AN EMPIRICAL STUDY ON THE VOLATILITY IN INDIAN OPTIONS EQUITY MARKET WITH REFERENCE TO INDIA VOLATILITY INDEX

A PROJECT REPORT

Submitted by

K.DIVYA

Reg. No. 0820400006

In partial fulfillment of the requirements

For the award of the degree

Of

MASTER OF BUSINESS ADMINISTRATION

JUNE, 2010

KCT Business School

Department of Management Studies

Kumaraguru College of Technology

(An autonomous institution affiliated to Anna University, Coimbatore)

Coimbatore – 641 006

DBFS Securities Ltd.

10th June 2010

TO WHOMSOEVER IT MAY CONCERN

This is to certify **that Ms.K.DIVYA (08MBA06)**, II MBA student of **KCT Business School,** Kumaraguru College of Technology, Coimbatore has successfully completed her project on **" AN EMPIRICAL STUDY ON THE VOLATILITY IN INDIAN OPTIONS EQUITY MARKET WITH REFERENCE TO INDIA VOLATILITY INDEX"** at our Organization from 9th March 2010 to 10th June 2010. She has done this under the guidance and supervision of Mr.M.N. Poorna Chandra.

We place on record with deep appreciation that she has provided an excellent work with dynamism and dedication. Her commited involvement for the internship program is highly appreciated by DBFS Securities Ltd.

We wish her a bright career and Best of Luck for her future endeavor.

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14/06/2010

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DECLARATION

I hereby declare that the project entitled **"AN EMPIRICAL STUDY ON THE VOLATILITY IN INDIAN OPTIONS EQUITY MARKET WITH REFERENCE TO INDIA VOLATILITY INDEX"** submitted for the Master of Business Administration degree is my original work and the dissertation has not formed the basis for the reward of any Degree, Associate ship, Fellowship or any other similar titles.

Signature of the student

K. Divya 14/06/2010

(K.DIVYA)

ROLL NO: **(08MBA06)**

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

I thank the GOD, Almighty for his blessings bestowed upon me, which gave strength, confidence and health for completing this project.

I express my sincere gratitude to our beloved Chairman **Arutchelvar Dr.N.Mahalingam,** the prime guiding spirit of Kumaraguru College of Technology.

I express my sincere gratitude to our beloved Co-chairman Dr.**B.K.Krishnaraj Vanavarayar, B.Com, B.L,** the prime guiding spirit of Kumaraguru College of Technology.

I express my sincere gratitude to our beloved correspondent **Mr.M.Balasubramaniam, M.Com, MBA(U.S.A),** the prime guiding spirit of Kumaraguru College of Technology.

I express my sincere gratitude to our beloved Principal in-charge **Prof.Dr.S.Ramachandran,** the prime guiding spirit of Kumaraguru College of Technology.

I wish to express my sincere thanks to **Prof.Dr.S.V.Devanathan, Ph.D.,** Director, KCT Business School, for his continuous encouragement throughout my project.

I wish to express deep sense of obligation to **Mr.A.Senthil Kumar, Senior lecturer**, KCT Business School, for his intensive guidance throughout my project.

I am greatly indebted to thank all other faculty members of KCT Business School for their kind patronage.

I wish to reserve a warm and special note of thanks for my project guide to **Mr.M.N.Poorna Chandra**, Branch Manager, DBFS Securities Ltd, Bangalore Branch whose support and guidance helped me to complete this project successfully.

I take this opportunity to express my love and gratitude to my beloved parents for their being with me in my entire endeavor including this special achievement. Finally I thank all my friends for their help, and moral support of need.

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EXECUTIVE SUMMARY:

Volatility of an asset is measured by the variability in the price over time measured as the variance or the standard deviation of the returns on the asset. Volatility Index is a measure of market's expectation of volatility over the near term. Predicting the volatility has attracted much research attention since it's a direct function for pricing the risky asset. In this context the study examines the volatility present in the India options equity market with specific reference to India VIX. The study also throws light on the composition and the performance of the India VIX during the period of market turbulence. The study also focuses on the scrips that form part of the underlying price and present with those scrips that are considered to have more influence over the India VIX. The study is conducted on the VIX values considered for a period of two years since its introduction by the NSE. The study also shows the computational methodology of the India VIX which is same as the methodology adopted by CBOE currently for computing VIX on S&P 500 options. The tools that were used for the analysis include summary statistics; test for Autocorrelation, Stepwise multiple regression and the test for multi-collinearity. The results of the study reveal that the market has been highly volatile during the two year period. The sensitivity of the India VIX is observed from the changes in the value of the India VIX during the times of Satyam scam, Mumbai terror attack and the European Union and IMF announcement of massive package for Greece. . The time series data, India VIX is tested for the effect of autocorrelation. The data reveal the presence of autocorrelation indicating that there exists correlation between the values at different points in time. The regressed effect caused by the scrips on the India VIX is quite high, not considering the element of multi-collinearity. The test for multi-collinearity was carried out to provide a reliable estimate of the individual regression coefficient. The results show that only some scrips have an influence over the India VIX. India VIX has thus been a performance indicator and has been useful to gauge the volatility in the market. The significance of the India VIX will be of more prominence in the futures to come with the go-ahead signal given by the Securities and Exchange Board of India to introduce derivative contracts on Volatility Index (VI).

