

Effect of the Launch of Nifty Weekly Options on the Relationship between Nifty and India VIX

Subhiksha Kannan, Peddina SriPriya, Drishty Wadhvani, Rohit Choraria



Abstract: This paper examines the impact of the introduction of weekly expiry on Nifty options on the relationship between Nifty and India VIX. It demonstrates that the introduction of weekly expiration on Nifty options resulted in a significant decrease in the association of market returns and volatility. This decrease was visible across options-based volatility metrics like India VIX and non-options-based volatility metrics like Annualized Volatility of Futures and Underlying asset (Nifty Index). This study finds that shorter expiries and resultant larger volumes lower the correlation between market performance and various volatility indicators. This is done by testing the effect of Nifty volumes in the Options segment as a moderator variable in the relationship between Nifty and India VIX.

In other words, an increase in India VIX now indicates a lower decline in Nifty than it did earlier. This paper also indicates that the inverse must also be true. Longer expiries and comparatively lower volumes contributed to a higher negative correlation between Nifty and India VIX. By comparing correlations in the periods before and after the introduction of weekly expiry on Nifty options, we measure the impact of volumes and expiration time.

Keywords: India VIX, Nifty, negative correlation, volatility, weekly expiry options

I. INTRODUCTION

1.1 Stock Market Volatility

Stock market volatility is an integral part of the market system. Volatility in the stock market is a phenomenon that is closely tracked by practitioners and academicians alike. In simple terms, volatility is a statistical measure of degree of fluctuation in trading prices of stocks and other financial instruments observed in a particular time period.

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Various tools have been used to measure and assess the impact of volatility. The realised volatility computed using mean, variance and standard deviation represents historical volatility. If one expects the same pattern to follow, this measure can be extrapolated to future time periods as well. Another method involves using options as a base for calculating volatility.

This alternative is far more intuitive and forward-looking as the option prices calculated using the Black-Scholes pricing model indicate the probability of share prices reaching a particular exercise or strike price. This is because the Black-Scholes model uses five key variables – the current market price of the underlying asset, the strike price, the risk-free rate of return, time to maturity, and volatility – This type of volatility measurement captures Implied Volatility, which is a better reflection of the market sentiment.

1.2 What is the VIX?

Recognising the need for a tool to capture the implied volatility of the market, the Chicago Board of Options Exchange (CBOE) introduced the Volatility Index (VIX) in 1993, which was constructed on the basis of the S&P 100 Index Options. This was later revised in 2003 so that it is based on the S&P 500 Index options. VIX is the most popular tool for quantifying market volatility and one that has stood the test of time. It is considered the gold standard of volatility measures.

As opposed to traditional, historical measures, the VIX was ground-breaking in the sense that it offered a continuous stream of information to investors of the volatility expected in the near term in the form of an annualised percentage. It shows the market sentiments, risk and expectation of investors. The VIX is computed by taking an intraday weighted average of the implied volatilities of eight near-the-money, nearby American call and put option contracts on the S&P 500 index. Such weightage is given in a manner that the VIX represents the implied volatility of a hypothetical at-the-money option contract with a constant maturity of 22 trading days to expiration [1]. Due to its method of derivation and its ability to perceive both increase and decrease in market index, it is also known as the fear gauge or fear index. Since its introduction, the VIX and other volatility indices around the world built along its lines, have become synonymous with market volatility. In India, NSE's Nifty 50 is a free-float market capitalisation weighted index which encompasses the stocks of the top fifty companies and has representation from various sectors. India VIX or the India Volatility Index was introduced by the National Stock Exchange (NSE) of India in April 2008.

India VIX captures the expected market volatility of the Indian market over a period of next thirty calendar days on the basis of Nifty Options. Volatility and the India VIX value move in a similar manner. A higher value of India VIX indicates higher expectations of volatility, i.e. a noteworthy change in Nifty and a low value of India VIX indicates expectations of lower volatility, i.e. an insignificant change.

1.3 The Relationship between Volatility Indices and Stock Index Returns

India VIX was at its all-time high on 19 May 2009, standing at a value of 56.07. It rose to a peak post Lehman Brothers’ crisis while Nifty touched a bottom. This alone illustrates a key feature of the India VIX and all other stock

index options-based volatility indices – they all have been found to exhibit a significant negative and asymmetric contemporaneous relationship with their respective stock market indices.

There is abundant literature that proves, analyses and explains this unique relationship between India VIX and Nifty returns. The two are negatively correlated i.e. when India VIX is low, indicating low levels of market volatility, the Nifty is typically at high levels. This negatively relationship is, in addition, asymmetric, in that negative returns on the Nifty have a greater impact on the India VIX compared to positive returns of the same amount [1].



Figure 1: Movement of Nifty and India VIX (2009-2020) (Data source: NSE)

The chart in Figure 1 depicts the movement of Nifty and India VIX since the launch of the latter in 2008 till February 2020. It is clearly noticeable how the two indices move in opposite directions simultaneously/contemporaneously. Where the Nifty falls, the India VIX spikes, and vice versa.

India VIX was introduced 10 years ago and since then both Nifty and VIX have had drastic changes in their values. The maximum value of India VIX (56.07) is 2.9 times higher than the mean (19.33), and the minimum value (10.45) is 0.46 times lower than the mean. Similarly, the maximum value of Nifty (12.36) is 1.64 times higher than the mean (7.53) and the minimum value (2.57) is 0.66 times lower than the mean. Both values are positively skewed (India VIX- 1.87, Nifty- 0.35) which shows that the data distribution graph has a longer tail on the right side and most values are concentrated on the left side of the mean. Skewness is more for India VIX as it has reduced drastically since its introduction.

When there is an increase in volatility, the risk increases and returns decline. A majority of the investors in the market are concerned about the uncertainty of realising the expected returns, and are hence directly interest in matters of volatility and risk. This led to the introduction of several hedging products built around volatility indices as the underlying assets as they cover the downside risk by virtue of their naturally negative correlation with the stock market index.

The scatter plot given in Figure 2 depicts the relation between Nifty and India VIX. Correlation has been calculated by taking closing values of both from 2/03/2009 (which is the date from which historical data is available on the India VIX) till 4/02/2020. It is a downward sloping line indicating a negative correlation, and the two have a moderately high negative correlation of -0.6277.

Although the normal relationship between India VIX and Nifty is negative, this reverses occasionally.

According to an analyst [2], who examined the sudden strong positive correlation between the VIX and the S&P 500 Index in the US, when such a relationship occurs as a result of both indices rising together, it reflects a market in which is oversaturated with risk and with investors who are extremely dependent on equity-heavy portfolios and hence, a reliance on volatility-based hedging tools.

