# The impact of the Introduction of the VIX Futures in India

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November 2014

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**Abstract**

Market tradable volatility futures were introduced in February 2014 in the Indian capital markets. This study uses this event as a backdrop to study the impact in two different ways. One is through an event study and the other through building minimum variance portfolios. The recentness of the introduction of this instrument in the Indian context makes this study novel. It was found in this study that there were positive abnormal returns prior to the announcement of the introduction of the futures and positive abnormal volumes after the announcement was made. In the later part of this study I find that there is no evidence of the much purported diversification benefits of using the volatility instrument for long term investors.

# Chapter 1

# Introduction

Volatility Index Futures as tradable instruments are a pretty recent phenomenon. The Chicago Board Options Exchange (CBOE) introduced the Volatility Index Futures based on the volatility index(VIX) of the CBOE S&P 500 Index on 26$^{th}$ March 2004. Ever since then there has been a growing interest in academia and also in the Finance industry in these new instruments. The CBOE goes as far as to claim that the VIX futures have established themselves as an asset class in their own right.

This growing demand for sophisticated investment products has not been restricted to the American markets alone. In a globalised economy the ever increasing demand for these types of products has reached Indian shores too. On February 7th 2014 the National Stock Exchange (NSE) of India announced the introduction of the exchange tradable Volatility Futures contracts on the Indian Volatility Index. The Indian Volatility Index captures the implied volatility from the market traded options of the NIFTY which is the Benchmark index of the NSE. The contracts started trading on the 26$^{th}$ of February 2014. This very recent development offers a rare opportunity to conduct an event study. The clarity with respect to the event dates and the sort of a natural experiment setting is exploited in this thesis. This study forms the first part of the paper. In the later part of the paper the validity of the assertion that Volatility is an asset class is tested purely in the Indian market scenario.

In a very recent study by Shaikh and Padhi (2013) the information content of the Indian volatility index (IVIX) is explored. The study focuses on the predictive power of the volatility index with regards to the realised volatility of the future returns. They find there to be significant evidence for the subsuming power of the volatility index in being able to predict the volatility of future returns in the Indian context. The IVIX is not a tradable instrument in itself and because of this fact the introduction of tradable futures contracts based on the IVIX is an event that could have market wide implications. Essentially it means that the market participants will now have a tradable instrument that captures their expectations more accurately. Hence this event is a perfect setting for conducting an event study and this type of event study in the Indian context is the gap which my paper attempts to fulfil.

DeLisle et al. (2010) explore the possibility of generating superior returns by holding S&P 500 VIX in a portfolio. They find that holding S&P 500 VIX futures in a portfolio does not give superior returns to the investor . DeLisle et al. (2010) do not find an explanation for the same but allude to the lack of liquidity and/or mispricing to be the reason for the underperformance. Holding a synthetic S&P 500 VIX which is reconstructed using the options underlying the S&P 500 VIX index does yield superior returns. This method was chosen to circumvent the non-investible nature of the index in itself. Hafner and Wallmeier (2007) also explore Volatility as an asset class in itself in the European context. Their study is based on the Over The Counter (OTC) contracts rather than on exchange traded volatility indices or instruments. They find in their study that the returns have an option like return profile rather than the return profile of the underlying securities. Nevertheless there are no studies that explore the suitability of volatility as an asset class in the Indian context. Once again this is the gap which the later part of my paper deals with.

The paper henceforth is organised as follows. In the second chapter a literature review of the current state of the art academic literature is performed. This is followed by the introduction of the Volatility futures in the Indian markets to give the reader a better context to appreciate the novelty

of this study. This is followed by the description of the Data and also the Empirical set-up used to conduct the event study. This chapter ends with the detailed discussion of the findings and also the implications of the same. The fourth chapter deals with the proposition of using the Volatility futures in portfolio management. The context is narrowed down to India and taken further in the later sub-sections of this chapter to include the data and the methodological set-up. This is followed by a detailed discussion of the results and also the implications for the research question. Finally in chapter five the big picture is presented to give the reader a summary of the findings and also the scope for further research and investigation in this area.

# Chapter 2

# Literature Review

Several studies on the information content of volatility indices exist in academic literature. Similarly there exist quite a few studies on the feasibility of using volatility as an asset class.

Early works like Whaley (2000) go on to explain the nature and purpose of the VIX index in the context of CBOE, which pioneered the VIX index and also market traded volatility instruments. In his work Whaley (2000) details out the derivation of the index using the implied volatility method applied to the market traded options on the S&P 100 index.

Chung et al. (2011) study the information content of the VIX options and their impact on the dynamics of the S&P 500 index. The key finding from their study is that the information content obtained from the VIX options was far more significant when compared to the information content of the S&P 500 index options itself. They also find that the information content of the VIX options in predicting market returns is more effective during the periods of higher market volatility. Chen et al. (2011) examine the possibility of including volatility related assets into benchmark portfolios to obtain superior returns in the American context. Their study finds that the investors can indeed improve their risk adjusted returns as measured through the portfolio Sharpe ratio.

Bagchi (2012) studies the direct and cross-sectional relationship between the India VIX and parameters like stock beta, market capitalization and

market to book value of equity. He finds that there is a significant relationship between the India VIX and the portfolio returns. This study strengthens the need for exploring the research question I deal with in the second part this paper, which is the exploration of volatility as an asset class in itself.

A more recent study by Shaikh and Padhi (2013) on the information content of the implied volatility index in the Indian context on the India VIX has much bearing on my study. Shaikh and Padhi (2013) investigate the predictive power of the India VIX in predicting the realized return volatility. Their empirical study finds that the India VIX which is an implied volatility index subsumes all market-wide information content thus making India VIX the best predictor of realised volatility.

Dash and Moran (2005) explore the possibility of using the VIX futures as an asset class for hedge funds. They test the performance of hedge fund portfolios with a tactical allocation towards volatility and a static allocation. They find that the cumulative returns of the tactical allocation portfolio out performs the static allocation portfolio which in turn out performs the hedge fund portfolio with no volatility allocation.

Daigler and Rossi (2006) compare the returns of a pure S&P portfolio versus a S&P - volatility portfolio. They found that including the VIX in an equity only portfolio did not enhance the returns profile but it did significantly reduce the risk of the portfolio. Guobuzaite and Martellini (2012) test for the benefits of using volatility as an asset class in their study. They use the VSTOXX index as a proxy for the volatility instrument and the EUROSTOXX index as the target portfolio of whose return characteristics are altered by the gradual introduction of the VSTOXX index. The portfolio they obtained is subsequently compared with a global minimum variance portfolio represented in their study by the MSCI Europe minimum volatility index. They find that the portfolio they obtained by the optimal combination of the EUROSTOXX and the VSTOXX index significantly outperforms the global minimum variance portfolio. Bouchaud et al. (2001) conduct a quantitative investigation of the correlation between the individual stocks on the S&P 500 and volatility and the correlation between the S&P index and volatility. They find that the index correlations are stronger than the stock

correlations and the decay in index correlations to be faster than that for the stocks. They explain this phenomenon through the so called 'retarded effect' where the reference price used to scale updates is not the instantaneous price but the moving average price.

Chen et al. (2011) take a much broader approach by looking at a much wider pool of Volatility related assets like VIX index, VIX futures and VIX squared for the purposes of testing the diversification potential. They use the mean-variance spanning test to determine that the addition of new instruments significantly improves the investment opportunity set. They find that investing in a VIX related instrument increases the investment opportunity set. Brière et al. (2010) explore the benefits of volatility exposure for the purposes of strategic asset allocation from the perspective of the US long term equity investor. They evaluate the two strategies of taking a direct exposure to the VIX trough the VIX futures contracts on the CBOE and capturing the spread between the implied and realised volatility through variance swaps. They find that the strategy of taking direct exposure to the VIX futures brings in the diversification effect in equity portfolios due to its negative correlation with equities.They also note the hedging nature of the VIX future exposure during severe downturns. The strategy of exposure to the volatility risk premium does not increase the diversification for equities but it does boost the returns. They recommend a calibration of the two strategies to improve the portfolio returns for a given level of risk.

In contrast to the body of literature that extol the virtues of volatility Alexander and Korovilas (2011) find that the volatility instruments only appear to be beneficial to sophisticated investors with short time horizons and also that these instruments are only useful in times of extreme volatility and there is a low likelihood of predicting such events.

# Chapter 3

# VIX futures in the Indian stock market - an event study

## 3.1 Chronology of derivative instruments in Indian markets

The National Stock Exchange of India is one of the two biggest stock exchanges of India, the other being the Bombay Stock Exchange or the BSE. The National Stock Exchange of India has a market capitalization of about 1.57 trillion USD [1]. NIFTY is the key benchmark index of the National Stock Exchange. It represents the fifty biggest companies based on the market value free-float weights.

The National Stock Exchange of India or the NSE was incorporated in November 1992. The Capital market segment of the stock exchange went live in November 1994. By October 1995, NSE had become the single largest stock exchange in India. The year 2000 was a landmark year where many firsts were introduced in the exchange. Some of them were the commencement of internet trading, the start of trading in derivatives through index futures. This was followed by further increasing the range of tradable instruments in 2001 through the introduction of Index options and also the introduction of futures and options on individual securities. The trend of

[1] as on 9th September 2014

launching innovative products continued on with the introduction of sector specific indices and their derivatives. The most important fact to be noted is the ever increasing popularity of such products as evidenced by the trading volumes and the liquidity in each of the segments. Following this trend, the India VIX was launched in April 2008, which is a landmark year due to the global financial crisis around this period. It is also the first volatility index in the country. India VIX is calculated as an implied volatility based on the most liquid option contracts on the NIFTY. The methodology is similar to the one followed by the Chicago Board of Options Exchange (CBOE) but adapted to the Indian context due to differences in the nature of the underlying option contracts.

On February $7^{th}$ 2014 the announcement was made that the much awaited tradable instrument on the India VIX, the India VIX futures would be launched. The India VIX futures started trading on the exchange from the $26^{th}$ of February 2014. For the purpose of this study these two events, namely the announcement and the actual start of trading are of importance.

The India VIX futures contract is unique as it is of weekly expiry with three weekly expiries available at any given point of time. The reasoning being that the Indian markets can predict about 60 days ahead the expected volatility. The VIX futures contract is a measure of expected volatility 30 days into the future. Hence the longest weekly expiry contract of 3 weeks is for 21 days plus 30 or 51 days is the time period over which the India VIX futures can predict the expected volatility. The expiry day is chosen as Tuesday because the last Thursday of every month is the expiry of the monthly derivatives on the NIFTY and 30 days prior to the expiry would coincide with a Tuesday.

## 3.2 Data and Methodology

### 3.2.1 Data

For the purpose of the event study the most important issue is to precisely identify the event dates. In the context of this paper the event dates are

very precisely known due to the recentness of the events. The announcement regarding the introduction of the India VIX futures was made on the $7^{th}$ of February 2014 through an official circular. The India VIX futures instruments started trading on the $26^{th}$ of February 2014.

