INDIA VIX: Examining The Negative And Asymmetric Volatility Index – Market Return Relationship

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INTRODUCTION

India's National Stock Exchange (NSE) introduced India VIX in April 2008. India VIX is a volatility index based on the computation methodology of Chicago Board of Options Exchange (CBOE). However, the NSE made some changes like *'Cubic Spline Fitting'* to the India VIX computation methodology to suit the microstructure design of NIFTY Options order book. India VIX captures the expected market volatility over the next 30 calendar days. It uses the best bid and asks quotes of the out-of-the-money near and mid-month NIFTY option contracts traded on the derivatives segment of NSE. Market participants' perception of Volatility in the near term is depicted by India VIX. Volatility Index is different from price index like NIFTY. Volatility Index calculates the Implied Volatility from time-series data of option (both call and put) prices. Thus, volatility index is a model free quantity. India VIX is now computed and disseminated on a real-time basis throughout each trading day by NSE.

LITERATURE REVIEW

Several studies examining the correlation between changes in the volatility index and market returns and the asymmetric volatility – return relationship have been reviewed to understand the research gap and methodology adopted by earlier researchers.

Giot (2003) in a study titled *"On The Relationships Between Implied Volatility Indexes And Stock Index Returns,"* the author shows that there is a negative and statistically significant relationship between stock returns and implied volatility indices. The study reveals that for S&P 100 index, there is asymmetric relationship as negative stock index returns yield bigger changes in VIX than positive index returns.

Corrado, et al. (2003) studied the implied volatility indexes in *"The Forecast Quality of CBOE Implied Volatility Indexes."* The researchers found that the forecast quality of CBOE implied volatilities for VIX has significantly improved. The research assessed the information content and forecast quality of implied volatility. Statistical technologies of OLS Regressions and instrumental variable regressions were used. The results suggested that the CBOE Implied Volatility indexes dominate historical index volatility in providing forecasts of future price volatility for the S&P 100 and NASDAQ 100 stock indices.

In his study entitled *"Can the VIX signal market direction?"* Alessandro (2007) examined whether VIX is an important factor influencing the S&P 500 future returns. The method adopted here is a regression based on dummy variables. The author found that the VIX based strategy outperforms the long-only strategy on the same underlying index. This is a belief shared by traders and market participants as opined by the author.

The Behavioral Finance explanation for the negative asymmetric volatility index- return relationship was studied by Hibbert, et al. (2008). The authors examined the short-term dynamic relation between the S&P 500 (Nasdaq 100) index return and change in implied volatility at both - the daily level and the intraday level. The study proposed a behavioral explanation as an alternative to Leverage hypothesis and the Volatility feedback hypothesis. The empirical results indicated a strong daily and intraday negative return-implied volatility relation. The research further suggested that the presence and magnitude of the negative relation and the asymmetry are closely associated with extreme changes in the index returns and the strength of this relationship is consistent with the implied volatility skew.

Whaley (2009) in the study entitled *"Understanding VIX"* describes the VIX, its history and purpose. The author

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examined the VIX relation to the stock market. The study tested and accepted the proposition that the change in VIX rises at a higher absolute rate when the stock market falls than when it rises. The literature attributed the introduction of VIX to Whaley (1993).

Badshah (2009) in his paper titled *"Asymmetric Return-volatility Relation, Volatility Transmission And Implied Volatility Indexes"* investigated the asymmetric volatility-return phenomenon using VIX, VXN, VDAX and VSTOXX. The author further examines implied volatility transmissions across implied volatility indexes using Granger Causality, generalized impulse response function and variance decomposition. The study found that there are pronounced negative and asymmetric volatility-return relationships between each volatility index and its underlying stock market index. It further reveals that there are significant spillover effects across the volatility indexes and bi-directional causality running between the volatility indexes.

Siripoulos, et al. (2009) in their paper titled *"Implied Volatility Indices – A Review"* studied the information content of implied volatility indices across the world. The authors' research findings suggest that implied volatility indices include information about future volatility beyond that contained in the past volatility. The study further reveals that there is a statistically significant negative and asymmetric contemporaneous relationship between implied volatility changes and the corresponding underlying equity index returns. In his master's thesis entitled *"The Secret Life of Fear: Interdependencies Among Implied Volatilities Represented By Different Stock Volatility Indices Treated As Assets,"* Nousiainan (2010) investigated the systemic interdependencies of selected volatility indices with underlying assets as major stock indices of developed financial markets. The time period under study ranged from January 2000 to June 2009, thus including normal market conditions and crises. In the Indian context, there are very few studies relating to volatility index as it has less data history. Data on the NSE website (www.nseindia.com) is available only from March 2009.