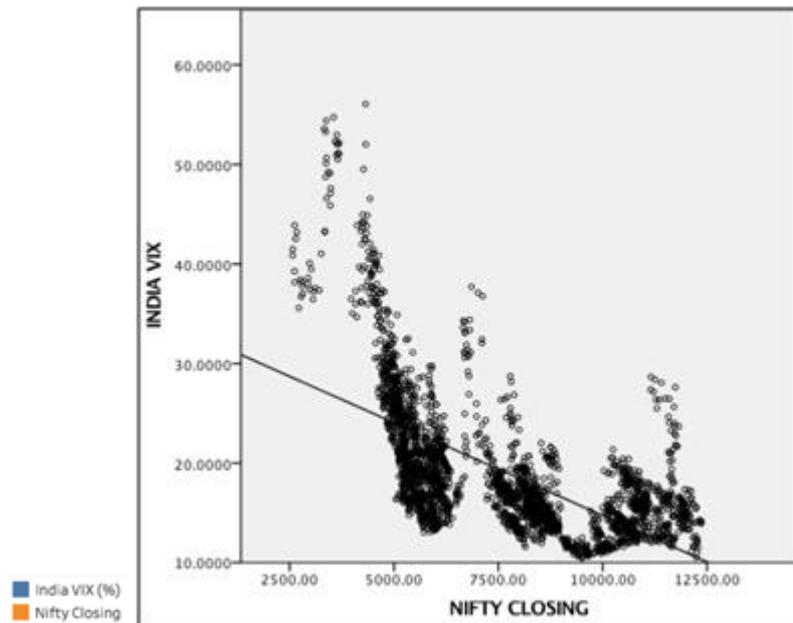


Figure 2: Scatter plot and line of best fit of Nifty and India VIX since its launch (Data source: NSE)

In the Indian context, this kind of an unusual positive correlation between Nifty and India VIX has arisen only five times since the introduction of India VIX in 2008. In the past cases (2010, 2014-15, and 2017), after rising, they both fell at an approximate range of 3-8% which is a sign of the market's corrective action. The most recent case is the one being studied in this project, which the researchers have attributed to the introduction of weekly expiry on Nifty options in February 2019.

1.4 Introduction of Weekly Expiry on Nifty Options

On 11 February 2019, the NSE announced the introduction of weekly expiry on Nifty option contracts. Prior to this, Nifty option contracts had three monthly contracts, three quarterly contracts, and eight semi-annual contracts. This launch followed the success of Bank Nifty weekly options in 2016, which, at the time of the introduction of Nifty weekly options, were the world's most traded index option according to data from the Futures Industry Association. Moreover, index options in general have become extremely popular in the Indian stock market and trading in such options makes up 82% of all the trades on the NSE. The new weekly Nifty options gained market approval immediately. At the end of 11 February 2019, volumes on Nifty options surged, with volumes in weekly options at the strike price closest to the spot comprising 60% of overall volumes at that strike.

Volatility is influenced by several factors like investor sentiments, market information, news about the company's financial performance, major geopolitical events, etc. Investors do not always act completely rationally but their irrational movements also affect market returns and volatility. This paper examines the effect of the introduction of weekly expiry on Nifty options on the negative correlation between Nifty and India VIX as theorised in earlier studies. This study is useful for understanding the changing correlation of India VIX and Nifty options since 11 February 2019 which marks the introduction of weekly options. Post this event, the negative correlation was found to be reducing.

The recently-launched Nifty weekly options are gaining popularity among traders, who are shifting portions of their bets from monthly expiring contracts to these shorter-term options which expire weekly. The new shorter expiry offers several attractive features to traders, the main ones being that they carry a lower premium for option buyers and provide for additional diversification in hedging strategies. Almost a month after their introduction, Rohit Srivastava, a fund manager noted that "Some traders would have shifted, 15 per cent of volume is now happening in weekly options, out of total option volumes. A large part of it can be associated with shifting [from monthly to weekly expiries]."

The focus of this study is in analysing the impact of the introduction of weekly expiry on Nifty options on the negative correlation between Nifty and India VIX, as explained before. It is expected that the additional volumes traded in the Nifty's Options segment will act as a moderator variable in changing (reducing) the degree of negative relationship.

Additionally, this study examines the difference between the relationship that an options-based volatility measure (i.e. India VIX) has with Nifty and the relationship that a futures-based (Nifty futures annualised volatility) and an underlying-based (Nifty annualised volatility) volatility measure has with the Nifty. Finally, the possible effect of different time intervals on the relationship between the Nifty and India VIX is briefly dealt with.

II. REVIEW OF LITERATURE

Stock markets are driven by volatility, and therefore, there is and always has been robust discourse over the most appropriate indicator of market volatility. While there is a multiplicity of volatility measures calculated in different ways, very few have stood the test of time.

The VIX and all other indices (including the India VIX) developed on the same lines are considered the gold standard of volatility measurement in the market. This is mainly due to the fact that it captures future expected volatility not by mere extrapolation of past returns but by harnessing the hidden variable in options pricing – implied volatility.

However, the VIX has not always been universally accepted as the best indicator of volatility. Several studies were published in the years after its introduction which concluded that it was biased and ineffective. For instance, in their study, [3] analysed the S&P 100 call options for the years 1985-1989 to compare the informational value of their inherent implied volatilities to historical volatility values in predicting future volatility. They conclude that there is no significant difference between the implied volatility of index options and conditional volatility measures like GARCH and EGARCH.

Contrary to the above-mentioned hypothesis, [4] posit that implied volatility inherent in stock options is a superior informational source for the future expected volatility compared to historical volatility by constructing a model comprising data from over eleven years (November 1983 to May 1995) on the OEX (S&P 100 Index options). More importantly, they attempt to disprove earlier researchers by using a longer time frame and using non-overlapping samples. Moreover, they divided the period of study into two sub-periods – one preceding the stock market crash of 1987 and the second following the crash. It was found that the OEX proved to be a better predictor of the crash than the historical volatility measures.

Another researcher [5] wrote a similar paper concentrating on the asymmetric relation between Nifty and India VIX. It tries to analyse the effect of bullish and bearish situations on this asymmetric relation and also measures the spill over of volatility from VIX to stock market. This paper tries to compare VIX with different methods like GARCH, EGARCH and EWMA so as to measure the effectiveness of VIX in computing volatility, Personal bias of investors and changing risk appetite affect the stock market movement and take the form of bubbles and crashes. People are more scared of loss than they are happy about the gains. Option prices are greatly affected by expected volatility and if the stock market is efficient enough, such prices will be reflected in the market too. When volatility is more, prices of options are also higher. Since, volatility is one of the factors which determines the price of an option, it also impacts the value of the option. This paper tries to examine the difference in reaction of VIX towards rise and fall in stock market and checks the existence of short and long-term relation between Nifty and VIX.

In order to understand the multiplicity of variables that have an effect on stock market volatility, a researcher [6] wrote about how the capital market is influenced by many internal and external factors. At the same time, this capital environment directly impacts micro and macro-economic variables. This research analyses the effect of Macro economic factors on India Volatility Index (VIX). 10 of NSE's sectoral indices and 10 macro-economic variables such as export, import, etc. have been used in this study. It focuses on analysing the impact of such variables on

Sectoral Index and VIX. The second objective is to find the interdependence of these variables and stock market indices. This study helps policymakers and investors determine hedging strategy when there are changes in macro-economic factors.