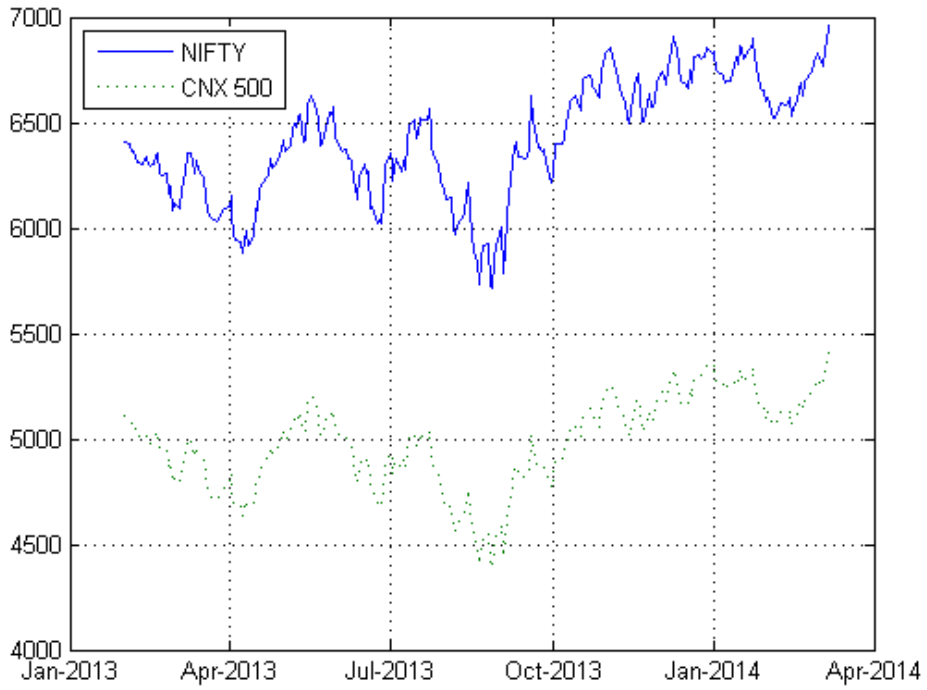



Figure 1: Price movement of the CNX 500 and the NIFTY during the estimation period of the event study. The y-axis is the absolute price level adjusted for the total return index for this period. the x-axis is the time period through the estimation window, starting from the $1^{st}$ February 2013 to $6^{th}$ March 2014.

For the purpose of the event study the daily closing prices of the NIFTY and the daily closing prices of CNX 500 index are used. The CNX 500 is a broad based index representing about 96% of the free float market capitalization of the stocks listed on the NSE. The constituent 500 companies are based upon 72 diverse industry indices. The effect of the events is studied through the changes on the NIFTY index since the volatility index is itself based on the volatility of NIFTY. The CNX 500 index is used as the broad

based index that is used to predict the behaviour of the NIFTY in the event window. The period of the data in my data set starts from the 1st of February 2013 and ends at 6th of March 2014 for both the indices. The choice of the period is simply based on 1 year data prior to the event window start date. The daily closing prices are adjusted for gross total returns for both these indices. This has been done to remove any unwanted distortion due to dividend payouts or buy-backs.

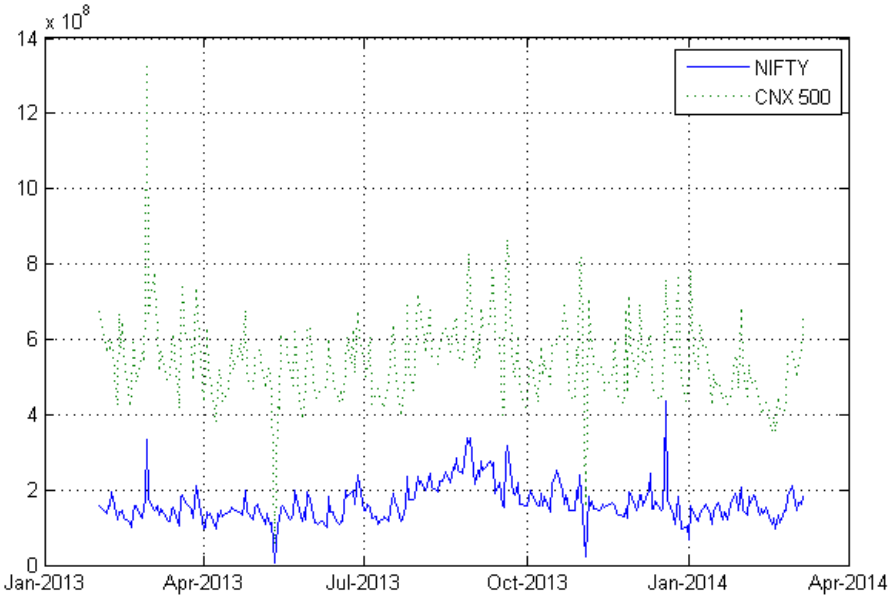



Figure 2: Volumes of the CNX 500 and the NIFTY during the estimation period of the event study. The Y-axis is the absolute Volumes in number of shares traded on the respective indices for this period. The X-axis is the time period through the estimation window, starting from the 1$^{st}$ February 2013 to 6$^{th}$ March 2014.

The event study also studies the impact on the daily traded volumes due to the announcement and implementation of the India VIX futures. The daily trading volume in terms of the number of shares traded traded of NIFTY and CNX 500 is obtained for the same period from the 1$^{st}$ February 2013 to 6$^{th}$ March 2014.

### 3.2.2 Methodology

The most important decision for any event study is the choice of the events followed by the choice of the length of the estimation period and the size of the event window. The choice of the events themselves in this study are unambiguously defined. The estimation period is chosen to be 1 year data starting from the 1$^{st}$ of February 2013 to 30$^{th}$ of January 2014. The number of trading days in this period are 249. The choice of the length of the event window is slightly more trickier in this study. Campbell (1997) discuss at length with empirical proof that for a given length of estimation period the power of the strength increases with the decreasing size of the event window. There is no general consensus in the academic literature about the choice of the estimation period or the choice of the length of the event window. In this study the choice of the event window is made based on the fact that the two event dates are separated by a period of 10 trading days. To maintain consistency of the estimation parameters of the market model used in this study the estimation period used for both the events is the same. Hence to avoid the overlap of the event windows the event window size used in this study are 11 days, that is [-5,5] for both the announcement and implementation events.

The daily closing prices of the two indices used in this study are converted into continuous returns. The market model is used to obtain the values of the estimators over the estimation period. The model that is thus obtained is used to find the abnormal returns during the event window as the difference between the model predicted returns and the actual return. The abnormal returns obtained over the period of the event window are cumulated to obtain the Cumulative Abnormal Returns (CAR). This process is applied in similar ways to both the events.

The analysis of the abnormal volumes is slightly different due to the distributional properties of the volume data. Therefore the volume data has to be natural log-transformed to obtain a better distribution. The process for the transformation is the one followed in Ajinkya and Jain (1989) and also in Pfister and Von Wyss (2010). If $V_p$ is volume of a security in period

P then the transformed volume $V'_p$ is given as

$$V'_p = ln(1 + V_p)$$

Post transformation the same estimation period is used to obtain the parameters using the market model and the same event window is used as used in the event study of the effect of the returns. The abnormal volumes are obtained as the difference between the model predicted volume and the actual traded volumes. Also the Cumulative Abnormal Volumes( CAV) are obtained as the cumulated abnormal volumes over the period of the event window.

The null hypothesis in this study is that both the events (announcement and implementation) produce no abnormal returns or volumes.

H01a : The abnormal returns in the announcement event period is zero.

H01b : The abnormal volumes in the announcement event period is zero.

H02a : The abnormal returns in the implementation event period is zero.

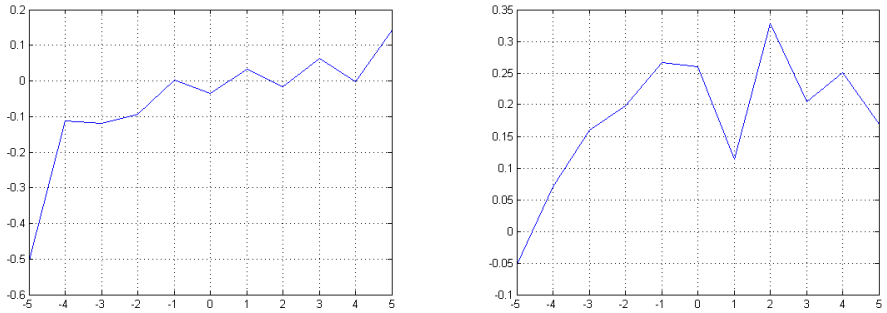
H02b : The abnormal volumes in the implementation event period is zero.

For the purpose of hypothesis testing in this study the standardised t-test is used. According to Campbell and Wasley (1992) the tests for abnormal returns suffer from the non-normality of the abnormal returns which is a key assumption for the test specifications. They find that the test statistic often rejects the null hypothesis in the absence of abnormal performance. Nevertheless they find that this behaviour is less severe and less pervasive across event conditions. Brown and Warner (1985) acknowledge the difficulties in event-studies that arise due to the issues like non-normality of returns or the excess returns, bias in the estimators in the market model obtained through the OLS method and issues related to auto-correlation. In spite of these issues that Brown and Warner (1985) identify, they suggest that for daily data characteristics, such as the one used in this study, pose no serious or significant problems for event study methodologies. They also conclude that the market model is not significantly outperformed by alternate methodologies used to identify abnormal returns. They also find that the standard parametric tests are well specified, especially more so in the case of daily

data than in the case of monthly data.

## 3.3 Results of the Event Study

### 3.3.1 Announcement Event




(a) Abnormal returns (b) Abnormal volume

Figure 3: 3a Abnormal returns behaviour around the date of announcement which is t=0 on the X-axis and the Abnormal returns in percentage on the Y-axis. 3b Abnormal volume behaviour around the date of announcement which is t=0 on the X-axis and the Abnormal volume on the Y-axis

The abnormal returns in the event 'announcement window' does not show any lead indications towards any positive returns before the actual event date at t=0 or the $7^{th}$ of February 2014. There is however a positive abnormal return after the event announcement date reaching a maxima of about 0.1%. The significance of these positive abnormal returns is tested subsequently in this section. The abnormal volumes behave in a slightly more different way. There seems to be positive abnormal volume of 0.05 at t=-4 and this stays above this value throughout the event window. Nevertheless only a test for significance can ascertain the validity of these patterns.

| Day/Period | Abnormal Return | t-Stat | Sig |
|---|---|---|---|
| -5 | -0.51% | -3.11 | *** |
| -4 | -0.11% | -0.69 | |
| -3 | -0.12% | -0.73 | |
| -2 | -0.09% | -0.57 | |
| -1 | 0.002% | 0.02 | |
| 0 | -0.04% | -0.21 | |
| 1 | 0.03% | 0.19 | |
| 2 | -0.02% | -0.1 | |
| 3 | 0.06% | 0.39 | |
| 4 | -0.002% | -0.01 | |
| 5 | 0.14% | 0.88 | |
| [-5 , -1] | -0.83% | -2.28 | ** |
| [+1 , +5] | 0.22% | 0.6 | |
| [-5 , +5] | -0.65% | -1.19 | |

*,**,*** indicates significance at 90%,95% and 99% confidence intervals

**Table 1:** The abnormal returns tabulated according to the days or the periods along with their corresponding t-statistics using the standardised t-test. The abnormal returns are calculated for the announcement event

From Table 1 it can be seen that there are no significant abnormal returns after the announcement date represented by day 0. It is surprising however to find that about 5 days before the announcement event there is a significant abnormal return. This cannot be interpreted as evidence for information front running as the sign of the abnormal return is negative. This would be investigated subsequently in this section by expanding the event window on the pre-announcement period to check the exact time before the actual announcement that this abnormal return was observed. The cumulative abnormal returns(CAR) over the pre-announcement show an abnormal return but post-announcement CAR show no abnormal returns whatsoever. Based on this evidence the null hypothesis H01a cannot be rejected.

The abnormal return only on the day -5 in Table1 gives room for further

investigation if there was indeed some indications of the news of the introduction of the IVIX futures being available before hand to market participants. To investigate this issue further still, I change both the event window and the estimation windows. The new estimation window spans from 7$^{th}$ November 2007 to 24$^{th}$ January 2014. This gives an asymmetric event window of length of 16 days that is [-10,+5].