Mishra, et al. (2010) in their paper entitled *"Global Financial Crisis and Stock Return Volatility in India,"* the researchers examined the volatility of stock returns and the impact of the global financial crisis. The author argued that : *"The stock market volatility has drastically increased in recent days, and economies are currently passing through a turbulent period, as reflected in all financial markets and asset classes. The global economic slowdown, the US real estate decline, the credit crisis and the recent reversal in the resources trend are all creating a great deal of turbulence and worry in the capital markets. Financial institutions and other companies around the world have been affected by volatility in the share and property markets. Thus, the US financial crisis reveals that stock price volatility can undermine financial as well as real sector stability. The study of volatility is, therefore, imperative in an emerging-market nation like India. This paper examines the behavior of time varying stock return volatility in India. Using S&P CNX Nifty based daily stock returns for a period from March 2006 to March 2009 in GARCH class models, the study concludes the persistence of stock return volatility and its asymmetric effect."*

Debasis (2011) examined the predictive ability of India VIX. In a NSE paper entitled *"Some Preliminary Examination of Predictive ability of India VIX,"* the researcher examined the behavior of India VIX. The author employed Market-to-Book value of equity and market capitalization as controlling variables and document that India VIX yields a positive and significant relationship with portfolio returns. The author suggests that India VIX is a distinct risk factor, capable of predicting the price discovery mechanism of the market.

Padhi (2011) in a NSE working paper titled *"On The Linkages Among Selected Asian, European and US Implied Volatility Indices"*examined the implied volatility linkages. The results suggested that the US implied volatility index has a substantial impact over the variations of other international implied volatility indices. The author's research revealed that the selected volatility indices have no notable impact over India VIX. The author surmised that this may be attributable to the Indian market's lag in terms of integration with the global financial system.

STATEMENT OF THE PROBLEM

Market participants crave for more information in the context of market turmoil and financial crises impacting the global economic environment. With this need in mind, NSE has begun to disseminate India VIX real-time data. Thus, it is important to understand what exactly the index means so that traders can fully capture its usefulness. Further, to avoid misunderstanding and misconception, the study describes the India VIX, how it helps to assess the state of the current economic environment. The present study attempts to characterize the contemporaneous negative and asymmetric volatility index – market return relationship in the Indian context.

NEED FOR THE STUDY

There are several studies that document the relationship between price indices and volatility indices in the international context. However, as India VIX is relatively new and has small history of observations, there is a need to study and document these established relationships in the Indian context. The need arises as a better understanding of the volatility index leads to insights into the use of indices as a market timing tool, design of derivatives based on volatility for hedging purposes as measures of uncertainty in the market.

OBJECTIVES OF THE STUDY

The following are the major objectives of this study :

1) To ascertain the relationship between India VIX changes and NIFTY Returns;

2) To analyze the asymmetric nature of Volatility-Return relationship;

3) To ascertain the India VIX normal range of fluctuation.

HYPOTHESES

As stated earlier, the main objective of this study is to test the relationship between price index returns and volatility index changes. Accordingly, the following two hypotheses were tested :

- **H_{01} : There is no significant negative correlation between NIFTY returns and India VIX Changes.**
- **H_{02}: There is no significant asymmetric relationship between India VIX Changes and NIFTY Changes.**

METHODOLOGY OF THE STUDY

This study closely follows the methodology adopted by Whaley (2008).

a) Sample Size : The present study attempts to test the relation between NIFTY Return and India VIX changes. The sample consists of 676 observations of India VIX and NIFTY daily closing values.

b) Period Of The Study : The present study used the data of daily closing prices of NIFTY and India VIX for the period from 02.03.2009 to 22.11.2011.

c) Sources Of The Data : This study depends on secondary data. The data regarding NIFTY closing values and India VIX values were obtained from NSE database maintained at the NSE website. The other relevant information was obtained from books, Journals and various websites like SEBI etc.

d) Tools Used For The Analysis : The following tools were used for the present study :

