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A Study on India Volatility Index (VIX) and its Performance as Risk Management Tool in Indian Stock Market

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ABSTRACT

This study is aimed at examining the relationship between India VIX and NIFTY and to examine the usefulness of volatility index as risk management tool for stock market trading. It is found that relationship between NIFTY and VIX is strong when market is moving down and vice a versa. I observed that two indices moved in opposite direction. The linear association between the India VIX and NIFTY is statistically significant. The result indicated that statistically significant relationship exist between percentage change in the level of India VIX and rates of returns for various holding periods on index future contract on CNX Nifty Index and CNX midcap 50 Index. In terms of trading strategies it is found that portfolio performance can be improved by shifting the portfolio from midcap to large cap stocks when India VIX goes up and shifting the portfolio from large-cap to mid-cap when India VIX goes down.

KEYWORDS   Stock Market Volatility, Volatility Index, Timing Strategies

INTRODUCTION
For most investors, the prevailing market turmoil and lack of clarity on where it's headed are a cause for concern. Majority of investors in markets are mainly concerned about the uncertainty in getting the expected returns as well as the volatility in returns. Though it is difficult to predict the market return of the stock, there are established models that can be used to predict the volatility in return. In order to predict the perceived volatility of stock market over a period, markets have developed indices that capture the movements in stock price volatility. One of such indices is the volatility Index (VIX).

Volatility Index is a measure of market's expectation of volatility over the near term. Volatility Index is a measure, of the amount by which an underlying Index is expected to fluctuate, in the near term, (calculated as annualized volatility, denoted in percentage e.g. 20%) based on the order book of the underlying index options. AS VIX measures perceived stock market volatility, both upside and downside, VIX is often referred as the investors fear gauge. The low VIX level implies that investors are more optimistic and complacent than fearful in the market, which indicates no or low potential risk perceived by the investors. On other hand, a high level of volatility index indicates that investors perceive significant level of risk and expect that market will move sharply in each direction. So, when the markets witness a sharp upside or downside during periods of volatility, the VIX tends to rise. As volatility falls, the index does too. Hence, the higher the India VIX values, the higher the expected volatility, and vice versa. This property of India Volatility Index makes it a crucial tool for managing the risk in stock market.

REVIEWS OF LITERATURE
Andersen Torben, Bollerslev Tim, Diebold Francis, Labys Paul (January 2002) In this paper authors provided a framework for integrating high-frequency intraday data into the measurement, modeling, and forecasting of daily and lower frequency return volatilities and return distributions. Use of realized volatility computed from high-frequency intraday returns, permits used of traditional time series methods for modeling and forecasting. Further they found that the theory of continuous time arbitrage time processes and the theory of quadratic variation, research scholars developed formal links between the realized volatility and the conditional covariance matrix. Their results hold promise for practical modeling and prediction of large covariance matrices relevant in asset allocation, asset pricing and financial risk management applications.

Banerjee Ashok and Kumar Ritesh This paper focuses on comparing the performance of conditional volatility model (GARCH) and Volatility Index in predicting underlying volatility of the NIFTY 50 index. Using high frequency data the underlying volatility of NIFTY 50 index is captured. Several approaches to predict realized volatility are considered. The primary finding of the study is that forecast error is minimum for VIX. This shows that a model free estimator of volatility captures the underlying volatility better than traditional econometric model of volatility (GARCH). This has noteworthy repercussion for a volatility trader, who can observe the VIX, as disclosed by National Stock Exchange, and can predict the volatility of the underlying cash market.

Thenmozhi M. and Chandra Abhijeet (2013) This paper studies the asymmetric relationship between the stock market returns and India Volatility Index (VIX), and indicates that there is negative correlation between the NIFTY returns and changes in the India VIX levels; in case of high upside market movements, returns on two indices move independently of each other. The relationship is not as significant for higher quartiles, when market takes sharp downturn. This property of India VIX makes it a unique tool for managing the risk, whereby various derivative products based on the volatility index can be used for portfolio insurance against the bad declines. Their analysis of timing strategy based on changes in the level of India Volatility Index, revealed that shifting large cap/midcap portfolios, with increases or decreases by a certain percentage point can be helpful in sustaining positive returns.

Pandey Ajay Based on four different criteria related to bias and efficiency of the various estimators and models, this study analysed the estimation and forecasting ability of three different traditional estimators, four extreme value estimators, and two conditional volatility models. As a benchmark, it used 'realized' volatility estimates. The major findings of the study were as follows,

- For estimating the volatility, the extreme value estimators perform better on efficiency criteria that the conditional volatility models.
- In terms of bias, conditional volatility models perform better than the extreme value estimators.
- As far as predictive power is concerned, extreme value estimators estimated from sample of length equal to forecast period perform better than the conditional volatility estimators in providing five-day and month ahead volatility forecasts.