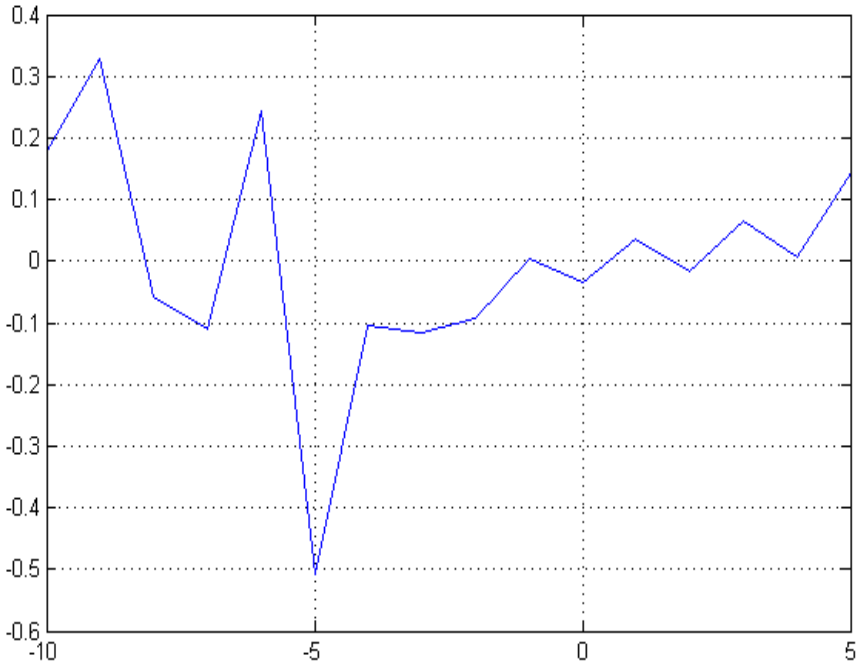



Figure 4: The abnormal returns in percentage are on the Y-axis and the modified event window spanning -10 to +5 days is depicted on the X-axis

From the figure 4 the reaction of the market as evidenced through the movement of the abnormal returns during the 'modified announcement window' shows that there is a very sharp reversal on day -5 which might be the reason for observing a statistically significant result. However it can be seen that there are no sharp movements around the announcement day represented as day 0. The tests of significance can ascertain the real magnitude of these abnormal returns.

| Day/Period | Abnormal returns | t-Stat | Sig |
|---|---|---|---|
| -10 | 0.18% | 1.10 | |
| -9 | 0.33% | 2.04 | * |
| -8 | -0.06% | -0.35 | |
| -7 | -0.11% | -0.67 | |
| -6 | 0.24% | 1.51 | |
| -5 | -0.51% | -3.14 | *** |
| -4 | -0.11% | -0.65 | |
| -3 | -0.12% | -0.72 | |
| -2 | -0.09% | -0.57 | |
| -1 | 0.004% | 0.02 | |
| 0 | -0.04% | -0.21 | |
| 1 | 0.04% | 0.21 | |
| 2 | -0.02% | -0.09 | |
| 3 | 0.06% | 0.40 | |
| 4 | 0.005% | 0.03 | |
| 5 | 0.14% | 0.88 | |
| [-10 , 5] | -0.04% | -0.05 | |
| [-10 , -1] | -0.23% | -0.45 | |

*,**,*** indicates significance at 90%,95% and 99% confidence intervals

**Table 2:** The abnormal returns tabulated according to the days or the periods along with their corresponding t-statistics using the standardised t-test. The abnormal returns are calculated only for the announcement events.

From the table 2 we find that on day -9 there was an abnormal return of significance evaluated at the 90% confidence interval. It is surprising to find that this abnormal return is positive. This could indicate a possible evidence of information front-running. These abnormal returns are not sustained over the period but appears only once at day -5 significant at the 99% confidence interval, but this time the abnormal returns are negative. This can be due to the massive reversal in the abnormal returns on this day as seen in figure 4. To ascertain the overall significance of abnormal returns over the new

expanded time-line the cumulative abnormal returns for different periods are calculated. One for the entire period from day -10 to +5 and the other from day -10 to day -1, that is the period before the announcement was made. In both there periods I find that there is no significant abnormal returns. This is consistent with the findings from the initial event-study on abnormal returns.

| Day/Period | Abnormal Volume | t-Stat | Sig |
|---|---|---|---|
| -5 | -0.05 | -0.26 | |
| -4 | 0.07 | 0.35 | |
| -3 | 0.16 | 0.8 | |
| -2 | 0.20 | 0.99 | |
| -1 | 0.27 | 1.33 | |
| 0 | 0.26 | 1.3 | |
| 1 | 0.11 | 0.56 | |
| 2 | 0.33 | 1.64 | |
| 3 | 0.20 | 1.02 | |
| 4 | 0.25 | 1.25 | |
| 5 | 0.17 | 0.84 | |
| [-5 , -1] | 0.64 | 1.43 | |
| [1 , 5] | 1.06 | 2.39 | ** |
| [-5 , 5] | 1.97 | 2.97 | *** |

*,**,*** indicates significance at 90%,95% and 99% confidence intervals

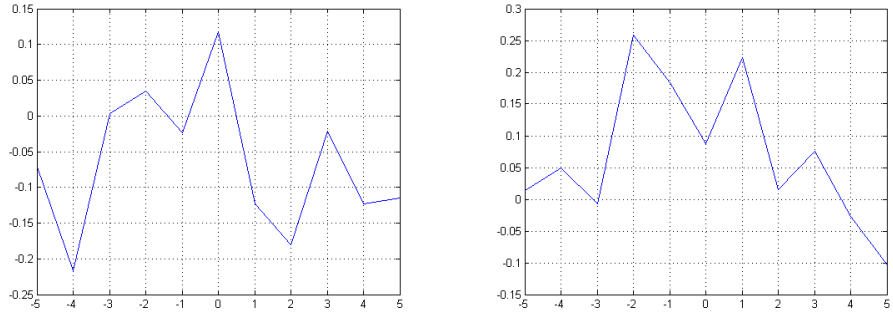
**Table 3:** The abnormal volumes tabulated according to the days or the periods along with their corresponding t-statistics using the standardised t-test. The abnormal volumes are calculated for the announcement event

From Table 3 it can be seen that there is significant abnormal volumes observable both pre and post announcement event. It is however observed that the Cumulative Abnormal Volume(CAV) over the period post announcement and the entire period are statistically significant. Based on this evidence the null hypothesis H01b is rejected at the 95% confidence interval. This is a surprising result as there are no abnormal volumes on the individual days even

at a low level of significance but these small abnormal volumes add up over the event window to show positive abnormal volumes. A much closer look at the volume data for this period reveals that the CNX 500 volumes drop over this period while the NIFTY volumes remain at the same level, causing a statistically significant CAV. Looking more closely at the literature on this peculiar result reveals that according to Ajinkya and Jain (1989) the volume reaction behaviour to events is not explained by theory as in the case of the prices where we have the efficient market theory. Kim and Verrecchia (1991) explain the changes in trading volume is proportional to both absolute price change and also the information differential precision among traders. They further suggest that the volume changes are reflected as the summation of the differences in the reactions of the traders while the price changes are only the reflection of the aggregate or the average reaction of the traders. Bamber (1986) also finds that the volume reaction is more pronounced than the price reaction due to the summation effects of reactions on volume changes due to new information.

The finding from this study suggests that although there has been no significant price reaction there has been a statistically significant reaction in volume increases due to the announcement of introduction of the India VIX futures on the NSE.

### 3.3.2 Implementation Event




(a) Abnormal returns

(b) Abnormal volume

Figure 5: 5a Abnormal returns behaviour around the date of implementation which is t=0 on the X-axis and the Abnormal returns in percentage on the Y-axis. 5b Abnormal volume behaviour around the date of implementation which is t=0 on the X-axis and the Abnormal volume on the Y-axis

The reaction of the market as evidenced through the movement of the abnormal returns during the 'implementation window' shows that there is only a sharp and sudden spike around the date of the actual implementation on the $26^{\text{th}}$ of February 2014 to about 0.1%. There is a similar pattern in the reaction of the volumes as captured in the abnormal volumes during this period with a maximum abnormal volume of 0.25, although the spike is spread over a longer time window. The tests of significance can ascertain the real magnitude of these abnormal returns and volumes.

| Day/Period | Abnormal Return | t-Stat | Sig |
|---|---|---|---|
| -5 | -0.07% | -0.42 | |
| -4 | -0.22% | -1.33 | |
| -3 | 0.003% | 0.02 | |
| -2 | 0.034% | 0.21 | |
| -1 | -0.02% | -0.14 | |
| 0 | 0.12% | 0.72 | |
| 1 | -0.12% | -0.75 | |
| 2 | -0.18% | -1.11 | |
| 3 | -0.02% | -0.13 | |
| 4 | -0.12% | -0.75 | |
| 5 | -0.12% | -0.7 | |
| [-5 , -1] | -0.27% | -0.74 | |
| [+1 , +5] | -0.56% | -1.55 | |
| [-5 , +5] | -0.71% | -1.33 | |

*,**,*** indicates significance at 90%,95% and 99% confidence intervals

**Table 4:** The abnormal returns tabulated according to the days or the periods along with their corresponding t-statistics using the standardised t-test. The abnormal returns are calculated for the implementation event

From Table 4 it can be seen that there has been no abnormal return on any day in the event window both pre and post implementation event. It is also seen that there is no Cumulative abnormal return(CAR) around the implementation date and also over the entire period. With this evidence we fail to reject the H02a null hypothesis.

| Day/Period | Abnormal Volume | t-Stat | Sig |
|---|---|---|---|
| -5 | 0.01 | 0.06 | |
| -4 | 0.05 | 0.24 | |
| -3 | -0.007 | -0.03 | |
| -2 | 0.26 | 1.29 | |
| -1 | 0.18 | 0.92 | |
| 0 | 0.09 | 0.44 | |
| 1 | 0.22 | 1.11 | |
| 2 | 0.02 | 0.07 | |
| 3 | 0.08 | 0.37 | |
| 4 | -0.03 | -0.13 | |
| 5 | -0.10 | -0.52 | |
| [-5 , -1] | 0.50 | 1.11 | |
| [1 , 5] | 0.18 | 0.4 | |
| [-5 , 5] | 0.77 | 1.16 | |

*,**,*** indicates significance at 90%,95% and 99% confidence intervals

**Table 5:** The abnormal volumes tabulated according to the days or the periods along with their corresponding t-statistics using the standardised t-test. The abnormal volumes are calculated for the implementation event

From Table 5 it can be seen that there has been no abnormal volume on any day in the event window both pre and post implementation event. It is also seen that there is no Cumulative abnormal volume(CAV around the implementation date and also over the entire period. With this evidence we fail to reject the H02b null hypothesis.

# Chapter 4

# Volatility as an asset class - evidence from India

## 4.1 Data and Methodology

### 4.1.1 Data

In this study the applicability of the Volatility futures as an asset class in itself is tested in the Indian capital market context. This is achieved through the construction of an efficient frontier of several portfolios using the IVIX and the NIFTY. The main reason for using IVIX instead of the IVIX futures is that the IVIX futures were only recently introduced in the Indian market on the National Stock Exchange, that is on 26$^{th}$ February 2014. This is a very short duration to obtain a reasonable sample to construct a portfolio. The IVIX on the other hand has data over a much longer time span,hence it is used in this study as a proxy to reflect the behaviour of the actual tradable instrument IVIX futures.