In his study, [1] found that there exists a strong negative asymmetric relationship between stock market volatility indices based on implied volatility and their respective stock index returns by specifically focusing on the S&P 100 and NASDAQ100 indices. The analysis was done by splitting up the period under study into three distinct sub-periods – low volatility in a bull market (1 August 1994 to 30 May 1997), high volatility in a bull market (2 June 1997 to 31 March 2000), and high volatility in a bear market (3 April 2000 to 31 January 2003). It was found that in the case of high-volatility trading conditions, negative (or positive) stock index returns lead to comparatively smaller increase (or decrease) in the volatility index as against the same type of movement in lower-volatility conditions suggesting that option traders may attempt to increase the level of volatility in low-volatility conditions to bring their positions to profitability but may be discouraged by the higher risk in highly volatile trading environments to do the same. Moreover, it was found that the relationship between the S&P 100 index and the VIX was asymmetric in addition to having a negative contemporaneous relationship. This meant that the magnitude of movement in the VIX in response to negative returns on the S&P 100 index was greater than its response to positive returns of the same amount.

Since the introduction of India VIX, many authors have tried to examine its relationship with Nifty. In one such study, [7] developed a formula to assess the asymmetric relation between India VIX and CNX Nifty. It has helped calculate the change in India VIX due to 1% rise or fall in Nifty (it's -2.259% change in India VIX when CNX Nifty rises by 1% and 3.006% when Nifty falls by 1%). Closing values of both variables have been used to examine the relation with help of descriptive statistics and the conclusion was that they both are positively skewed and platykurtic. Other tools like mean, median, Jarque-Bera, ADF of daily return, etc. have also been used to analyse the data. Linear and quadratic effect of Nifty on India VIX has been tested and is found to be significant. The asymmetric relation also depends on size of market return and can help in the mitigation of downside risk at times of high volatility.

Researchers, [8] in their paper, explained the contemporaneous inter-temporal relationship between stock returns and volatility. It's important to understand implied volatility of stock market so as to predict the future position. Volatility is larger during the negative return phase and smaller or lesser during positive return. The two hypotheses used to support this statement are leverage and volatility feedback effects. They observed that the absolute value of correlation during low volatility periods was greater than the high volatility periods. Data for five years on the India VIX and Nifty was analysed.

Though other papers had also analysed such asymmetric behaviour before, the new aspect in their study was to consider India VIX instead of VIX used by Chicago Board of Exchange (CBOE). India VIX formula uses similar method of calculation as CBOE after accounting for the required changes. It's even mentioned that this difference in volatility changes for positive, zero and negative returns can be used to price future options.

Other research [9] has showed how the two benchmark indices, Nifty and Sensex on their own might not be able to indicate the true performance of Indian Stock markets. Trading is affected by many things. Instances of global financial crisis such as that of Lehman Brothers had also affected the Indian stock markets. And in such cases, it is not possible for investors to rely solely on the popular indices to build profitable trading strategies. Various reports and findings show that other participant's strategies can add value to the trading system. Spot market index and Futures are inversely correlated with VIX. A high level of VIX indicates more volatility and it increases open interest because more and more investors want to hedge themselves against risk. This increase in open interest makes the market more liquid and ultimately leads to a decrease in price of Nifty index. Thus, VIX gives a volatility signal to those who are worried about market movements. Nifty Index can be used for variety of purposes like benchmarking fund portfolios. Index funds and Index based derivatives are considered useful tools in capturing variations in market prices as they influence movements in Nifty Index. Volatility measure like VIX gives different implications for expected return of different strategies. Therefore, VIX and Futures can be used together as a fear gauge to understand the underlying asset fluctuation in stock market.

Some researchers have used tools like Granger causality methods and Johansen's co-integration to find the relationship between Nifty index returns and India VIX for the four-year time period from April 2010 to June 2014. They have used time series analysis and correlation to try and find out whether Nifty can be used to determine VIX. This led to the indication of bidirectional causality from Nifty to VIX. Co- integration was confirmed between the two and in the short run Nifty will cause VIX movements whereas the reverse is true for long run. It is important to understand the behaviour and efficiency of the variables to be able to use appropriate derivative on India VIX for the purpose of risk management and hedging. [10]

In another interesting study, the impact that day of the week has on VIX and Nifty for the period March 2009 to February 2016 was examined [11]. OLS and GARCH models have been used in the study and it is said that investors can use the information of respective days and safeguard themselves from risk in the Indian stock market. Tuesday and Thursday have negative effects on India VIX whereas Monday has a strong positive effect whereas, Wednesday has a weak positive effect on Nifty and Monday effect wasn't observed. Sub periods have also been considered in order to increase the accuracy of the results. Efficient Market Hypothesis doesn't consider such calendar anomalies but it can help investors pocket extra profits by just observing the calendar patterns. Volatility and risk can be considered as important as the returns. Investors need to

will need to check whether high (low) volatility will be associated with high (low) returns. This can help them adjust their portfolios according to the volatility of respective days in a week. A highly volatile market calls for greater returns, and VIX can be an important determinant for the same.

The importance of using behavioural theory to explain short term volatility was investigated in another study. This method was compared with traditional models like volatility feedback hypothesis and leverage. Tools like quantile regression and VAR were able to explain the relationship better than traditional methods. Behavioural biases like extrapolation and representative effects can be observed in market participants and they have an impact on India VIX making it an effective hedging instrument for adverse market movements. VAR was used to understand the cause and effect relationship between implied volatility and return. To further understand the contemporaneous relationship, quantile regression models have been used to examine the effect of returns throughout the change distribution of implied volatility quantiles and the effect of implied volatility on the quantiles of return distributions. This study compares feedback and leverage effects separately with behavioural theory. Also, behavioural theory was seen to give better relationship indications than traditional ones on a consistent basis. The monotonic effect was increasing from median to higher levels of India VIX quantile distribution. This asymmetric effect and the behavioural theory can be of major use in emerging markets and can be used to imply the same for India VIX futures which were introduced recently. [12]

In their study, the researchers compare the ability of the India VIX in predicting future realised volatility against that of conditional volatility models like GARCH and ARCH. They use a regression approach and find that the mean absolute percentage error (MAPE) is the lowest for the India VIX, and hence, conclude that it is the superior measure for representing present expectations of future volatility. Secondly, they regress the changes in India VIX separately with positive and negative Nifty return variables in order to ascertain if the relationship is negative and asymmetric. They find on the basis of their quantile regression estimates that the effect of negative Nifty movements impact the India VIX more than positive movements of the same amount. [13]

III. RESEARCH DESIGN

3.1 Statement of the Problem/ Need for the Study

Past studies over the years have exhibited the asymmetric, negative correlation between Nifty and India VIX. In other words, when the expected market volatility as indicated by the India VIX falls, then the Nifty index typically rises and vice versa.

The aim of this study is to assess the impact of the introduction of weekly expiry on Nifty options from 11 February 2019 on this repeatedly established asymmetric, negative correlation between India VIX and Nifty.

We find that the relationship of Nifty with the India VIX has undergone a change with the introduction of weekly options expiry. Our study details the tests carried out, our findings and possible causes. These findings challenge the taken-for-granted negative correlation of Nifty-India VIX and provide insights which are useful for risk managers and academicians, not just in India but world over. It provides an additional dimension on how the finance world looks at volatility, thereby enriching the existing body of knowledge on the subject.