RESEARCH OBJECTIVES
Specifically, the objectives are,
- To study the relationship between India Volatility Index (India VIX), CNX Nifty Index(NIFTY)
- To study the performance of Volatility Index as a barometer of investor's sentiment and volatility in stock market

- To examine the performance of VIX as a risk management tool and for employing timing strategies for stock market trading.

SCOPE OF THE STUDY
The study is conducted by taking the data for the period of 7 years from March 2009 to April 2015.

ANALYSIS AND INTERPRETATION
This section of research paper covers detailed analysis and interpretation of the data based on various statistical tools.

1. Relationship between NIFTY and India VIX
This section throws light on the relationship between NIFTY and India VIX. The said relationship is studied with the help of graphical presentation and correlation and regression.

Chart 1: Movement in NIFTY and VIX
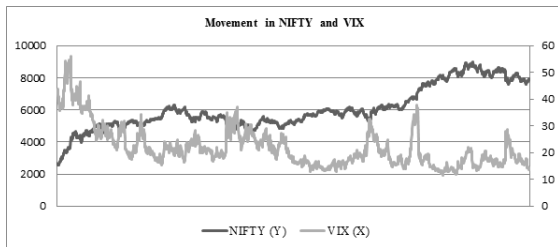
(Source: NSE Website)

It can be observed from the above chart that NIFTY and VIX moved in opposite direction during the study period. This indicates the adverse relationship between NIFTY and India VIX. The degree of correlation between NIFTY and India VIX during the study period is -0.64. This indicates that two indices move in opposite direction. I expected the inverse relationship between NIFTY and VIX, as higher level of volatility in the market would mean the negative sentiment among investors and there could be lower trading, leading to less trading volume and lowering index. On other hand, a low volatility value reflects a boost in sentiment of investors and higher level of trading participation in the market. Hence, the Nifty index and the India VIX are inversely related.

Table 1: Overview of yearly relationship between NIFTY and VIX

Years	Overall Market Movement	Index Volatility	Return Volatility	Correlation	R-Square
Year 2009	Up	726.36	2.16	-0.26	0.07
Year 2010	Up	420.53	1.02	-0.65	0.42
Year 2011	Down	350.21	1.32	-0.71	0.51
Year 2012	Up	300.23	0.96	-0.52	0.27
Year 2013	Down	227.27	1.14	-0.56	0.31
Year 2014	Up	786.55	0.80	-0.29	0.08
Year 2015	Down	348.17	1.02	-0.67	0.45
Average Correlation when market is up					-0.43
Average Correlation when market is down					-0.65

(Source: NSE Website)

It is observed that the relationship between NIFTY and India VIX is weak when volatility in Nifty returns is high and relationship is strong when Volatility in Nifty returns is low. This indicates that high volatility in market distorts the relationship between market and volatility index. This corroborates that, VIX serves as good predictor of NIFTY in times with low volatility in market. Further it is found that relationship between NIFTY and VIX is strong when market is moving down and relationship is weak when market is moving up. This phenomenon is also corroborated by low degree of R-Square in years with high volatility and high R-Square in years

with low volatility. This implies that, VIX has milder impact on NIFY in years with low volatility and relatively higher impact in years with low volatility.

Result of Regression Analysis:
The relationship between NIFTY and India VIX is studied with the help of regression analysis, by taking daily NIFY values as dependent variable and daily VIX values as Independent variable.

Hypothesis:
H0: Slope of regression line not significantly different from zero
H1: Slope of regression line significantly different from zero

Table 2: Result of Regression Analysis for Daily Values of India VIX and NFITY

Regression Statistics								
Multiple R	0.638617							
R Square	0.407831							
Adjusted R Square	0.407482							
Standard Error	1021.508							
Observations	1695							
ANOVA								
	Df	SS	MS	F	Significance F			
Regression	1.00	1216677869.30	1216677869.30	1165.98	0.00			
Residual	1693.00	1766609057.00	1043478.47					
Total	1694.00	2983286926.30						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	
Intercept	8503.814	76.1280	111.7040	0	8354.499	8653.129	8354.499	
X Variable 1	-112.75	3.30	-34.15	0.00	-119.23	-106.27	-119.23	