The IVIX index is used as one of the asset in the two asset portfolio while the other asset is the NIFTY or the CNX500. The key reasons for using the NIFTY/CNX500 indices is the breadth of those indices and the wide-spread use of these indices as benchmarks for portfolio performance comparisons in the Indian capital market context.

For the construction of the IVIX based efficient frontier, the IVIX closing

values are obtained for a period of seven years from Bloomberg. This period is from 1st November 2007 to 10th October 2014. Similarly the gross total return daily data for the NIFTY is used over the same period. The CNX500, a broad based index of the stocks traded on the National Stock Exchange is also used for comparison purposes and the gross total return daily data is used covering a similar period. In a similar way total return daily data is obtained for each of the sub-periods in this study namely the period of the 2008 financial crisis and the period after the introduction of the IVIX futures.

CNX Low Volatility Index (CNX LVI) is a benchmarking index consisting of a portfolio of fifty stocks traded on the National Stock Exchange. It is re-balanced quarterly with the main selection criteria being that the constituent stocks have the lowest volatility based on the past one year data. The daily closing price is obtained for the estimation period from 1st November 2007 to 10th October 2014.

This study evaluates the performance of the minimum variance portfolios during the 2008 Financial crisis. Although there is no consensus on the exact start and end of the Financial crisis, the reference to the year 2008 is ubiquitous across academic literature. Phillips and Yu (2011) use recursive regression models to identify the beginning of asset bubbles. They track the beginning of the bubbles in the real estate market as early as 2002 and the consequent spread of the bubbles into different sectors and consequent burst during 2008. They find a sort of convergence in the period of the collapsing of the bubbles in Housing Prices, Oil Prices and Mortgage backed securities in 2008. Late 2007 and early 2008 were marked by some of the biggest Financial events. Guillén (2009) tracks these events. Some of the notable events during this period from Guillén (2009) are On December 6th 2007 US president George W Bush unveiled a plan to help more than a million household facing foreclosures. On January 9th 2008 the World Bank announced that the global economy will slow down. The 21st of January 2008 marked the day of the biggest global stock market collapse since September 2001. The Macro-economic responses were also quite spectacular during the period which began to show their effect by the end of the 1st quarter of

2009 with several statements from the Obama administration indicating an impending recovery. For the purpose of this study the start date of the Financial crisis is assumed to be 1st January 2008 and the end date to be end of April 2009 or the last available trading date of the month which is 29th of April 2009.

The well defined period of the IVIX futures introduction enables us to to choose the start and end dates unambiguously as the 26th of February 2014 and the latest possible end date for this study as the 10th of October 2014.

### 4.1.2 Methodology

The daily closing price data over the period from 1st November 2007 to 10th October 2014 of the IVIX, NIFTY, CNX500 and CNX LVI is converted to a time series of continuous returns. If $P_1$ is the price on day 1 ($d_1$) and $P_2$ is price on $d_2$ where $d_2 = d_1+1$. Then the continuous return $r_1$ is given as

$$r_1 = ln\left(\frac{P_2}{P_1}\right)$$

Initially a portfolio consisting of two assets namely the IVIX and NIFTY is constructed. This is achieved by calculating the mean returns over the estimation period of the IVIX and the NIFTY and their respective variances. The covariance of the returns of the two time series is also computed. Since the portfolio has two assets the portfolio weight $w_1$ of asset $a_1$ with return $r_1$ and weight $w_2$ of asset $a_2$ with return $r_2$ sum up to 1. The return (R)of this simple two asset portfolio is calculated as

$$R = w_1.r_1 + w_2.r_2$$

The weight of one of the asset is increased from 0 to 1 while the weight of the other is decreased from 1 to 0 thus obtaining a range of returns in a mean-variance exercise. The portfolio variance is calculated as

$$V_p = w_1^2.v_1 + w_2^2.v_2 + 2.w_1.w_2.Cov_{1,2}$$

Where $V_p$ is the portfolio variance, $w_1$ is the weight of asset $a_1$ with variance $v_1$ ,$w_2$ is the weight of asset $a_2$ with variance $v_2$, $Cov_{1,2}$ is the covariance of the returns between the two assets. A range of portfolio variances are obtained corresponding to the range of portfolio returns obtained by altering the asset weights in the portfolio. The portfolio standard deviation is obtained as the positive root of the portfolio variance. From the set of the thus obtained portfolios the one with the lowest variance is chosen as the minimum variance portfolio.

For the sake of comparison, a minimum variance portfolio comprising of the IVIX and CNX500 is also constructed. The performance of these two portfolios namely the IVIX-NIFTY portfolio and the IVIX-CNX500 portfolio are compared with each other and also benchmarked against the CNX Low Volatility index. The comparisons are made in three different settings. Firstly, the performance is compared over the entire estimation period from $1^{st}$ November 2007 to $10^{th}$ October 2014. Second, the performance is compared during the 2008 financial crisis over the period from $1^{st}$ January 2008 to $29^{th}$ of April 2009. Finally, performance comparison is made for the period during which the IVIX futures contracts were available for trading from the $26^{th}$ of February 2014 to $10^{th}$ of October 2014.

## 4.2 Results and Discussion

### 4.2.1 IVIX as an Asset Class in a Minimum Variance Portfolio

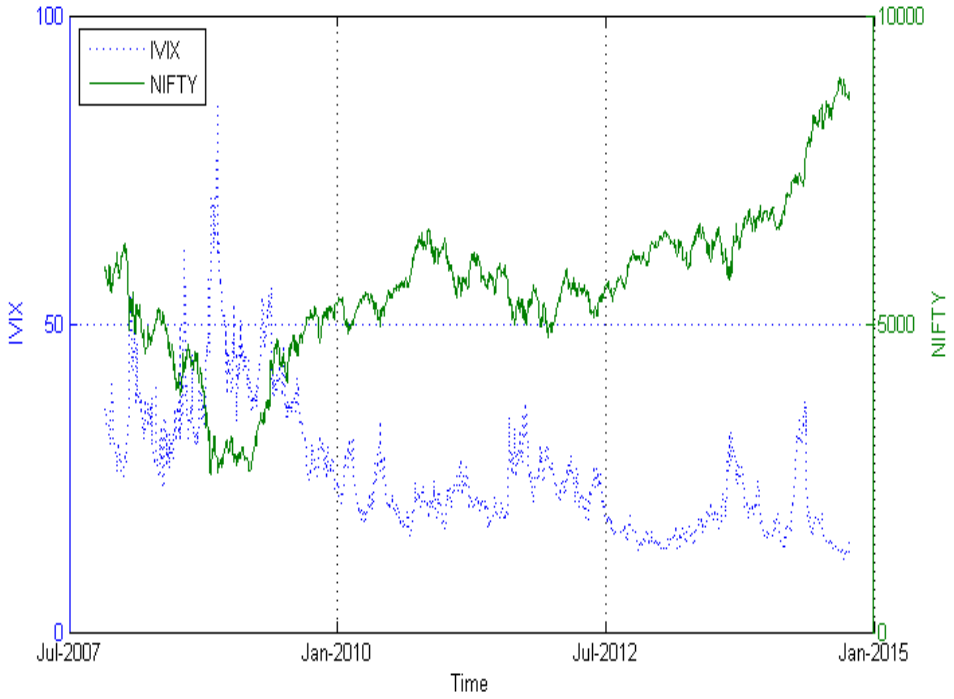



Figure 6: Time series price evolution of the IVIX and the NIFTY with the IVIX levels indicated in the left side of the Y-axis and the NIFTY levels indicated on the right side of the Y-axis. The X-axis represents the sampling period that is spread over from 1$^{st}$ November 2007 to 10$^{th}$ October 2014.

A visual inspection of figure 6 brings out the approximate inverse relationship between the IVIX and the NIFTY index. The key point to note is the markedly sharp positive movements in the IVIX during the 2008 financial crisis corresponding to the sharp negative movements in the NIFTY during the same period.

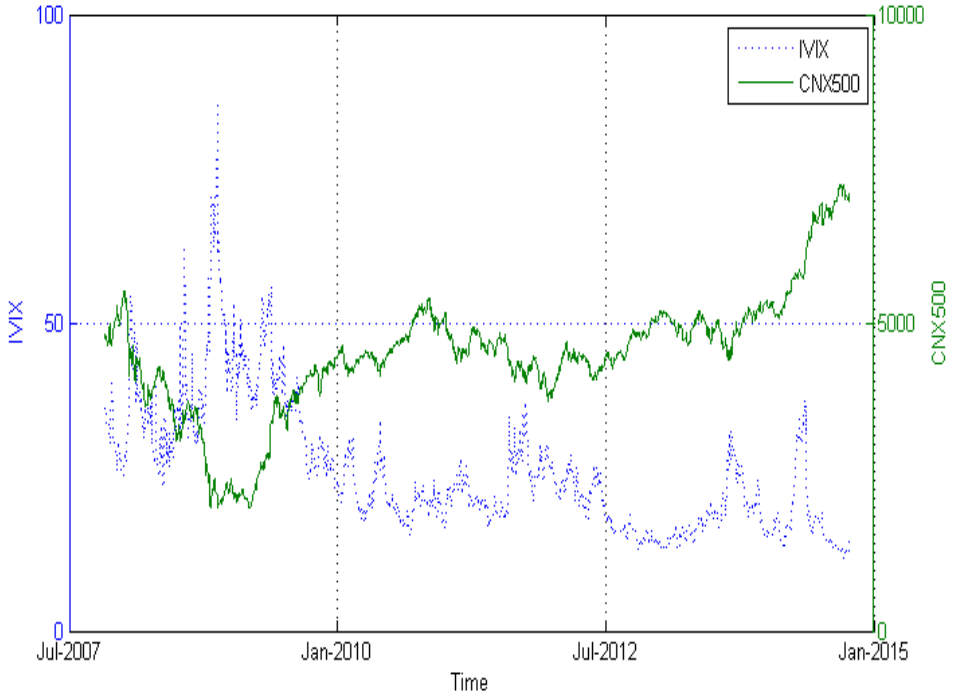



Figure 7: Time series price evolution of the IVIX and the CNX500 with the IVIX levels indicated in the left side of the Y-axis and the CNX500 levels indicated on the right side of the Y-axis. The X-axis represents the sampling period that is spread over from 1$^{st}$ November 2007 to 10$^{th}$ October 2014.

The relationship between the CNX500 and the IVIX from figure 7 shows a similar characteristic to the one of the IVIX and the NIFTY. From both figures 6 and 7 it can be seen that there has been an increasing divergence between the price levels of these two indices suggesting an increasing negative correlation with time.