3.2 Research Gap

Previous studies on the relationship between the India VIX and stock market returns have dealt with data from an environment where Index options were expiring monthly. As a result, a clear research gap emerges since this study seeks to analyse the correlation between Nifty and India VIX for a specified period before and after the introduction of weekly expiry on Nifty options from 11 February 2019 (the cut-off date). Hence, the values of the inverse and asymmetric relationship as theorised in earlier studies are likely to undergo a change. This study is based on very recent data, from 15 November 2018 to 13 May 2019, pertaining to the Nifty index, the India VIX, the Nifty Options volumes, Nifty futures annualised volatility and Nifty annualised volatility values.

3.3 Objectives of the Study

1. To analyse the impact of the introduction of weekly expiry on Nifty options on the correlation between Nifty and India VIX, as theorised in previous studies.
2. To ascertain whether changes in Nifty Options volumes in the periods before and after the introduction of weekly expiry on Nifty options have an impact on the correlation between Nifty and India VIX, as theorised in previous studies.
3. To compare the relationship of Nifty with futures annualised volatility as against its relationship with India VIX which is an options-based volatility measure.
4. To determine whether the correlation behaviour between Nifty and India VIX remains unchanged for different time intervals in the periods before and after the introduction of weekly expiry on Nifty options.

3.4 Hypotheses

This paper focuses on 4 hypotheses, 1 & 2 being the Primary Hypotheses and Hypothesis 3 being the Secondary Hypothesis. The introduction of weekly expiry on Nifty Options has not been analysed in the previous papers so point 1 and 2 become the most important areas for study.

1. **Hypothesis 1 –**
H₀: The introduction of weekly expiry on Nifty options does not have an effect on the theorised negative correlation between Nifty and India VIX.
2. **Hypothesis 2 –**
H₀: Nifty Options Volumes does not have an effect on the correlation between Nifty and India VIX.
3. **Hypothesis 3 –**
H₀: Options based volatility measures i.e. India VIX, futures-based volatility measures i.e. Futures annualised volatility, and Nifty annualised volatility should have identical relation with Nifty.

3.5 Scope of the Study

The date of introduction of weekly expiry on Nifty options, 11-Feb--2019, has been taken as the cut-off date and the correlations between Nifty, India VIX and other variables such as Nifty Options volumes, Nifty futures annualised volatility, and Nifty annualised volatility for upto 60 days pre and post cut-off date i.e. 120 days in total, are analysed. The reason this study restricts the analysis to 120 days is that a preliminary analysis that was conducted for 150 days did not show a significant difference but was rather merely an extension of the results of the 120-days analysis.

The following variables are used in this study - closing values of Nifty, India VIX, Nifty Futures annualised volatility, Nifty annualised volatility, and Nifty Options volumes.

3.6 Operational Definition of Concepts

3.6.1 Introduction of Nifty weekly options –

Earlier, Nifty Options having monthly expiries alone, were available. From 11-Feb-2019, these continued and additionally weekly options expiring every week were introduced by the exchanges.

The introduction of Nifty weekly expiry options reduced the time to expiry. These options expire every Thursday, with the first series expiring on 14th February, 2019. The launch of weekly expiry options on Bank Nifty in 2016 was successful and led to the introduction of similar options for Nifty too, in anticipation of an increase in trading volumes. In order to analyse the same, Nifty Options volumes have been considered. [14]

3.6.2 India VIX –

India VIX is the market volatility index developed by the National Stock Exchange of India (NSE). It indicates the expected market volatility over the next 30 days as an annualised percentage. As the India VIX rises, market volatility is also expected to rise. The index is calculated using the methodology developed by the Chicago Board of Options Exchange (CBOE), who introduced the first volatility index in the US called the VIX, based on underlying S&P 100 Index options. NSE adapted the computation to suit the characteristics of the Indian options market. Hence, India VIX is calculated on the basis on near and next month bid-ask quotes for Nifty out-of-the-money option contracts.

Another important characteristic of India VIX is its relationship with Nifty returns. Several studies and reports have empirically proven that there exists a strong negative asymmetric relationship between India VIX and Nifty. As the Nifty rises, the India VIX falls and vice versa. However, this opposite movement is not proportional. As studied earlier [1], the degree of change in volatility is much larger for large negative market returns as compared to positive market returns of equal size.

3.6.3 Nifty Options Volumes -

Nifty Options volumes represent the increase in trading volumes on that particular day. Daily trading volumes include contracts entered into for all expiries and strike prices of call and put options.

3.6.4 Nifty Futures Annualised Volatility -

The futures annualised volatility is a measure of changes in values of Nifty Futures on an annualised basis. When a financial asset is more volatile, the premium paid for it is higher. Investors need to understand this in order to hedge themselves whenever required. Daily returns are calculated by using the logarithmic formula for the current and previous day closing price of Futures. The current day volatility is computed using the standard deviation, return value and previous day volatility. This value is then annualised by multiplying it with the square root of 365.

3.6.5 Nifty Annualised Volatility -

This is calculated in a similar manner as Futures annualised volatility. The only difference is that it calculates volatility for underlying Nifty itself and not for a derivative contract. The daily returns are calculated by finding the log of current and previous day Nifty closing values. Current day volatility is calculated by using the values of log returns and previous day volatility in the standard deviation formula which is then annualised by multiplying it with the square root of 365.

3.7 Methodology

3.7.1 Quantitative analysis using SPSS –

In order to analyse the relationship between Nifty, India VIX and the other variables in the study, quantitative tools such as Pearson's Correlation, Moderator Analysis using the PROCESS Macro extension, and descriptive statistics (mean, standard deviation, variance, skewness, and kurtosis) from IBM'S SPSS and Microsoft Excel have been used.

3.7.2 Longitudinal study –

This study deals with the relationship between the same set of variables over a period of 120 days beginning 15-Nov-2018 and ending on 13-May2019, with 11-Feb-2019 as the cut-off date. Moreover, different time intervals (i.e. 15 days pre and post-cut-off date, 30 days pre and post-cut-off date, and 60 days pre and post-cut-off date) have been analysed separately to study the impact on the relationship between the variables.

3.7.3 Event-based –

The study can be considered to be event-based pre-post study, as the date of the introduction of weekly expiry on Nifty options is taken as the cut-off date.

3.7.4 The methodology of previous studies –

The asymmetric negative correlation between Nifty and India VIX was quantified to be -0.812 using similar methods i.e. Pearson's Correlation on SPSS in a previous study [13] which used data spanning the period between 01-Mar-2009 and 30-Nov-2012 which has served as a strong base to substantiate the methodology of this study.

3.8 Data Collection

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3.8.1 Variables under study:

- i. Closing values of Nifty
- ii. Closing values of India VIX
- iii. Nifty Options Volumes -
- iv. Nifty Futures Annualised Volatility
- v. Nifty Annualised Volatility

3.8.2 Data Source:

The 120 trading days' data from 15/11/18 to 13/05/19 has been collected for Nifty, Nifty Options volumes, India VIX, Underlying and Futures Annualised Volatility directly from the NSE India website.