From the above result of regression analysis following regression line can be drawn in the form of Y=a+bX

$$Y=8503.814+112.75*X$$

Low degree of R Square (0.407831) indicates moderately high impact of VIX on NIFTY. This shows that 40.78 percent variability in NIFTY can be predicted by variability in India VIX. Further the result of ANOVA and t-test indicates that at 5 percent significance level null hypothesis is rejected implying that, slope of regression line is significantly different from zero. From this it can be inferred that regression model is adding to the explanation of the variation of dependent variable (NIFTY). Using above regression line the predicted values of NIFTY were calculated for the study period. The degree of correlation between actual NIFY values and predicted NIFTY values is 0.64. This shows that this model can predict dependent variable actual (Actual NIFTY Values) with 63% reliability. Based on this, it can be summarized that India VIX is the good barometer of investor sentiments and volatility.

2. India Volatility Index as Risk Management Tool
This section throws light on some potential uses of Volatility Index in stock market. Prior studies as well as my data analysis in previous section clearly indicated that stock market returns are inversely related with implied volatility index.

As per Whaley (1993), a market volatility Index offers a reliable estimate of expected market volatility in short run, which is very useful information for many investment decisions like hedging risk, assets allocation among others. It also provides market volatility standard that can be useful in developing volatility based derivative products. As any such market volatility index should be based on security markets which are highly liquid, the India VIX can be used for this purpose as it based on CNX Nifty index, which has remained remarkably liquid for quite some time. Further the asymmetrical relationship between Nifty and India VIX returns observed through my analysis makes the India Volatility Index an effective tool to hedge risky positions in volatile stock market.

It is apparent from my analysis that there exists asymmetrical relationship between India VIX and Nifty returns. This reflects that on an average, there exist inverse relationship between Nifty returns and changes in India VIX levels, but returns on two indices move independently in case of high upward movements in the market. This unique property of VIX makes it a strong contender for use as risk management tool, whereby various derivative products developed on the basis of volatility index can be used to control portfolio erosion during the worst declines.

3. India VIX and Timing Strategy
Like many of the earlier studies, this study also found that changes in India Volatility Index offers strong signals about the daily Nifty returns. In this section I examine the effectiveness of volatility index in employing timing strategies for stock market trading. Theoretically state of equilibrium in the market results in positive relationship between market risk premium and variance of market portfolio (Methron, 1980), which entails that any excess return on the market portfolio over the risk free rate should be positively related with the volatility of market portfolio. Buying this argument, French et al.(1987) stated that due to positive relationship between market risk premium and expected volatility, future discounts used for the valuation of security would also rise in case of any unexpected rise in level of market volatility. This would result in further decline in stock prices. In short, any unexpected increase in volatility would most likely be related to unexpected negative stock returns.

Based on the above arguments I assumed changes in volatility as the main driver for time varying risk premium. Following the methodology of Copeland and Copeland (1999), I explored the timing strategies based on size. This strategy recommends that an investor would shift his portfolio containing small cap stocks to the portfolio containing the portfolio of large cap stocks when implied volatility increases, and vice a versa following decline in implied volatility. The economic explanation for this strategy is given in the original strategy as follows: "In general small cap stocks earn higher returns than large cap stocks(Basu,1983; and Fama and French, 1992), but we believe that small cap stocks perform better when expected volatility increases" (Copeland and Copeland, 1999).

For examining the relationship between timing strategy based on volatility index and size of portfolio, CNX Nifty Index futures is considered as proxy for large cap portfolio and the Nifty Midcap 50 is considered as proxy for small cap portfolio. Based on the assumption that future contracts written on these two indices are highly liquid and tradable at extremely low cost, these two indices were chosen as representative portfolios. The daily returns on CNX Nifty future Index and daily returns on Nifty midcap future index were regressed on the percentage change in India VIX. The percentage change in India VIX was defined as the difference between India VIX at time t and 75 days historical moving average of India VIX divided by 75 days historical moving average of India VIX. The sample for studying this relationship included daily data from March, 2009 to December, 2015. After making adjustment for 75 days moving average, my sample contained 1620 observations. I then regressed the difference in returns on Nifty future index on the percentage change in India VIX. The result of this regression analysis is given in table 3