1) The market returns proxied by NIFTY and changes in India VIX were calculated with the help of following formula:

$$RNIFTY_t = 100 (Log\ NIFTY_t - Log\ NIFTY_{t-1})$$

$$RIVIX_t = 100 (Log\ IVIX_t - Log\ IVIX_{t-1})$$

Where $RNIFTY_t$ = Market Returns in %

$RIVIX_t$ = % Changes in INDIA VIX

2) OLS Regression : We regress the daily rate of change of India VIX on the daily rate of Change of NIFTY.

$$RIVIX_t = \beta_0 + \beta_1\ RNIFTY_t + \beta_2\ RNIFTY_t^- + \epsilon_t$$

Where $RIVIX_t$ = The daily rate of change of India Volatility Index (IVIX);

$RNIFTY_t$ = The daily rate of change of S&P CNX NIFTY;

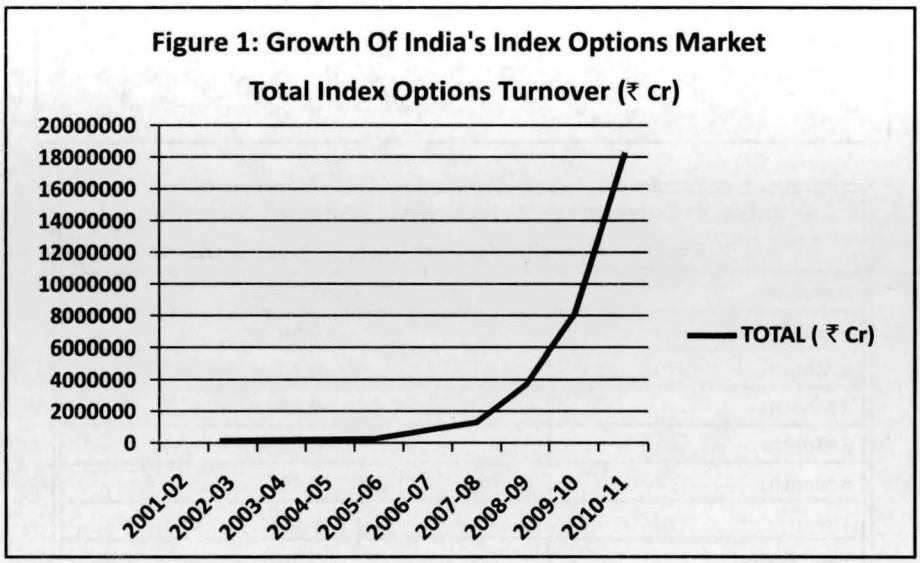
$RNIFTY_t^-$ = The daily rate of change of NIFTY conditional on market going down and zero otherwise.

ANALYSIS OF THE STUDY

a) Growth of India's Index Options Market: It is pertinent here to examine the Index Options Market as the Calculation of India VIX involves the best bid-ask quotes of near and next month NIFTY options contract. A representative implied volatility index requires prices from an active underlying index options market. As we observe from Table 1, trading volumes in NIFTY Index options market improved dramatically in recent years.

b) Relationship Between India VIX And NIFTY : The descriptive statistics for India VIX, NIFTY, % Change in NIFTY,

Table 1 : Growth Of India's Index Options Market			
YEAR	INDEX CALLS (₹ Cr)	INDEX PUTS(₹ Cr)	TOTAL (₹ Cr)
2001-02	2466	1300	3766
2002-03	5670	3577	9247
2003-04	31801	21022	52823
2004-05	69373	52581	121954
2005-06	168632	169837	338469
2006-07	398219	393693	791912
2007-08	668816	693295	1362111
2008-09	2002544	1728957	3731501
2009-10	4049266	3978699	8027965
2010-11	9090702	9274664	18365366
Source: NSE Fact Book, 2011			



% Change in India VIX is described in the Table 2.

The Scatter Plot depicts the negative relationship between % Changes in Indian VIX and % changes in NIFTY.