- a) **Daily Volatility Files** provided details on the daily Nifty closing values, Nifty Annualised and Futures Annualised volatility. [15]
- b) **Daily Bhavcopy Files** have been used to calculate the Nifty Options volumes. The number of contracts has been taken instead of open interest because open interest represents the contracts active on that day but the number of contracts is the actual increase in volumes on that particular day only and for each expiry date. Nifty options volumes have been calculated by adding the contracts of call and put options for different strikes and expiry dates. [15]
- c) **Historical Index Data** was used to collect daily closing values of India VIX. [16]

3.9 Sampling

This is a population study and hence, no samples have been used for the purpose of analysis. Instead, the relevant data has been collected for each of the 120 trading days covered in this study directly from NSE's historical data files.

3.10 Plan of Analysis

The data has been sourced directly from the NSE India website. This study is being undertaken to analyse the behavioural trends of Nifty and India VIX and other variables before and after the introduction of Nifty weekly expiry options by:

- 3.10.1 Calculating Pearson's correlation for the pre and post-cut-off periods between Nifty and India VIX
- 3.10.2 Using the PROCESS Macro extension developed by Dr Andrew Hayes for SPSS to analyse the effect of Nifty Options Volumes as a moderator variable on the relationship between Nifty as the independent variable and India VIX as the dependent variable for the pre and post-cut-off periods.
- 3.10.3 Calculating Pearson's correlation between the 15-days, 30-days, and 60-days correlation between Nifty and India VIX and the average Nifty Options volumes for the same time intervals
- 3.10.4 Calculating Pearson's correlation for the pre and post-cut-off periods between India VIX and other volatility measures i.e. Nifty Futures annualised volatility and Nifty annualised volatility

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3.10.5 Using SPSS to calculate the descriptive statistics of the data in order to understand its characteristics

Pilot Study: Prior to carrying out the analysis on the complete data for the 120 days being analysed in this study, a pilot study was first conducted using only 15 days' data to check a variety of factors – the suitability of various data sources, establishing the basic relationships between the various variables, and time and scope limitations.

3.11 Limitations of the Study

This study has the following limitations:

3.11.1 The period covered by the analysis is 120 days split into 60 days before and 60 days after the cut-off date.

3.11.2 The study is limited to the usage of the following variables- daily Nifty closing values, Nifty Options volumes, India VIX, Nifty Annualised and Futures Annualised volatility

IV. DATA ANALYSIS AND INTERPRETATION

4.1 General Characteristics of the Data

Table I: Descriptive Statistics

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
NIFTY CLOSING	120	10488.4500	11787.1500	11056.6567	380.204098	.621	.221	-1.114	.438
U/A ANNUALIZED VOL.	120	.1161	.2024	.149097	.0238701	.722	.221	-.854	.438
FUTURES ANNUALIZED VOL.	120	.1223	.2124	.155172	.0234882	.718	.221	-.810	.438
INDIA VIX	120	14.3325	27.3825	18.016896	3.0251457	1.357	.221	1.286	.438
Valid N (listwise)	120								

For the data collected for the period under analysis (15/11/18 to 13/05/19), the following basic statistical characteristics can be observed:

1. The maximum price of Nifty Index is 0.0661 times higher than the mean index price and the minimum value is 0.0514 times lower than the mean index price. For India VIX, maximum volatility value is 0.5198 times higher than the mean VIX level and the minimum value is 0.2045 times lower than the mean value of VIX.
2. For Nifty Annualised volatility, the maximum value is 0.3575 times higher than the mean and minimum value is 0.2213 times lower than the mean. As per the data of Futures Annualised Volatility, maximum volatility is 0.3688 times higher than mean and minimum volatility is 0.2118 times lower than mean.

(Data source: NSE) U/A stands for the Nifty50 Index



Figure 3: Movement of India VIX and Nifty for 120 trading days from 15/11/18 to 13/05/19

3. Standard deviation represents the average distribution of data around the mean. So, on average, the deviation of Nifty from its mean is 380.2041 and similarly, it's 3.0251 for India VIX.
4. The skewness of Nifty, India VIX, Nifty Annualised Volatility and Futures Annualised Volatility suggests they are all positively skewed. This signifies a longer tail on the right side of the probability density function as compared to the left side and maximum values lie on the left side of the mean.
5. The kurtosis values for all variables are less than 3 indicating a platykurtic distribution with flatter peaks than a normal distribution.

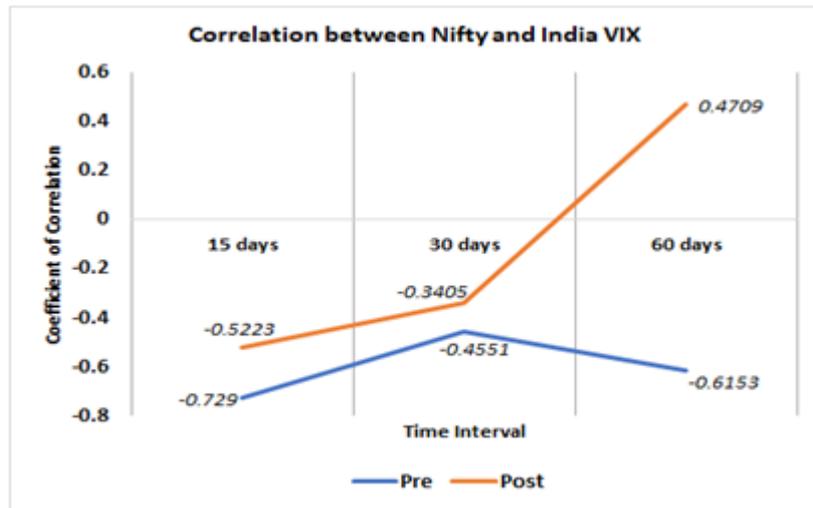


Figure 4: Correlation between Nifty and India VIX for Different Time Intervals (Data source: NSE)

4.2 Primary Hypotheses

4.2.1 Hypothesis 1:

Given below (Figures 5 & 6) are two scatter plots of Nifty and India VIX for 60 days before and 60 days after the cut-off date, respectively. For the pre-cut-off period, the

line of best fit in downward-sloping, which indicates that there is a negative correlation between India VIX and Nifty. For the post-cut-off period, the line is upward-sloping, indicating the positive correlation between the two.

