Nifty index prices, the maximum price of the Nifty index is about 0.47 times higher than the mean index price. Whereas, the minimum is 0.54 times lower than the mean price level. While testing the same for India VIX, maximum value observed is about 1.45

times higher than the mean VIX level and the minimum value is 0.49 times lower than the mean value of VIX.

Exhibit 1: Descriptive Statistics of India VIX Level and CNX Nifty Index for the Period 2nd March, 2009 to 30th September, 2014.

Descriptive Statistics	*India VIX*	*CNX Nifty*
Mean	22.8530	5557.4050
Median	22.8520	5480.2500
Maximum	56.0700	8173.9000
Minimum	11.5650	2573.1500
Std. Dev.	7.7630	884.4540
Skewness	1.4270	0.2700
Kurtosis	2.2850	1.9140
J-Bera	776.8570	230.4830
Probability	0.0000	0.0000
ADF of daily return	-10.522***	-10.4378***
Observations	1389	1389

*** Significant at 1%

Moreover, top 95 percentile of the VIX index level is observed during the period of March, 2009 to August, 2009, immediately after the introduction of VIX.

The skewness result of Nifty Index suggests that it is positively skewed. This signifies that the tail on the right side of the probability density function is longer than the left side and maximum of the values lie on the left side of the mean. Similarly, India VIX is also positively skewed. Both implied volatility index and Nifty index are platykurtic. So, the values are less clustered around the mean, signifying both of them have fatter middles and few extreme values.

Test of *Jarque-Bera statistics* shows that normality is not observed for both Nifty Index and implied volatility index. ADF test for India VIX return and CNX Nifty return shows that both the series are stationary for the period of analysis.

Research Design and Methodology

We assess the contemporaneous relationship between relative changes in stock index and implied volatility index using ordinary least square method in a linear regression framework. We design the following equation to investigate the relationship.

$$RVIX_t = \beta_0 + \beta_1 D^- + \beta_2 RNifty_t + \beta_3 RNiftyt D^- + \varepsilon_t \quad (1)$$

Where we define $RVIX_t$ = ln (VIX_t) – ln (VIX_{t-1}) as the daily relative changes in the level of implied index VIX. Correspondingly $RNifty_t$ = ln ($Nifty_t$) – ln ($Nifty_{t-1}$) is daily return on CNX Nifty index. D^- is a dummy variable defined as 1 conditional to market going down or 0 otherwise. ε_t is *iid* assumed to be normally distributed.

Literature suggests that there exists asymmetric relationship between stock and implied volatility index return. By asymmetric relationship we mean degree of change in implied volatility index level would be different for positive and negative stock index return. To capture the asymmetric relationship between stock and implied volatility index, we introduce the dummy D^-. The intercept dummy co-efficient (β_1) and interactive dummy co-efficient β_3 are introduced to measure the degree of asymmetry between these two returns.

We follow Giot (2005) to assess the size effect of the stock index return (Nifty index return) on the changes of implied volatility index level, we will introduce the following equation.

$$RVIX_t = \beta_0 + \beta_1 D^- + \beta_2 RNifty_t + \beta_3 RNifty_t D^- + \beta_4 RNifty_t^2 + \beta_5 RNifty_t^2 D^- + \varepsilon_t \quad (2)$$

On the above regression, $RNifty_t^2$ signifies the size of the return. By the above regression (equation 2), we assess if the magnitude of the stock index return has an effect on the change of the levels of implied volatility index.

Empirical Results

The findings for the contemporaneous relationship between CNX Nifty index return and India VIX change is reported in the Exhibit 2. Equation (1) results are reported without considering the size effect of the Nifty index return.

The regression results for equation (1) demonstrate that all the coefficients are statistically significant. Negative slope co-efficient β_2 signifies the negative return relationship between Nifty return and implied volatility index return. Moreover, asymmetric effect is evident from the below statistics. For each 1% change in Nifty index return corresponds to -2.106% change in VIX level (when market is going up) and 2.443% (when market is going down).

Exhibit 2: reports the results of the contemporaneous relationship between relative changes in stock index and implied volatility. Equation (1) $RVIX_t = \beta_0 + \beta_1 D^- + \beta_2\ RNifty_t + \beta_3\ RNifty_t\ D^- + \varepsilon_t$ reports the results without considering the size effect of the CNX Nifty 50 index returns. Equation (2) $RVIX_t = \beta_0 + \beta_1 D^- + \beta_2\ RNifty_t + \beta_3\ RNifty_t\ D^- + \beta_4\ RNifty_t^2 + \beta_5\ D^-\ RNifty_t + \varepsilon_t$ reports the results of considering the size effect of CNX Nifty return.