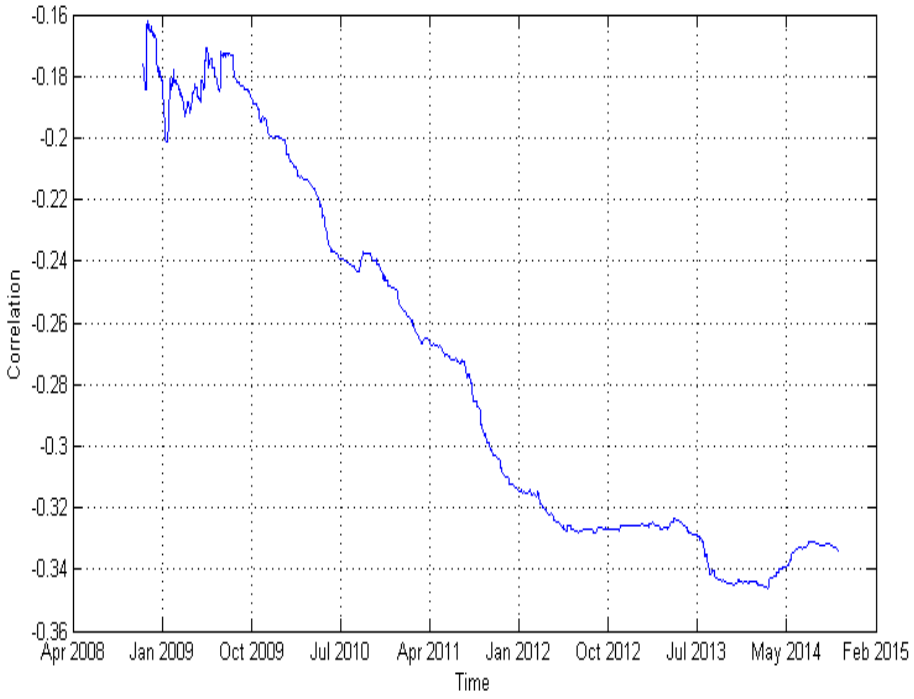



Figure 8: Correlation between the IVIX continuous returns and the NIFTY continuous returns on the Y-axis over an increasing time window with initial window 1$^{st}$ November 2007 to 7$^{th}$ November 2008 and thereof increasing size upto 10$^{th}$ October 2014 in daily increments. The X-axis represents the time period from 7$^{th}$ November 2008 to 10$^{th}$ October 2014.

The intuition of a negative correlation formed after observing the price movement characteristics from figure 6 is further strengthened by the results obtained through the correlation analysis over an increasing window as depicted by the figure 8. The initial window is set as 1$^{st}$ November 2007 to 7$^{th}$ November 2008 and the correlation calculated for this period. Then the start date is held fixed but he end date of the window is increased by 1 day, again calculating the correlation for this new period. This exercise is done by adding 1 day at a time until we reach the maximum window breadth with end date of 10$^{th}$ October 2014 in daily increments. It is observed that starting from November 2008 the correlation of returns between the IVIX and the NIFTY has been increasingly negative. This implies that for every additional

day the marginal contribution has been to increase the magnitude of the correlation with the direction being predominantly negative. The whole period correlation coefficient for IVIX and NIFTY is -0.3340 while the whole period correlation coefficient for IVIX and CNX500 stood at a relatively stronger negative value of -0.3420.

The negative correlation between any volatility index and equity market returns is an almost universal finding across all academic literature on this topic. In the Indian context Kumar (2012) studies the statistical properties of the Indian volatility index. The negative correlation between the IVIX and the NIFTY indices obtained by his study is corroborated by the findings in my study.

Studies trying to explain this phenomenon attribute it to the the so called 'leverage effect'. This effect refers to the degree of dependency of the stock volatility to the amount of leverage in the company at a given level of Business risk. If the stock price falls through a certain amount there is an increase in its leverage, this increase in leverage leads to the perception that the stock of that particular company is more risky. Higher the leverage used in the company greater is the risk or stock volatility.

Pati and Rajib (2010) find evidence for the existence of the leverage effect in the Indian stock market. Their study is based on the NSE futures which is based on NIFTY which is the index used as part of my study. Figlewski and Wang (2000) question the symmetric nature of the 'leverage effect' in their study. They find that the leverage effect or the negative correlation between volatility and the asset prices are more stronger during a period of falling stock prices than in a period of raising stock prices. They suggest that the 'leverage effect' is essentially a 'down market effect'. Bollerslev, Litvinova and Tauchen (2006) also find evidence of this assymetry in high frequency data on the S&P 500.

This asymmetry is explained through the so called 'volatility feedback effect'. This effect accounts for the perceived increase in business risk for a given level for leverage. If volatility is already priced in a given market and a shock in terms of an increase in expected volatility occurs due to a global event for example. This leads to an expectation of higher required return

which immediately decreases prices, this price decrease can further increase leverage leading to a feedback effect. In my study I find that the magnitude of the correlation between the IVIX and the NIFTY has been increasing over time in the period where both the NIFTY and the CNX 500 have been appreciating with an annualized return of 8.58% and 8.47% respectively. According to the study conducted by Levinger et al. (2014) there has been a steady increase in the corporate debt levels in the Indian capital markets after the 2008 financial crisis. They found that the CAGR of the corporate credit to GDP ratio over the five year period starting from 2008 in India has been as high as 18.4% which is next only to the other major Asian economy - China. This makes the Indian stock market particularly vulnerable to sharp movements in prices and hence volatility. This strong negative correlation gives a strong intuition about the diversification benefits of including the IVIX in a portfolio of risky assets. This idea is tested in subsequent sections.

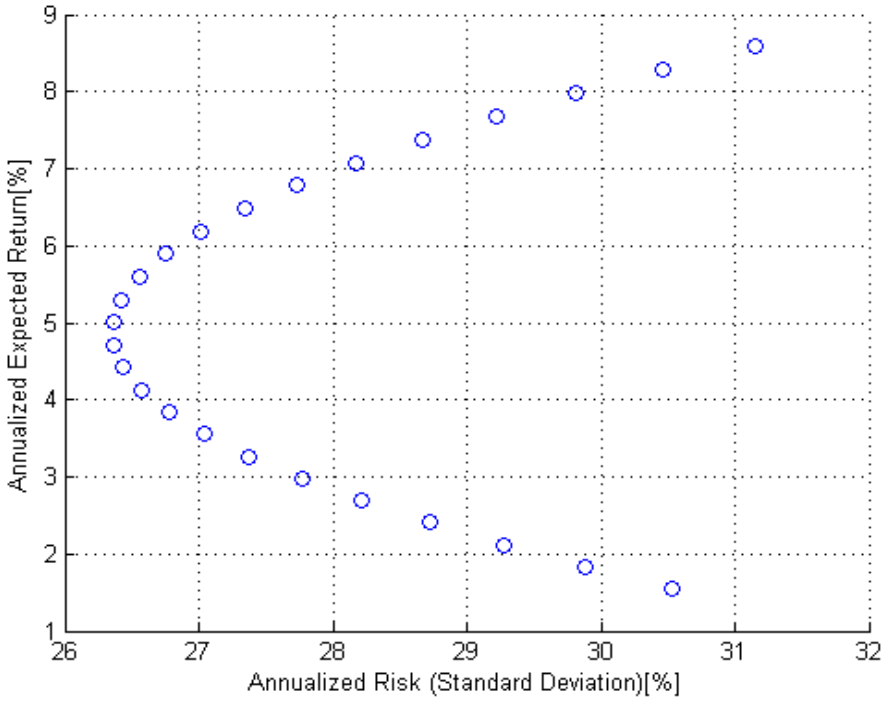



Figure 9: Efficient Frontier of the portfolio constituting the IVIX and the NIFTY calculated over the sampling period from 1$^{st}$ November 2007 to 10$^{th}$ October 2014. The Y-axis is the annualized percentage returns and the X-axis is the annualized standard deviation of portfolio returns.

The two asset portfolio constructed using the IVIX and the NIFTY was seen to have the minimum standard deviation of 26% as depicted in figure 9. The weights of the IVIX and the NIFTY in the portfolio was 12% and 88% respectively. The return of this minimum variance portfolio for the entire period was obtained as an annual rate of 5%.

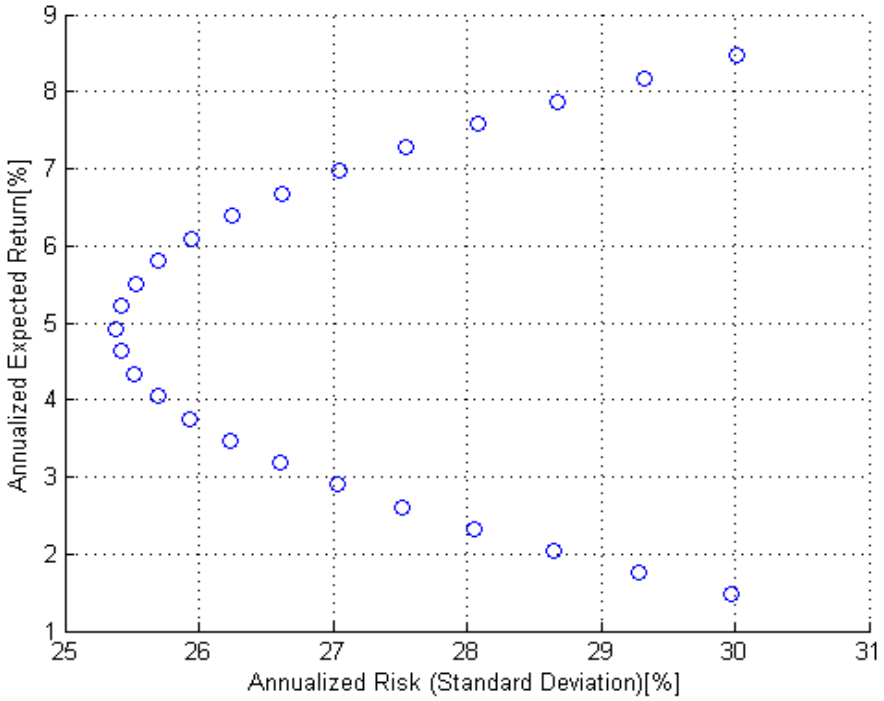



Figure 10: Efficient Frontier of the portfolio constituting the IVIX and the CNX500 calculated over the sampling period from 1$^{st}$ November 2007 to 10$^{th}$ October 2014. The Y-axis is the annualized percentage returns and the X-axis is the annualized standard deviation of portfolio returns.

A portfolio constructed using the IVIX and the CNX500 is observed to have a standard deviation of 25% as depicted in figure 13. The weights in this portfolio too were seen to be 12% and 88% for the IVIX and the CNX500 respectively.The return of this minimum variance portfolio for the entire period was obtained as an annual rate of 4.91%.

| Statistic | IVIX-NIFTY | IVIX-CNX500 | CNX LVI | NIFTY | CNX500 | IVIX |
|---|---|---|---|---|---|---|
| Mean | 5.01% | 4.91% | 17.04% | 8.58% | 8.47% | -17.84% |
| Std Dev | 26% | 25% | 22% | 31% | 30% | 119% |
| Skew | 0.0522 | -0.0908 | -0.3247 | 0.1272 | -0.0965 | 0.0516 |
| Excess Kurtosis | 15.9295 | 14.1145 | 10.0900 | 10.3671 | 9.6724 | 7.3600 |

The mean returns are annualized rates.IVIX-NIFTY is the portfolio of IVIX and the NIFTY. IVIX-CNX500 is the portfolio of IVIX and the CNX500. CNX LVI is the CNX Low volatility index. NIFTY, CNX500 and IVIX represents 100% exposure to the respective assets during the sample period from 1st November 2007 to 10th October 2014

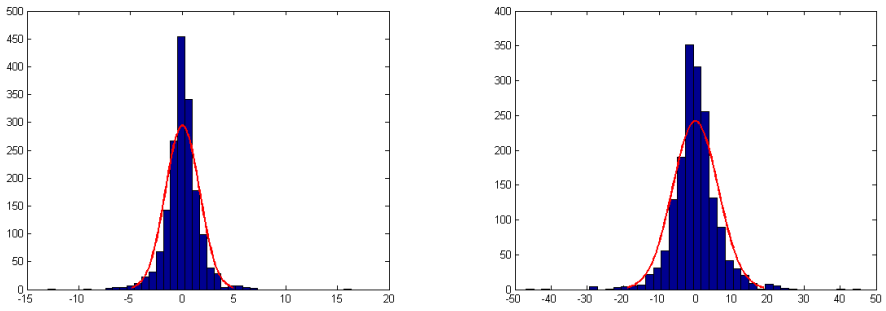
**Table 6:** Portfolio performance comparison over entire sampling period

From table 6 we can see that for the period of the whole sample, both the IVIX-NIFTY and the IVIX-CNX500 portfolios under-perform the CNX Low Volatility Index. The CNX Low Volatility Index outperforms the IVIX-NIFTY and the IVIX-CNX500 portfolios in the standard deviation comparison and also in the higher moments of Skewness and Kurtosis. It has to be noted however that the investments in a pure NIFTY or pure CNX500 asset yields a higher rate of return but at a much higher volatility as measured by their respective standard deviations. The addition of the IVIX to the NIFTY and the CNX has reduced the standard deviations by 16% and 17% respectively in percentage terms. The Sharpe ration maximization criteria for both IVIX-NIFTY and IVIX-CNX500 portfolios indicate a 0% allocation to IVIX. This is attributable to the negative returns of having exposure to pure IVIX asset and the high standard deviation observed.