Table 3: Result of Regression between Future Index and VIX and Small cap and VIX

Future Index and VIX				
Holding Period in Days	Alpha	Beta	R-Square	F-Statistics
1	0.0119	-0.0069	0.0136701	22.42
2	0.0266	-0.0127	0.0223660	37.02
3	0.0433	-0.0176	0.0283883	47.27
4	0.0601	-0.0214	0.0314607	52.56
5	0.0786	-0.0246	0.0332195	55.59
10	0.1457	-0.0434	0.0524388	89.54
15	0.2077	-0.0587	0.0658848	114.12
20	0.2790	-0.0736	0.0795834	139.89
Small cap and VIX				
Holding Period in Days	Alpha	Beta	R-Square	F-Statistics
1	0.0257	-0.0108	0.0219836	36.37
2	0.0585	-0.0199	0.0315698	52.74
3	0.0939	-0.0280	0.0387618	65.24
4	0.1320	-0.0346	0.0426928	72.16
5	0.1726	-0.0398	0.0447141	75.73
10	0.3400	-0.0667	0.0621252	107.18
15	0.4921	-0.0901	0.0741356	129.56
20	0.6646	-0.1110	0.0827969	146.06

(Source: NSE Website)

Data in above table indicates the result of regression analysis between future index and percentage change in VIX and Small cap index and percentage change in VIX. The result indicates statistically significant relationship between percentage change in the level of India VIX and difference between rates of returns for various holding periods on index future contract on CNX Nifty Index (Representing large cap portfolio) and CNX midcap 50 Index (representing midcap portfolio). Data further indicates that relationship becomes strong with increase in holding period.

I further examined trading strategies based on the movement in India VIX. Particularly the direction of movement in India VIX levels is considered as a strong signal to move between large cap portfolio and midcap portfolio. With increase in level of India VIX portfolio is shifted to large cap and with decline in level of India VIX portfolio is shifted to midcap. The result of this analysis is given in following table.

Table: 4 Timing Strategies based on VIX Movements

Holding Period	Movement in VIX	Average Daily Return		Trading Strategy
		Index Futures	Small Cap Index	
1	Increase in VIX	-0.084	-0.1802	Shift from Mid-cap to large-cap
	Decrease in VIX	0.0889	0.1802	Shift from large-cap to Mid-cap
2	Increase in VIX	-0.1763	-0.3534	Shift from Mid-cap to large-cap
	Decrease in VIX	0.1842	0.3628	Shift from large-cap to Mid-cap
3	Increase in VIX	-0.2886	-0.5236	Shift from Mid-cap to large-cap
	Decrease in VIX	0.2701	0.5033	Shift from large-cap to Mid-cap
4	Increase in VIX	-0.3739	-0.6682	Shift from Mid-cap to large-cap
	Decrease in VIX	0.3525	0.6584	Shift from large-cap to Mid-cap
5	Increase in VIX	-0.4791	-0.8256	Shift from Mid-cap to large-cap
	Decrease in VIX	0.4791	0.8838	Shift from large-cap to Mid-cap
10	Increase in VIX	-0.8296	-1.4604	Shift from Mid-cap to large-cap

	Decrease in VIX	0.8565	1.6158	Shift from large-cap to Mid-cap
15	Increase in VIX	-1.0722	-1.9652	Shift from Mid-cap to large-cap
	Decrease in VIX	1.1448	2.2306	Shift from large-cap to Mid-cap
20	Increase in VIX	-1.3494	-2.4121	Shift from Mid-cap to large-cap
	Decrease in VIX	1.4686	2.8366	Shift from large-cap to Mid-cap

(Source: NSE Website)

The result indicates that for all the holding periods portfolio returns can be enhanced or erosion in portfolio returns can be controlled by shifting the portfolio from midcap to large cap stocks when India VIX goes up and shifting the portfolio from large-cap to mid-cap when India VIX goes down. This indicates that India VIX can be very useful in employing timing strategies in stock market trading.

REFERENCES:
1. Andersen T., Bollerslev T., Diebold, F.X. and Labys, P. (2003), "Modeling and Forecasting Realized Volatility," Econometrica, 71, 529-626.
2. Banerjee Ashok and Kumar Ritesh, "Realized Volatility and India VIX", IIM Calcutta Working Paper Series, WPS No. 688/ November 2011
3. Thenmozhi M. and Chandra Abhijeet, India "Volatility Index (India VIX) and Risk Management in the Indian Stock Market" NSE Working Paper, W P/9/2013
4. Lee Soo Nong and Ryu Doojin, Stock Returns and Implied Volatility: A New VAR Approach, Economics, Vol. 7, 2013-3 | February 04, 2013
5. Thenmozhi M. and Chandra Abhijeet, India "Volatility Index (India VIX) and Risk Management in the Indian Stock Market" NSE Working Paper, W P/9/ Lee Soo Nong and Ryu Doojin, Stock Returns and Implied Volatility: A New VAR Approach, Economics, Vol. 7, 2013-3 | February 04, 2013