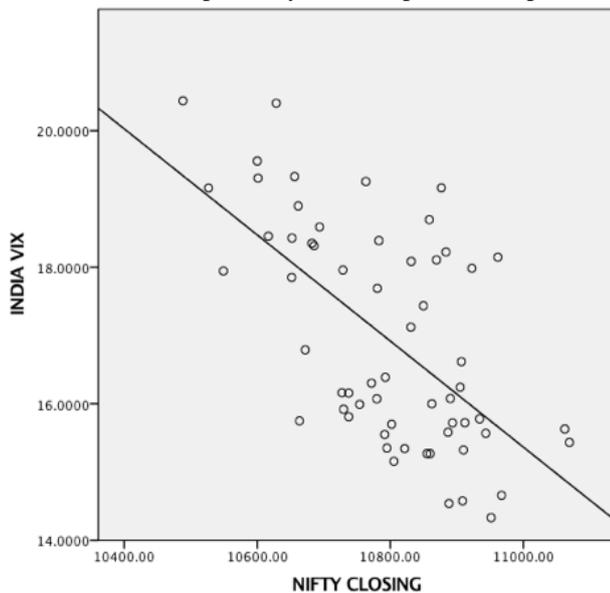


Figure 5: Scatter plot for 60 days pre-cut-off date

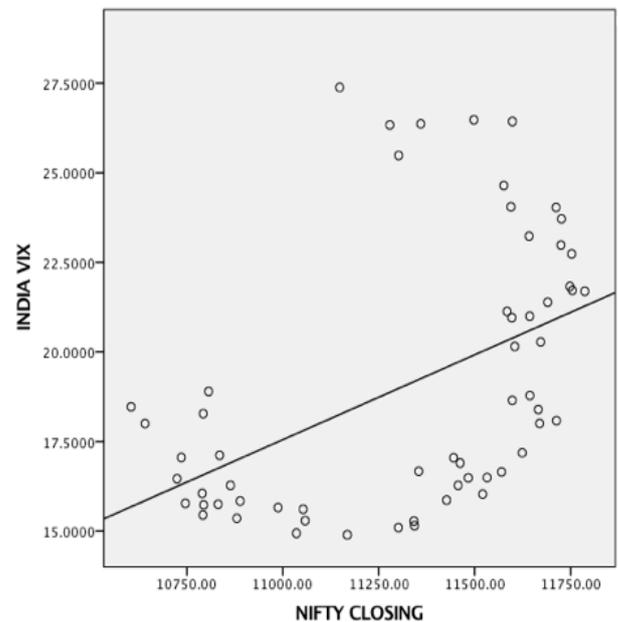


Figure 6: Scatter plot for 60 days post-cut-off date

(Data source: NSE)

Findings:

Using the data with respect to Nifty and India VIX, Pearson’s correlation between the two variables was calculated for 15, 30, and 60 days pre and post-cut-off date. The analysis of the data yielded the following findings:

1. **15 DAYS Pre and Post** – There is a high negative correlation between Nifty & India VIX values before the introduction of Nifty weekly expiry (-0.7290) and relatively low negative correlation (-0.5223) after signifying the asymmetric relation.
2. **30 DAYS Pre and Post** – Nifty & India VIX show a low negative correlation (-0.4551) prior to the introduction of weekly expiry on Nifty options, which decreases to -0.3405 post-cut-off date.
3. **60 DAYS Pre and Post** –

- a. There is a moderate negative correlation between Nifty & India VIX before the cut-off date (-0.6153) which becomes a moderate positive correlation post-cut-off date (0.4709). This is a very significant change as the relationship between Nifty and India VIX have been theorised to be negative and asymmetric.
- b. The average of 60 days closing Nifty values pre-cut-off date is 10793.77 whereas it is 11319.55 post-cut-off date. Similarly, the 60 days average value of India VIX pre-cut-off date was 16.97 which rose to 19.07 post-cut-off date.
4. **TOTAL of 120 DAYS** –
 - a. The correlation for the complete period under study is moderately positive (0.4662). This is, again, significant.

b. Figure 3 clearly depicts the steady rise in both Nifty and India VIX with few downfalls which were covered again. The maximum value of India VIX towards the end was 1.9 times the minimum value. Similarly, the maximum value of Nifty was 1.12 times the minimum value. Also, it can be observed that minimum values of both of them lie before the cut-off date and the maximum values are in post cut-off date.

Interpretations:

1. In each of the time intervals considered, it can be noted that Nifty-India VIX relationship has undergone a change. Weekly expiries bring with it shorter time to expiry, which, coupled with larger volumes and pricing efficiencies, may have contributed to this change. India VIX which is was earlier based on options expiring monthly, was now heavily influenced by options expiring weekly. The effect of Nifty Options Volumes as a moderating variable on the relationship between Nifty and India VIX is discussed in detail under Hypothesis 2. The Indian Options segment is used widely by all types of participants – traders, arbitrageurs, and hedgers – both retail and institutional, and the introduction of weekly options in Nifty showed an immediate spike in the interest of participants which is reflected in the increased volumes in the post-introduction period of the study. Moreover, several trading/hedging/arbitraging strategies involve covering the options position with the underlying. Hence, it is not surprising that the introduction of a shorter

expiry in Nifty Options had led to increased participation in not just Nifty Options but has perhaps even led to trading in the stocks of the Nifty50 (especially closer to the expiry of derivative contracts) in order to cover open positions. This is usually more prevalent in the trades of high volumes executed by large Asset Management Companies (AMCs). [17]

2. Historically, there have been very few cases (5 such cases have been found including the current one) of Nifty and India VIX having a positive correlation. In most of these cases, both of them rose together, which is the case here too. In the past cases (2010, 2014-15, and 2017), after rising, they both fell at an approximate range of 3-8% which is a sign of the market's corrective action. But in 2014, due to general elections, after rising together, Nifty continued to rise and India VIX fell drastically indicating market stability. A similar situation arose after the introduction of Nifty weekly options, where, after rising together, Nifty continued to rise but India VIX fell. [18]

This suggests that the positive correlation is a temporary phenomenon and is a departure from the normal relationship between Nifty and India VIX, but it is significant nonetheless.

4.2.2 Hypothesis 2:

Table II given below summarises the 15, 30, and 60 days' correlations between Nifty and India VIX (both pre and post-cut-off date) and average volumes for the same periods, along with the correlation between the same:

Table II: Correlation between Average Nifty Options Volumes and the Correlations between Nifty and India VIX

		CORRELATION BETWEEN NIFTY & INDIA VIX (A)	AVERAGE NIFTY OPTIONS VOLUMES (B)
PRE	60 DAYS	-0.6153	23,60,745
	30 DAYS	-0.4551	20,94,949
	15 DAYS	-0.729	26,17,958
POST	15 DAYS	-0.5223	39,77,232
	30 DAYS	-0.3405	39,23,739
	60 DAYS	0.4709	40,25,763
		CORRELATION BETWEEN A & B	0.5701

(Data source: NSE)

Findings:

1. Nifty Options Volumes have increased significantly after the cut-off date. The 60 days average volume post cut-off date is 1.71 times the pre-cut-off 60 days volume.
2. At the same time, the correlation between India VIX and Nifty has become less negative and has, in fact, become moderately positive in the post-introduction 60 days period.

Since from the above table it is clear that there exists a moderately positive correlation between average Nifty Options volumes and the correlation between Nifty and India VIX, it led us to analyse if the change in volumes has an association with the change in VIX- Nifty correlation.

For this, we have used Nifty Options volumes as a **moderator** to explain the strength of the relationship between the two variables - India VIX and Nifty.

Moderation Analysis

In order to check the moderation of Nifty Options Volumes on the relationship between Nifty and India VIX, the SPSS extension known as PROCESS Macro developed by Dr Andrew F. Hayes has been used, This is a regression model which takes into account several combinations of moderating and mediating relationships to provide insight on the statistical significance of the interaction effect a moderator/mediator has on other variables.