	Equation (1)		*Equation (2)*	
	Estimate	*t value*	*Estimate*	*t value*
β_0	-1.3170***	-5.825	-0.73256**	-2.837
β_1	1.0988**	3.18	-0.16796	-0.406
β_2	-0.7898***	-4.77	-1.63749***	-6.581
β_3	-1.8715***	-6.778	-2.61039***	-4.663
β_4			0.11055***	4.525
β_5			-0.61965***	-4.219
R^2	0.2530		0.2703	
Adj. R^2	0.2513		0.2677	

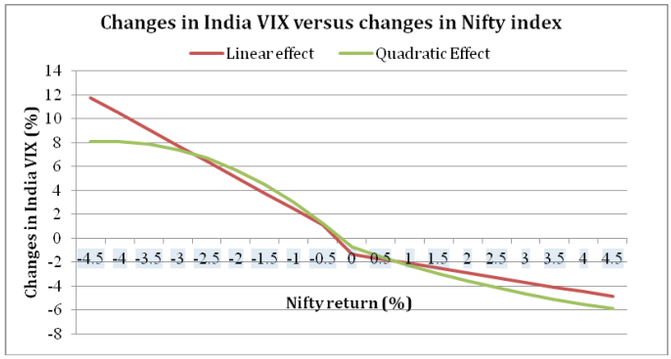
* Significant at 10%

** Significant at 5%

*** Significant at 1%

Results of the equation (2) show that CNX Nifty return is showing *size effect* on changes in VIX level. Both β_4 and β_5 are statistically significant at 1%. So, size of the return of CNX Nifty has an impact on level of VIX. The degree of asymmetry even increases taking the quadratic effect. For a 1% change in CNX Nifty return, change of the VIX level is -2.259% when market is going up versus 3.006% when market is going down.

Figure 3. Shows the linear and quadratic effect of Nifty return (%) on changes of India VIX (%)



Thus, changes in India VIX level move differently for higher or lower Nifty returns. And we may argue that in times of high volatility, the degree of asymmetry is even larger when compared to the periods of low volatility in Nifty returns. Figureure below (Figure-3) depicts the change in India VIX versus change in Nifty return - showing the difference in linear and quadratic effect.

Conclusion

The purpose of our study is to examine the contemporaneous relationship between return of CNX Nifty and change in India VIX level. To examine the same, we consider the daily return of the Nifty and daily changes in India VIX level. We test the linear and quadratic effect of Nifty return on changes of India VIX level. We find that both linear and quadratic returns of Nifty are significant for the change of implied volatility index. Based on the econometric analysis, we conclude that negative and asymmetric relationship exists between CNX nifty return and India VIX return. Moreover, the degree of asymmetry depends not only on the direction of the market movement but also on the size of the return of the market. At times of high volatility in returns, the degree of asymmetry of the India VIX is higher than that of low volatility in returns. The results signify that India VIX acts as a downside risk management tool in two ways. It provides insurance not only for downside market movement but also for the size of the downside movement.

References:

Badshah, I. (2009). Asymmetric return-volatility relation, volatility transmission and implied volatility indexes. *Volatility Transmission and Implied Volatility Indexes (February 15, 2009)*.

Banerjee, P. S., Doran, J. S., & Peterson, D. R. (2007). Implied volatility and future portfolio returns. *Journal of Banking & Finance*, 31(10), 3183-3199.

Dash, S., & Moran, M. T. (2005). VIX as a companion for hedge fund portfolios. *The Journal of Alternative Investments*, 8(3), 75-80.

Dowling, S., & Muthuswamy, J. (2005). The implied volatility of Australian index options. *Available at SSRN 500165*.

Giot, P. (2005). Relationships between implied volatility indexes and stock index returns. *The Journal of Portfolio Management*, 31(3), 92-100.

Rubbaniy, G., Asmerom, R., Rizvi, S. K. A., & Naqvi, B. (2014). Do fear indices help predict stock returns?. *Quantitative Finance*, 14(5), 831-847.

Sarwar, G. (2012). Intertemporal relations between the market volatility index and stock index returns. *Applied Financial Economics*, 22(11), 899-909.

Thenmozhi, M., & Chandra, A. (2013). India Volatility Index (India VIX) and Risk Management in the Indian Stock Market, NSE Working Paper W P/9/2013

Whaley, R. E. (1993). Derivatives on market volatility: Hedging tools long overdue. *The Journal of Derivatives*, 1(1), 71-84.

Whaley, R. E. (2000). The investor fear gauge. *The Journal of Portfolio Management*, 26(3), 12-17.

Whaley, R. E. (2009). Understanding the VIX. *The Journal of Portfolio Management,* 35(3), 98-105.