Table 2: Descriptive Statistics Of Nifty Close, India Vix Close, % Change In Nifty, % Change In India VIX				
Statistics	NIFTY_Close	IndiaVIX_Close	% Chg_Nifty	% Chg_VIX
Mean	5110.09	26.62164	0.09	0.09
Median	5221.05	24.17	0.05	-0.22
Standard Deviation	707.3317	8.39489	1.51	5.47
Kurtosis	2.355436	1.035678	19.84	1.65
Skewness	-1.33632	1.249743	1.83	0.47
Range	3739.3	40.85	22.36	44.76
Minimum	2573.15	15.22	-6.02	-21.62
Maximum	6312.45	56.07	16.33	23.15
Count	675	675	674	674

Figure 2: Relationship Between Nifty Close And India VIX Close

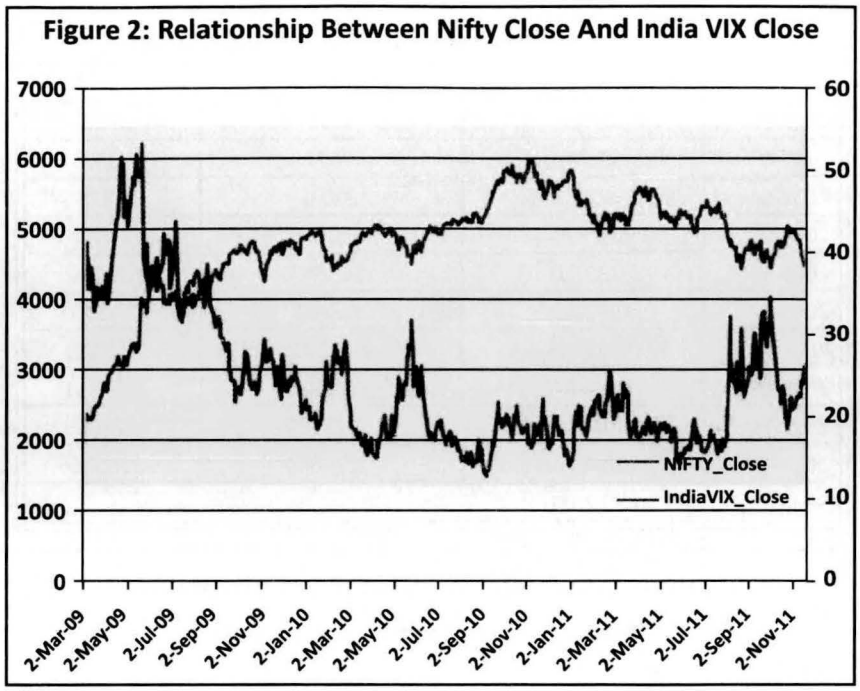
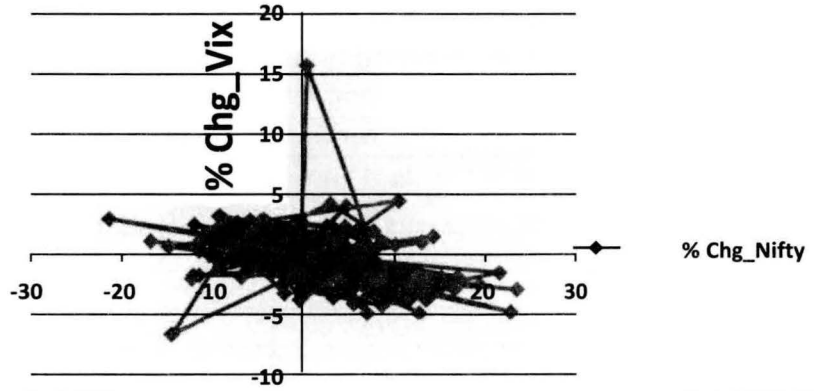


Table 3: Correlation Between % Change In Nifty And % Change In India VIX For Various Durations

Duration	Correlation
1 Week	-0.68
1 Month	-0.43
2 Months	-0.29
3 Months	-0.13
6 Months	-0.19
1 Year	-0.32
Total Period	**-0.48**

Figure 3: Scatter Plot Between % Change In VIX And % Change In Nifty



The Table 4 describes the correlation between % Change in VIX and % Change in NIFTY for various durations. The correlation is the highest in the short term. However, it remains at longer time intervals also as seen from the Table 4.

c) India VIX Normal Range : The researchers attempt to characterize what is normal and abnormal behavior of India