The simplest Moderation model (Model 1) was set up as follows:

- a) Nifty closing values were taken as the independent variable (X).
- b) India VIX closing values were taken as the dependent variable (Y).



- c) Nifty Options daily volumes were taken as the moderator variable (W).
- d) The PROCESS Model 1 was used to analyse the pre-cut-off and post-cut-off 60-day periods separately in order to understand if the significance of Volumes as a moderator had increased due to the introduction of weekly options in Nifty.

Given below in figures 7 and 8 is the summary of the model's output for both the periods:

In the figures given below -

- "prenifty" = Nifty closing values in the pre-cut-off date 60 days' period.

- "prevol" = Nifty Options Volumes for the pre-cut-off date 60 days period.
- "postnift" = Nifty closing values in the post-cut-off date 60 days' period.
- "postvol" = Nifty Options Volumes for the post-cut-off date 60 days period.
- "Int_1" represents the interaction effect of the moderating variable (i.e. Volumes) on the relationship between X and Y. This is considered to be statistically significant if the value 0 does not lie in between the LLCI and the ULCI (lower and upper limits of the confidence interval which is at 95% by default).

Model Summary							
	R	R-sq	MSE	F	df1	df2	p
	.6206	.3851	1.6807	11.6904	3.0000	56.0000	.0000
Model							
	coeff	se	t	p	LLCI	ULCI	
constant	116.6073	36.9678	3.1543	.0026	42.5514	190.6631	
prenifty	-9.2128	3.4208	-2.6931	.0093	-16.0656	-2.3600	
volpre	-.5877	1.5469	-.3799	.7055	-3.6866	2.5112	
Int_1	.0538	.1436	.3746	.7094	-.2338	.3414	

Figure 7: PROCESS Macro Output for Moderation Analysis (PRE-CUT-OFF)

Findings:

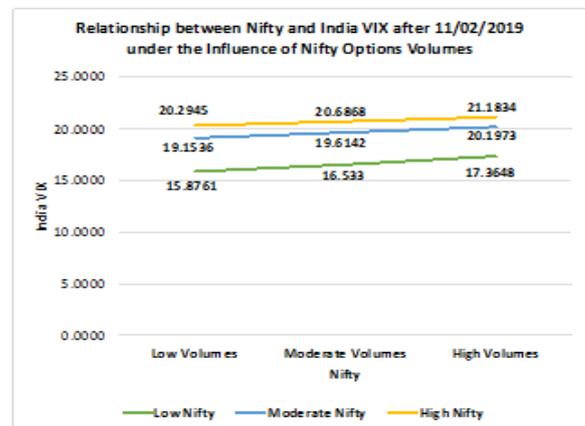
1. For both periods, the moderation model is significant as the p value is less than 0.05 but the interaction effect is not statistically significant.
2. However, the range of LLCI and ULCI has reduced from the pre-cut-off date period to the post-cut-off-date period, suggesting an increase in the interaction level of Volumes on the relationship between Nifty and India VIX

Model Summary							
	R	R-sq	MSE	F	df1	df2	p
	.4951	.2451	10.8366	6.0622	3.0000	56.0000	.0012
Model							
	coeff	se	t	p	LLCI	ULCI	
constant	-45.1923	34.9964	-1.2913	.2019	-115.2989	24.9143	
postnift	5.5540	3.0975	1.7931	.0784	-.6510	11.7590	
volpost	.2712	.8264	.3282	.7440	-1.3842	1.9267	
Int_1	-.0209	.0732	-.2859	.7760	-.1675	.1257	

Figure 8: PROCESS Macro Output for Moderation Analysis (POST-CUT-OFF)

Interpretations:

1. It is no doubt that on the introduction of weekly options in Nifty, trading in the Nifty options as a whole increased, leading to sharp surges in the daily volumes. This was because of several reasons - (i) Nifty weekly options allowed for greater participation of traders in the form of option buyers who now had to pay lesser premium than for a monthly option and for option writers who could additionally write shorter pay-off options including monthly options with larger premium receipts and (ii) the weekly options have opened up new ways to structure a hedge by combining lower-premium weekly expiries with the existing monthly options, leading to lower cash outflows.



Figures 9 (left) and 10 (right) showing Moderator Effect of Nifty Options Volumes on the relationship between Nifty and India VIX

2. Figures 9 and 10 given above depict the aforementioned moderation effect of Volumes on the relationship between Nifty and India VIX.

From the graph pertaining to the pre-introduction period, it is clearly noticeable that

- a. there exists a negative and asymmetric correlation between Nifty and India VIX, and;
- b. with the exception of the Moderate Volumes section of Low Nifty conditions, Nifty Options volumes have contributed to maintaining this negative correlation between Nifty and India VIX.

From the graph pertaining to the post-introduction period, it is clearly noticeable that

- a. the graph in Figure 10 is completely inverted, with the normally prevailing negative asymmetric relationship between the Nifty and India VIX has broken down and become a moderately positive one (as discussed under Hypothesis 1), and;
- b. Nifty Options volumes have been able to strengthen this positive relationship.

Therefore, despite the statistical insignificance of Nifty Options Volumes on the relationship between Nifty and India VIX in both the data sets used, the decrease in the band between the lower and upper confidence interval limits

coupled with the findings based on actual market events show that the introduction of weekly options in Nifty and the consequent rise in Options volumes have influenced the strength of the relationship between the Nifty and India VIX.

4.3 Secondary Hypothesis

Hypothesis 3:

H0: Options based volatility measures i.e. India VIX, futures-based volatility measures i.e. Nifty Futures annualised volatility, and Nifty annualised volatility should have identical relation with Nifty.

Findings:

1. India VIX is seen to have a moderate positive correlation with Nifty which is contrary to the usual negative asymmetric relation, which has been widely researched before.
2. Both Futures Annualised Volatility and Nifty Annualised Volatility have a moderately high negative correlation with Nifty.
3. India VIX has a low negative correlation with Futures Annualised Volatility as well as with Nifty Annualised Volatility.
4. Nifty Annualised Volatility has a high positive correlation with Futures Annualised Volatility, which is almost 1 (0.99).

Table III: Correlations for 120 days' data: (Data source: NSE)

		Correlations			
		NIFTY CLOSING	U/A ANNUALIZED VOL.	FUTURES ANNUALIZED VOL.	INDIA VIX
NIFTY CLOSING	Pearson Correlation	1	-.650**	-.606**	.462**
	Sig. (2-tailed)		.000	.000	.000
	N	120	120	120	120
U/A ANNUALIZED VOL.	Pearson Correlation	-.650**	1	.990**	-.239**
	Sig. (2-tailed)	.000		.000	.008
	N	120	120	120	120
FUTURES ANNUALIZED VOL.	Pearson Correlation	-.606**	.990**	1	-.226*
	Sig. (2-tailed)	.000	.000		.013
	N	120	120	120	120
INDIA VIX	Pearson Correlation	.462**	-.239**	-.226*	1
	Sig. (2-tailed)	.000	.008	.013	
	N	120	120	120	120

** . Correlation is significant at the 0.01 level (2-tailed).
* . Correlation is significant at the 0.05 level (2-tailed).