The return characteristics of holding only the volatility assets yields negative returns. Bakshi and Kapadia (2003) construct a delta neutral or a positive vega portfolio constructed over the S&P 500 options with the expected value of the gains distribution to be zero. Their study finds that the delta hedged portfolio significantly under performs zero and the under performance is increases with the increase in the time horizon for which the portfolio is held. They also find that at times of higher volatility the under performance is even more negative and all these results thus obtained are

statistically significant. They conclude that the volatility risk premium as implied from the equity options is negative. This idea implies that an exposure to pure volatility yields no compensation for investors. In my study I find that the returns from holding a pure volatility portfolio by hypothetically investing only in the IVIX is -17.84% per annum over the sampling period.

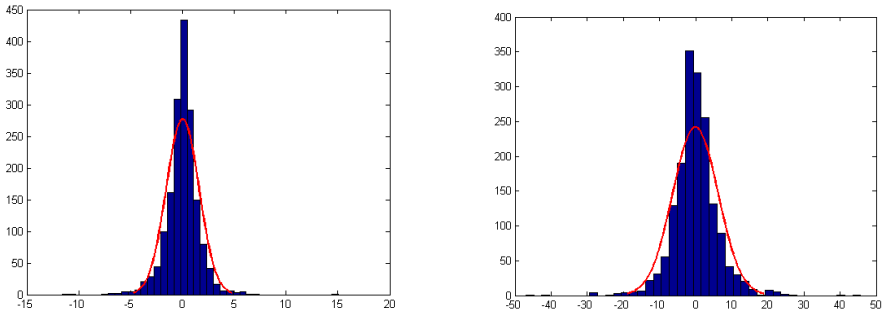
The volatility of IVIX represents the second derivative of equity market returns and is observed to be substantially high in my study. To investigate this further, histograms are plotted to compare the return distributions of the IVIX, CNX500 and NIFTY.




(a) NIFTY return distribution

(b) IVIX return distribution

Figure 11: 11a Histogram of the returns in percentage of the NIFTY index over the entire sample period.12b Histogram of the returns in percentage of the VIX over the entire sample period.




(a) CNX500 return distribution (b) IVIX return distribution

Figure 12: 12a Histogram of the returns in percentage of the CNX500 index over the entire sample period. 12b Histogram of the returns in percentage of the VIX over the entire sample period.

From figures 11 and 12 we can see that the return distribution of the IVIX is spread over a wider range than either the returns of the NIFTY or the CNX500 index.

### 4.2.2 IVIX based portfolios during the 2008 Financial Crisis

The mean-variance exercise conducted for the entire period is repeated for the sub-period of the financial crisis to ascertain the benefits of adding the IVIX into a portfolio of risky assets.

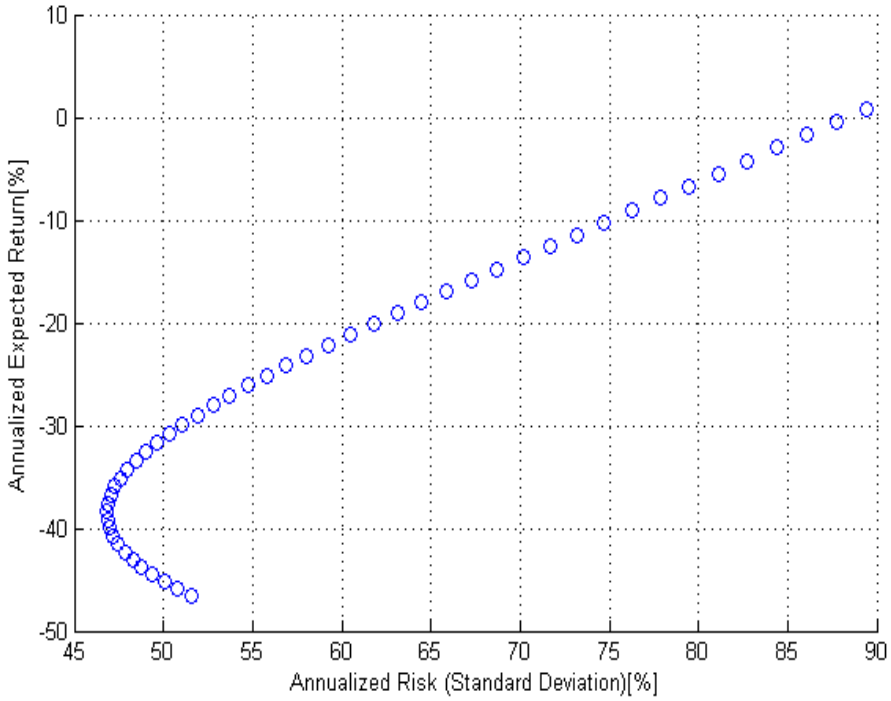



Figure 13: Efficient Frontier of the portfolio constituting the IVIX and the NIFTY calculated over the period of the financial crisis with a start date of 1st January 2008 to 29th April 2009. The Y-axis is the annualized percentage returns and the X-axis is the annualized standard deviation of portfolio returns.

Figure 13 shows the efficient frontier obtained for the sub-period of the financial crisis when the mean-variance exercise is performed over the IVIX-NIFTY portfolio. The results obtained as plotted in figure 13 indicate that the minimum variance portfolio weights is 12% IVIX and 88% NIFTY. The return of this minimum variance portfolio for the entire period was obtained as an annual rate of -38.41%.

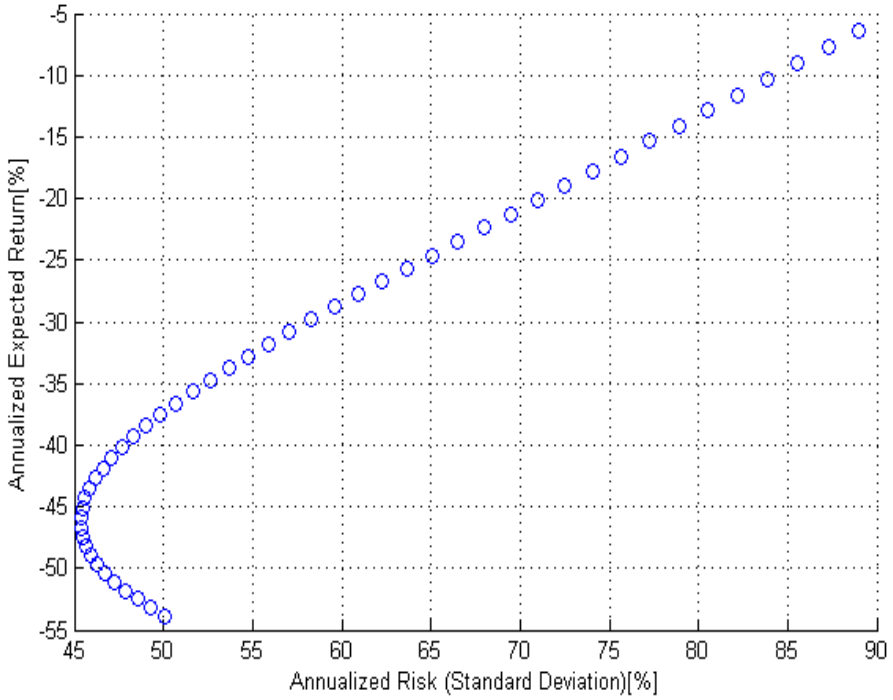



Figure 14: Efficient Frontier of the portfolio constituting the IVIX and the CNX500 calculated over the period of the financial crisis with a start date of 1st January 2008 to 29th April 2009. The Y-axis is the annualized percentage returns and the X-axis is the annualized standard deviation of portfolio returns.

Figure 14 shows the efficient frontier obtained for the sub-period of the financial crisis when the mean-variance exercise is performed over the IVIX-CNX500 portfolio. The results obtained as plotted in figure 14 indicate that the minimum variance portfolio weights is 12% IVIX and 88% CNX500. The return of this minimum variance portfolio for the entire period was obtained as an annual rate of -45.90%.

| Statistic | IVIX-NIFTY | IVIX-CNX500 | CNX LVI | NIFTY | CNX500 | IVIX |
|---|---|---|---|---|---|---|
| Mean | -38.41% | -45.90% | -40.02% | -46.60% | -53.85% | 95.59% |
| Std Dev | 47% | 45% | 37% | 52% | 50% | 184% |
| Skew | -0.4420 | -0.4135 | -0.5510 | -0.3359 | -0.3859 | 0.0758 |
| Excess Kurtosis | 2.7029 | 2.2111 | 2.5535 | 1.5529 | 1.5477 | 4.3820 |

The mean returns are annualized rates.IVIX-NIFTY is the portfolio of IVIX and the NIFTY. IVIX-CNX500 is the portfolio of IVIX and the CNX500. CNX LVI is the CNX Low volatility index. NIFTY, CNX500 and IVIX represents 100% exposure to the respective assets during the 2008 financial crisis period from 1$^{st}$ January 2008 to 29$^{th}$ April 2009

**Table 7:** Portfolio performance comparison during the 2008 financial crisis

From table 7 it is evident that all assets faced losses during the 2008 financial crisis. It is to be noted however that the portfolio with 100% exposure to the IVIX saw an un-precedented gains at an annualized rate of positive 95.59%. On the other hand the IVIX-NIFTY minimum variance portfolio over-performs the IVIX-CNX500 and also the CNX-LVI portfolio. The IVIX-NIFTY portfolio over-performs a pure NIFTY exposure. The IVIX-CNX500 underperforms the CNX LVI but still manages to over-perform the portfolio of pure CNX500 exposure.

Szado (2009) finds that the addition of the spot VIX and also the addition of the VIX futures to a diverse set of portfolio was beneficial in both increasing the returns of those portfolios and reduced the risk. A similar effect is seen in my study. The performance of the IVIX-NIFTY and the IVIX-CNX500 portfolios during the financial crisis yielded some interesting results. I find that this is the only period where both the portfolios outperform the investments in pure NIFTY (-46.6%) and pure CNX500 (-53.85%). In fact the IVIX-NIFTY (-38.41%) outperforms the actively managed CNX LVI (-40.02%). The most important reason for this out performance is the obvious out-performance of the IVIX during this period. It yielded an annualized return of 95.59% for this period.

The study by Kumar (2012) uses the same start date as the data used in my study. Kumar (2012) finds that when the market moves up sharply

the correlation between the IVIX and the NIFTY is not strong. He also finds that when the market declines in its most steepest move the negative correlation is statistically insignificant. He predicts that during a period of steady decline is when the IVIX shows a statistically significant negative correlation that can be exploited for the purpose of portfolio diversification. This asymmetric behaviour can be exploited by using a strategy based on timing and switching. There is a potential to use the IVIX as a sort of hedging tool during deteriorating market conditions. Thenmozhi and Chandra (2013) advocate a strategy that is based on the signalling power of the IVIX index. They suggest a strategy wherein if there is a positive change in the IVIX a shift from a mid-cap portfolio to a large cap portfolio is made and shift back from a large cap portfolio to a mid-cap portfolio after a drop in the IVIX. Their study is limited due to the lack of any performance related information.