Table 4: Normal Ranges For Daily Levels Of India VIX Over The Period March 2009 Through November 2011 And By Year								
Year	No of Obs	5%	10%	25%	50%	75%	90%	95%
All	674	17.81	18.6	20.45	24.17	30.04	39.34	43.68
2009	204	25.31	26.24	28.30	36.57	40.91	48.39	51.88
2010	252	16.99	17.63	19.36	20.98	23.03	28.07	29.93
2011	218	18.16	18.57	20.14	22.31	25.89	28.98	37.19

VIX. The Table 5 depicts this in a probabilistic way. The median daily closing level of India VIX is 24. 50% of the time India VIX closed between 20.45 and 24.17 (a range of 3.72 points). 90% of the time, India VIX closed between 17.81 and 43.68 (a range of 25.87 points). The widest range was experienced in 2009, with India VIX closing between 25.31 and 51.88 (a range of 26.57 points) about 90% of the time. The 5% and 95% percentiles indicate that the range of daily India VIX levels was from 18.16% to 37.19 % (a range of 19.03 points).

Table 5: Regression Output Of % Change In India VIX On % Change In Nifty				
SUMMARY OUTPUT				
Regression Statistics				
Multiple R	0.54			
R Square	0.29			
Adjusted R Square	0.29			
Standard Error	4.63			
Observations	674			
	Coefficients	Standard Error	t Stat	P-value
Intercept	-1.04	0.25	-4.07	0.00
X Variable 1	-0.79	0.18	-4.32	0.00
X Variable 2	-2.43	0.35	-7.02	0.00

d) Asymmetric Relationship Between Changes In India VIX- NIFTY Returns : The researchers hypothesize that India VIX rises at a higher absolute rate when the market falls than the fall in India VIX when the market rises. To test this proposition, the researchers regress the daily rate of change of the VIX against the daily rate of change of NIFTY. If the proposition is true, the slope coefficients should be significantly less than zero. The regression results indicate that the coefficient β_1 is -0.79 and is significant. The coefficient β_2 is found to be -2.43, and is statistically significant.
The resulting regression equation is

$$RIVIX_t = -1.04 - 0.79\ RNIFTY_t - 2.43\ RNIFTY_t$$

All the coefficients including the intercept are *significant at 1% level*. Hence, the two null hypotheses are *rejected.*
The number of observations used in the regression is 674 and R^2 is 0.285. The coefficients can be interpreted as follows. If the NIFTY rises by 1%, the VIX will fall by

$$RVIX_t = -1.04 - 0.79(1) = -1.83\%$$

On the other hand, if the NIFTY falls by 1% basis points, VIX will rise by

$$RVIX_t = -1.04 - 0.79(-1) - 2.43(-1) = 2.18\%$$

India VIX exhibits the fear of the downside than a barometer of investors' excitement in a market rally. Researchers note that this is correlation and not intended to express causality (Whaley, 2008).

FINDINGS OF THE STUDY

1) India's Index Options Market is registering a phenomenal growth in terms of turnover. This makes the volatility index to be representative of market volatility.

2) Liquidity in the Indian Index Options Market, as evidenced by huge volumes is substantially high. Hence, regulators and policy makers can afford to introduce derivatives based on India VIX.

3) There is an inverse relationship between Changes in India VIX and NIFTY.

4) The negative correlation between changes in India VIX and NIFTY is highest in the one-week time period at -0.68 and for 1-month at -0.43.

5) The median daily closing level of India VIX is 24. The wide range for India VIX is experienced in 2009, with a range of 26.57 points.

6) The regression results show a statistically significant asymmetric relation between market volatility-Index return.

CONCLUSION

The present study is an attempt to determine the contemporaneous negative and asymmetric relationship between Volatility Index – Market return. It is found that there exists a significant inverse relation between movements in India VIX and movements in NIFTY. Further, the results suggest that relation between rates of change in the India VIX are asymmetric and statistically significant. Thus, India VIX acts as a measure of investors' fear of the downside as international studies establish. The researchers conjecture that this contemporaneous negative asymmetric relationship can be utilized for hedging purposes by market participants when Volatility Derivatives are introduced in India.

SCOPE FOR FUTURE RESEARCH

a) The present study is carried out using OLS Regression. It may be extended by using advanced technologies like GARCH, EGARCH etc.

b) There is a scope of adding more indices like NIFTY JUNIOR, CNX 500 to see the correlation of India VIX.

c) Further, this study uses the NSE daily data. This can be extended by Intra-day data at high frequencies.

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