Interpretations

Volatility refers to the degree of fluctuations in the price of an asset and is measured in different ways. In general, stock market volatility and market returns are said to be inversely proportional; higher volatility corresponds to a higher likelihood of a declining market since high volatility implies higher risk. This high level of risk may deter investors from making higher returns, which in turn, leads to a fall in the stock market. Similarly, lower volatility corresponds to a higher probability of a rising market.

From the above analysis, the following can be noted as the main reasons for the difference between India VIX and the other two volatility measures:

1. Nifty Futures annualised volatility and Nifty annualised volatility are both **historical measures** of volatility. They are calculated on the basis of past days' closing Nifty index levels. On the other hand, India VIX is a **forward-looking measure** of volatility. It indicates the expected volatility for the next 30 days and hence, reflects the market sentiment, acting as a "fear gauge".

- Nifty Futures annualised volatility and Nifty annualised volatility are calculated using **Standard Deviation**, which indicates the degree to which the Nifty futures prices and the underlying index, respectively, have deviated from the mean.

India VIX uses an entirely different method of calculation as developed by the CBOE and adapted by the NSE. Since India VIX is based on Nifty options, the formula derives elements from the Black-Scholes Option Pricing Model and shares several key variables - Strike price of options, Risk-free rate of return, and Time to expiry. As a result, it is evident that India VIX, by virtue of being based on options, has incorporated **Implied Volatility** in its computation approach.

- Another significant finding is the **strong positive correlation** between Nifty futures annualised volatility and Nifty annualised volatility, which is almost 1 (0.99). This is due to the fact that they are based on Nifty futures prices and the Nifty50 index, respectively, and the Nifty futures prices are in turn closely related to the underlying index. Hence, it is no surprise that the volatility measures based on them are also strongly correlated.
- Ultimately, **the concept of volatility is singular**. It is the method of construction and the purpose of measurement (historical or forward-looking perspective) that lead to a divergence in the different measures of volatility, which naturally behave differently in relation to the stock market index. Hence, the null hypothesis has been disproved.

V. SUMMARY OF FINDINGS

Following were the findings for calculations on Nifty, India VIX, Futures Annualised Volatility and Nifty Annualised Volatility. For details on the values, please refer to Table A of the Appendix:

5.1 15 Days Pre And Post-Cut-Off Date -

- There is a high negative correlation between Nifty & India VIX values before the introduction of Nifty weekly expiry and relatively low negative correlation after signifying the asymmetric relation.
- There's a moderately high positive correlation between Nifty & Nifty Annualised Volatility and between Nifty & Futures Annualised Volatility values before the introduction of Nifty weekly expiry and low positive correlation after.
- There's a moderate negative correlation between Nifty Annualised Volatility & India VIX and Futures Annualised Volatility & India VIX. The negative correlations decrease marginally post Nifty weekly expiry introduction.
- There's a very high positive correlation between Nifty Annualised Volatility & Futures which decreases marginally post cut-off date.

5.2 30 Days Pre And Post-Cut-Off Date -

- Nifty & India VIX also show a low negative correlation which decreases minutely post cut-off date.
- A low negative correlation can be observed between Nifty & Nifty Annualised Volatility and between Nifty & Futures Annualised Volatility values before the

introduction of Nifty weekly expiry and comparatively higher negative correlations after.

- Nifty Annualised Volatility & India VIX and Futures Annualised Volatility & India VIX have a moderate negative correlation which becomes low negative correlation post cut-off date.
- There's a very high positive correlation between Nifty Annualised Volatility & Futures which decreases marginally post cut-off date.

5.3 60 Days Pre And Post-Cut-Off Date-

- We can observe a low negative correlation between Nifty & Nifty Annualised Volatility and between Nifty & Futures Annualised Volatility values before the introduction of Nifty weekly expiry and comparatively lower negative correlations after.
- There's a moderate negative correlation between Nifty & India VIX before the cut-off date which becomes moderate positive correlation post cut-off date. This is a very significant change as VIX has been theorised and proven to have a negative correlation with Nifty almost always.
- The low positive correlation between Nifty Annualised Volatility & India VIX becomes low negative correlation post cut-off date.
- Futures Annualised Volatility & India VIX has a very low positive correlation which increases a little after the cut-off date.
- There's a very high positive correlation between Nifty Annualised Volatility & Futures which decreases marginally post cut-off date.

5.4 Findings for Nifty Options Volumes as an influencing factor on the relationship between Nifty and India VIX:

- The average Nifty Options volumes have increased by 71% since the introduction of Nifty weekly expiry options.
- The volumes have a statistically minor moderating effect on the correlation between India VIX and Nifty.
- There is a moderately positive correlation between the average Nifty Options volumes and the correlation between India VIX and Nifty for the 15, 30 and 60 days pre- and post-cut-off date periods.

VI. CONCLUSION

The purpose of this study was to analyse whether the introduction of weekly expiry on Nifty options had an effect on the established negative and asymmetric relationship between Nifty and India VIX. This introduction not only provided a new product in the Nifty options segment but also an opportunity for traders to cover themselves in short durations. There can be cases when this asymmetric relation does not hold good and it becomes important to understand such situations. In this case, it was found that the driving factor for the sudden change in the relationship between Nifty and India VIX stemmed from a spike in Nifty Options volumes amidst a market where volatility was steadily rising in the lead up to the 2019 elections.

Besides the moderation impact of Volumes on this relationship, another reason for the positive correlation between Nifty and India VIX was the increased participation of Options traders and investors in the spot market as well in order to cover their positions.

Further, it was found that although there is only one concept of volatility, the method and purpose of measuring it has an impact on the relationship that measure

would have with Nifty. As a result, India VIX, which is an options-based measure derived from implied volatility exhibits a very different relationship with Nifty as compared to Nifty Futures annualised volatility and Nifty annualised volatility (the latter two have an almost perfectly positive relationship with each other). Moreover, it was noted that the correlation values between India VIX and Nifty change as the time intervals used for their calculation are changed.

APPENDIX

Table A Summary of Findings

ROW NO.	CORRELATION BETWEEN	15 days		30 days		60 days	
		PRE	POST	PRE	POST	PRE	POST
A	Nifty & India VIX	-0.7290	-0.5223	-0.4551	-0.3405	-0.6153	0.4709
B	Nifty & Nifty Futures Annualised Volatility	0.6351	0.1858	-0.0876	-0.3445	-0.4028	-0.1707
C	Nifty & Nifty Annualised Volatility	0.5103	0.1364	-0.1341	-0.2782	-0.4660	-0.3614
D	India VIX & Nifty Futures Annualised Volatility	-0.6864	-0.6057	-0.5331	-0.2773	0.0075	0.1823
E	India VIX & Nifty Annualised Volatility	-0.5787	-0.5497	-0.5035	-0.2305	0.1401	-0.0187
F	Nifty Futures Annualised Volatility & Nifty Annualised Volatility	0.9822	0.9569	0.9977	0.9588	0.9838	0.9200

(Data source: NSE)

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