### 4.2.3 IVIX based portfolios after IVIX Futures availability

The mean-variance exercise is repeated for the sub-period where the IVIX futures were available to check if the availability of market tradable instrument that tracked the IVIX results in a better estimate of the realized volatility and also to check if the addition of the IVIX into a portfolio of risky assets can improve returns.

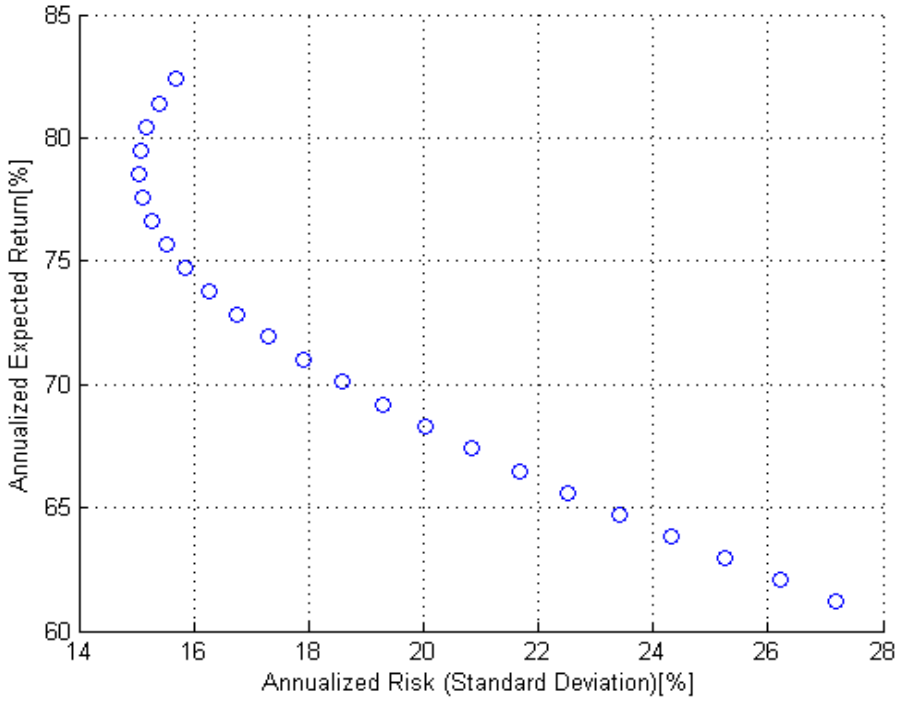



Figure 15: Efficient Frontier of the portfolio constituting the IVIX and the NIFTY calculated over the period of the introduction of the IVIX futures tradable contract. This period starts from 26$^{\text{th}}$ February 2014 to 10$^{\text{th}}$ October 2014. The Y-axis is the annualized percentage returns and the X-axis is the annualized standard deviation of portfolio returns.

In the period of the availability of the tradable IVIX futures the efficient frontier is as shown in the figure 15. The portfolio weights of the minimum variance portfolio on the frontier are 4% and 96% in the IVIX and the NIFTY respectively. This portfolio yields an annualised return of 78.50%. The magnitude of the return is due to annualization of sub-annual returns and also due to the bull run in the Indian markets.

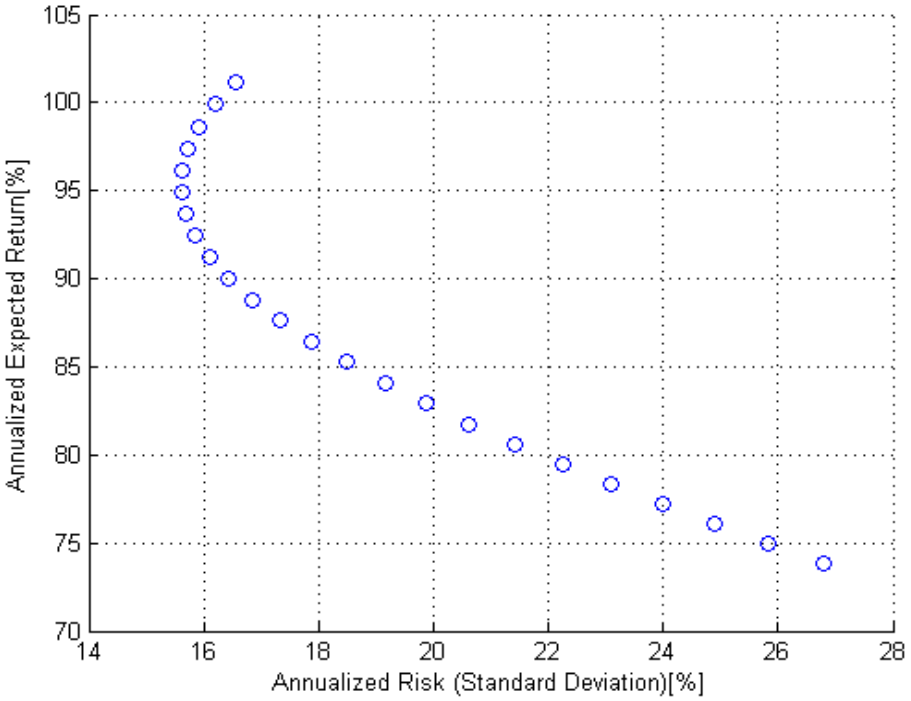



Figure 16: Efficient Frontier of the portfolio constituting the IVIX and the CNX500 calculated over the period of the introduction of the IVIX futures tradable contract. This period starts from 26$^{\text{th}}$ February 2014 to 10$^{\text{th}}$ October 2014. The Y-axis is the annualized percentage returns and the X-axis is the annualized standard deviation of portfolio returns.

In the period of the availability of the tradable IVIX futures the efficient frontier is as shown in the figure 16. The portfolio weights of the minimum variance portfolio on the frontier are 5% and 95% in the IVIX and the CNX500 respectively. This portfolio yields an annualised return of 94.89%. The magnitude of the return is comparable to the returns of the IVIX-NIFTY portfolio for similar reasons.

| Statistic | IVIX-NIFTY | IVIX-CNX500 | CNX LVI | NIFTY | CNX500 | IVIX |
|---|---|---|---|---|---|---|
| Mean | 78.50% | 94.89% | 103.92% | 82.36% | 101.16% | 6.71% |
| Std Dev | 15% | 16% | 13% | 16% | 17% | 142% |
| Skew | 0.1693 | -0.0488 | -0.3854 | 0.1770 | -0.2315 | -2.0575 |
| Excess Kurtosis | 3.5363 | 2.7357 | 0.2170 | 0.5301 | 0.5916 | 15.1722 |

The mean returns are annualized rates.IVIX-NIFTY is the portfolio of IVIX and the NIFTY. IVIX-CNX500 is the portfolio of IVIX and the CNX500. CNX LVI is the CNX Low volatility index. NIFTY, CNX500 and IVIX represents 100% exposure to the respective assets during the period which of IVIX futures availability which is from $26^{\text{th}}$ February 2014 to $10^{\text{th}}$ October 2014

**Table 8:** Portfolio performance comparison during the period of IVIX Futures availability

It can be seen from table 8 that the CNX LVI dominates all other portfolios. The portfolios of pure exposure to the NIFTY and the CNX500 dominate the IVIX-NIFTY and the IVIX-CNX500 portfolios respectively both in terms of superior returns but also in terms of the volatility as measured by the standard deviation. The pure IVIX portfolio has a very low return for this period but also higher standard deviation and relatively higher moments like the skew and kurtosis.

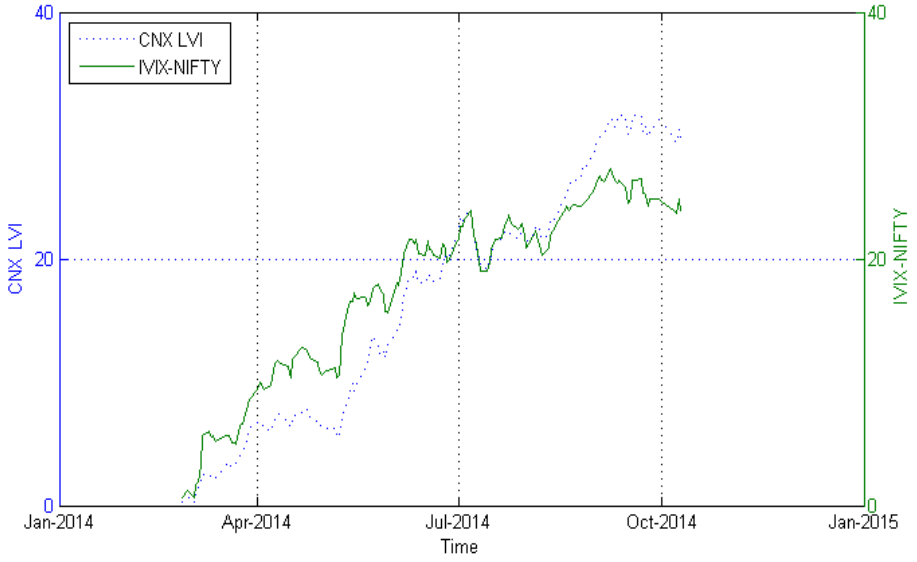



Figure 17: The evolution of the cumulative returns of the IVIX-NIFTY portfolio and the CNX low vol Index. The CNX low vol Index cumulative return levels are on the left side of the Y-axis and the IVIX-NIFTY portfolio cumulative return levels are on the right side of the Y-axis. The holding period is from 26$^{\text{th}}$ February 2014 to 10$^{\text{th}}$ October 2014 displayed on the X-axis.

The performance of the minimum variance IVIX-NIFTY portfolio obtained as in figure 15 is compared with the CNX LVI. From the figure 17 it is evident that the cumulative returns of the IVIX-NIFTY portfolio dominates at the beginning of the period while towards the end the cumulative returns of the CNX LVI dominates the IVIX-NIFTY portfolio cumulative returns. This behaviour indicates that the returns of the IVIX-NIFTY portfolio are more stable with fewer jumps unlike the return characteristics of the CNX LVI.

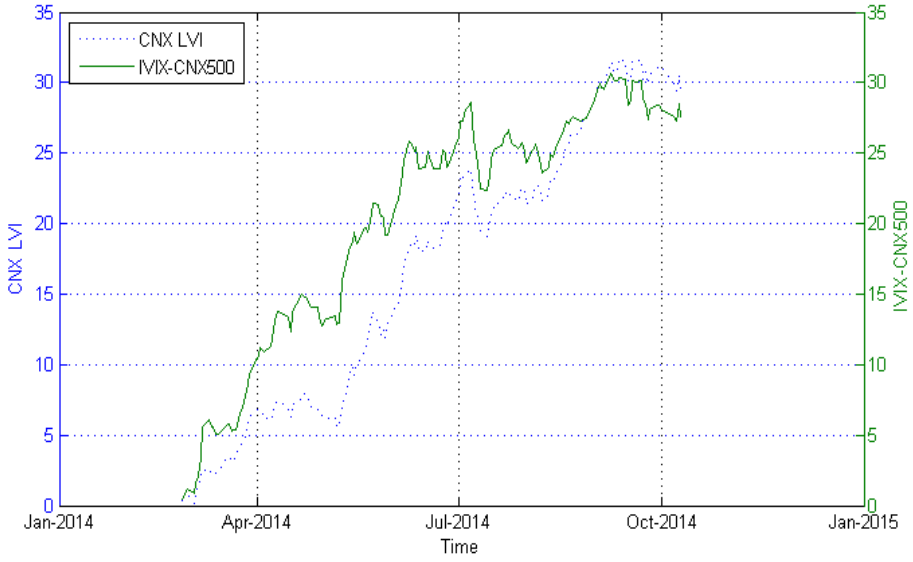



Figure 18: The evolution of the cumulative returns of the IVIX-CNX500 portfolio and the CNX low vol Index. The CNX low vol Index cumulative return levels are on the left side of the Y-axis and the IVIX-CNX500 portfolio cumulative return levels are on the right side of the Y-axis. The holding period is from 26$^{th}$ February 2014 to 10$^{th}$ October 2014 displayed on the X-axis.

The performance of the minimum variance IVIX-CNX500 portfolio obtained as in figure 16 is compared with the CNX LVI. From the figure 18 it is evident that the cumulative returns of the IVIX-CNX500 portfolio dominates at the beginning of the period while towards the end the cumulative returns of the CNX LVI dominates the IVIX-CNX500 portfolio cumulative returns. Nevertheless the difference between the returns is not as marked as in the case of the IVIX-NIFTY portfolio.

From my study it is evident that there seems to be a case for the use of volatility instruments at least during the periods of deteriorating market conditions. This requires the use of the IVIX futures as the tradable instruments. The IVIX futures price is quoted as 100*VIX level. The lot size is 550. Every contract has an expiry of three weeks. Volatility futures are known to have a negative cost of carry. This short expiry implies that there is a need for almost continuous active monitoring of the IVIX holdings with

highly contentious issues of transaction costs and roll-over costs which can come in the way of the attractiveness of these instruments. The activity of roll-over requires the devising of a strategy which requires the existence of trading data with liquidity, both of which the IVIX futures currently lacks due to the fact that the contract is relatively new, introduced at only 7 months old as of the time of this study. The sophistication and novelty of the the instrument causes a steep learning curve for the market participants.

The results of my study concur with that of Alexander and Korovilas (2011). In their study Alexander and Korovilas (2011) find no evidence to support the purported benefits of having the VIX futures as part of a tool-set for the purpose of diversification. They criticize the validity of the ex-post justifications of the usefulness of the inclusion of the VIX futures instrument in equity portfolios. They suggest that the activity of using the VIX futures for hedging purposes is best left to more sophisticated market players like prop traders, hedge funds and structurers in large banks. They caution the long term equity investors like mutual funds and pension funds from using the VIX futures as it needs a greater level of sophistication and a much shorter term view on the market. They do agree on the fact that having exposure to the VIX futures instrument in times of financial crisis is indeed useful.This result is evident from my study on the performance of the IVIX-NIFTY and IVIX-CNX500 portfolios during the 2008 financial crisis.

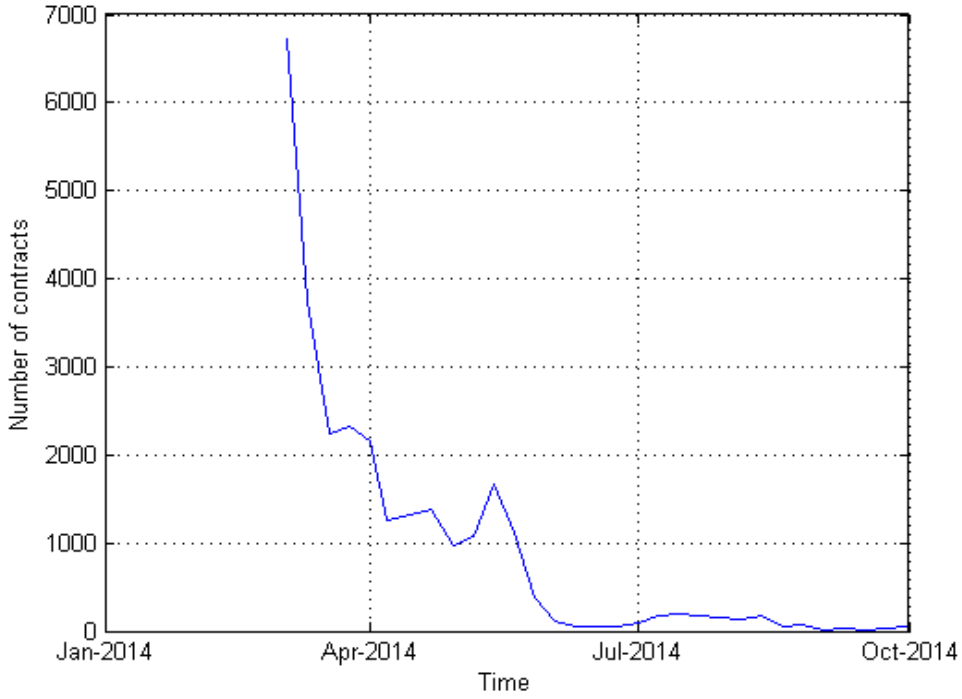



Figure 19: A drastic fall in the trading volumes in terms of the number of contracts of the IVIX futures on the NSE. The X-axis are the expiries starting from the first contract on the $4^{th}$ of March 2014 upto the September $30^{th}$ expiry contract

The biggest road-block as of the time of my study is the lack of liquidity in these instruments. As evident from figure 19. There has been a steady and consistent fall in the volumes except for the brief spike for the contracts in may. This is due to the important political event of the Indian national elections. Otherwise the trading volume has been disappointing and discourages any sort of robust analysis of implementation of the strategies developed in this study. Nevertheless experience from the volume data from the VIX on CBOE gives a cause for hope. When the CBOE VIX futures were introduced in 2007 the traded volumes in terms of the number of contracts was only 24million. The number has increased annually seven fold to a level of 183 million contracts as of the year 2013.[1]

[1]Source : CBOE

# Chapter 5

# Conclusions

The India volatility index (IVIX) futures were introduced recently on the $26^{th}$ of February, 2014 in the Indian capital markets. This recentness of the introduction was exploited in this paper to conduct an event study because of the natural experiment setting. The event study was conducted over two events, namely, the event of the announcement of the introduction of the instrument or the 'announcement event' which was on the $7^{th}$ of February, 2014 and the event of the implementation of the announcement or the 'implementation event' , marked by the launch of trading on the NSE (National Stock Exchange) of the IVIX. The impact of this introduction was studied on the NIFTY which is the benchmark index of the NSE. The impact was studied on both the price and the volumes of the NIFTY.

It was found that for the announcement event there was a statistically significant negative return before the announcement event on the start day of the event window. This result was further investigated by increasing the width of the pre-announcement side of the event window. It was found that there was a statistically significant positive abnormal return before the announcement was made. This can make a case for front running on the markets due to insider information. In the case of the impact on the volumes however, there was no abnormal volumes observed before the actual announcement or after, but the cumulative abnormal volumes in the post-announcement period was statistically significant. This is in-line with existing literature which

attributes it to the summation effects of reactions to volume due to new information. The event study conducted for the implementation event did not find any abnormal returns or abnormal volumes.

The key reason for the introduction of the IVIX futures was for it to be used by the market participants as an asset class. In the latter part of the paper, the applicability of IVIX futures as an asset class was investigated. Initial data analysis revealed the strong negative correlation between the equity market returns and the IVIX returns, building a case for potential diversification benefits of including the IVIX futures in a portfolio of risky assets. Due to the unavailability of historic data on the IVIX futures, the IVIX was used as a proxy. For the purpose of this study two types of portfolios were constructed, one based on the NIFTY and the other based on the CNX500, which is yet another broad based index tracking the NSE. The proportion of IVIX exposure to each of these portfolios was varied in a mean variance exercise to obtain an efficient frontier. The CNXLVI (CNX Low volatility index) is used as the performance benchmark. This exercise was repeated over the entire sampling period of past 7 years and the sub-period of the 2008 Financial crisis and the sub-period of the IVIX futures availability. It was found that over the full sampling period there was no benefit of exposure to the IVIX due to the significant under performance of both the IVIX-NIFTY and the IVIX-CNX500 portfolios to the benchmark CNXLVI. This could be explained by the negative returns of having 100% exposure to the IVIX over the sampling period. In the sub-period of the 2008 Financial crisis however the IVIX-NIFTY and the IVIX-CNX500 portfolios outperform the CNXLVI benchmark. This is attributable to the very high returns on the IVIX index in this period. In the period of the availability of the IVIX futures there is no benefit of IVIX exposure in both portfolios.

These findings in this study are in-line with existing literature on two counts. Firstly pure volatility exposure over a longer time horizon yields negative returns due to the negative volatility risk premium. Secondly, exposure to volatility is beneficial only during market down-turns due to the 'down market effect'. The main shortcoming of this study are the use of IVIX index instead of the IVIX futures to construct the portfolios. This is

however justifiable due to the lack of trading volumes in the IVIX futures. This however gives scope for further investigation at a later period to test the findings in my study. There is scope to investigate the implications of the introduction of roll-over and transaction costs. This is subject to the acceptance of this novel instrument in the Indian capital markets with good amount of trading liquidity.

# Chapter 6

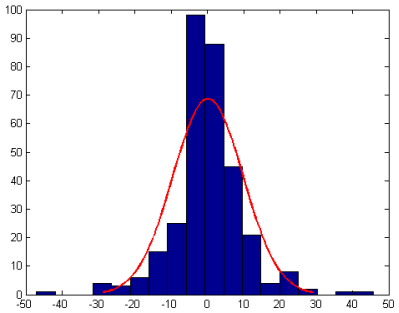
# Appendix

## 6.1 Correlations during different periods

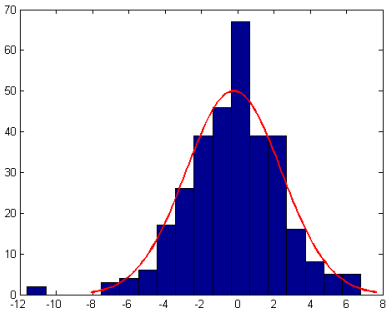
| Correlation period | NIFTY | CNX500 |
|---|---|---|
| IVIX(Financial crisis) | -0.1745 | -0.1890 |
| IVIX (Futures available) | -0.1525 | -0.2017 |

**Table 9:** The correlations between the IVIX and the indices NIFTY and CNX500 during the financial crisis and during the period of IVIX future availability

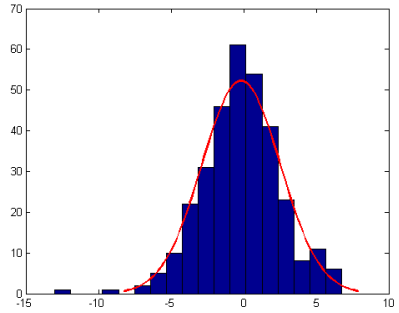
## 6.2 Return distribution during financial crisis



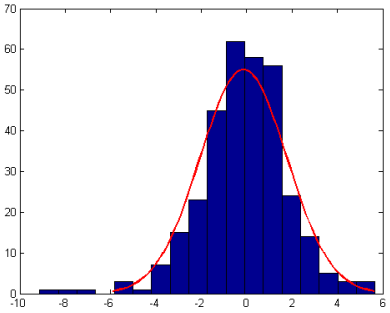

(a) IVIX return distribution




(b) CNX500 return distribution




(c) NIFTY return distribution




(d) CNX Low vol index return distribution

Figure 20: 20a Histogram of the returns in percentage of the IVIX, 20b distribution of CNX500 index, 20c distribution of NIFTY, 20d distribution of CNX low volatility index. All return distributions are plotted over the period of the financial crisis.

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