CHAPTER – 1

1. INTRODUCTION

1.1. BACKGROUND

1.1.1. OPTIONS:

Options are contracts that confer on the buyer of the contract certain rights (rights to buy or sell an asset) for a predetermined price on or before a pre-specified date. The buyer of the option has the right but not the obligation to exercise the option.

The exchange where most of the buying and selling of options contracts take place is called the **options market.** The most common way of trading options is through standardized options contracts. These are listed in various futures and options exchanges. The listing of the contracts and their respective prices is done using ticker symbols.

These exchanges publish the options prices continuously and create live options markets for options trading. Thus, the exchange offers the trading parties a platform to discover prices and execute transactions. These exchanges assume the role of intermediaries for buyers and sellers.

1.1.2. THE ROLE OF AN OPTION MARKET:

These exchanges ensure that the contract terms are backed by the credit of the exchange. They also safeguard the anonymity of the counterparties and enforce market regulations to ensure that the trades remain fair and transparent. During fast trading conditions, these exchanges ensure the maintenance of orderly markets.

1.1.3. OPTIONS MARKET AND OVER THE COUNTER OPTIONS:

In addition to exchange traded options, there are options that are not traded on any stock exchange. Such options are known as over-the-counter (OTC) options.

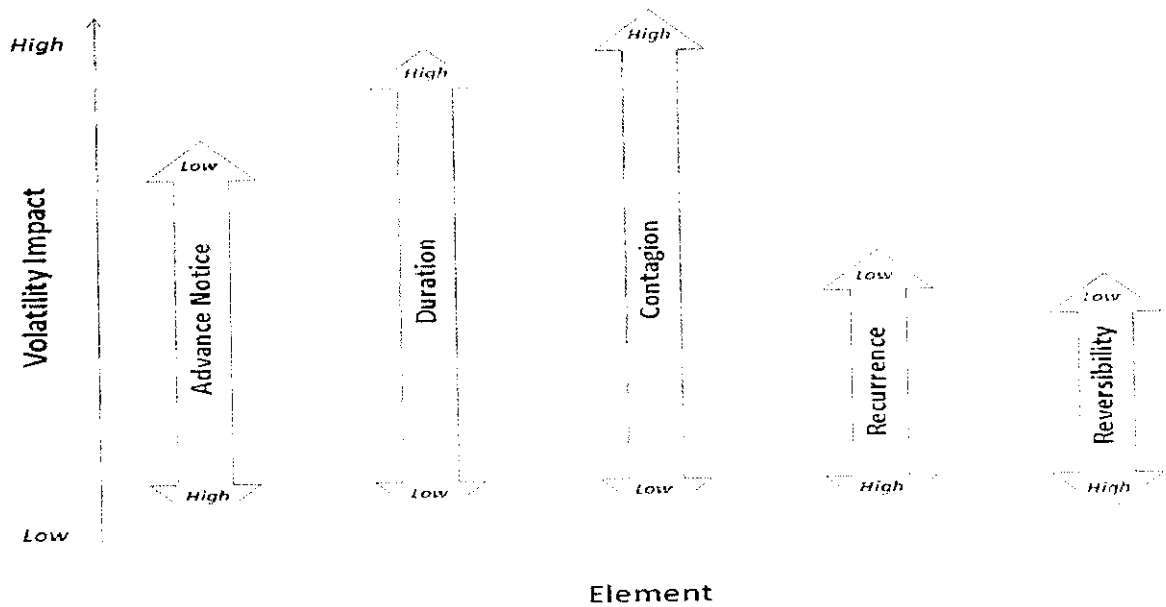
The OTC options contracts are agreed upon between two independent parties. Usually, one party is a well-capitalized institution.

Avoiding the exchanges enables traders of OTC options to tailor the terms of the trade. These transactions are not usually advertised in the market. They also face little regulatory requirements. Still, it is obligatory for the over-the-counter counterparties to establish credit lines and conform to clearing and settlement procedures.

1.1.4. VOLATILITY:

Volatility is the most basic statistical risk measure. Volatility is often described as the "rate and magnitude of changes in prices" and in finance often referred to as risk. Volatility of an asset is measured by the variability in the price over time measured as the variance or the standard deviation of the returns on the asset. The more the standard deviation the more volatile the asset is. This is also a measure of the riskiness of the asset since the more variation it has the more unpredictability associated with its returns.

1.1.5. A CONCEPTUAL FRAMEWORK FOR VOLATILITY EVENTS:



Source: *VIX and More* http://vixandmore.blogspot.com/2008/10/conceptual-

1.1.6. ORIGIN OF THE VOLATILITY INDEX:

The Chicago Board of Options Exchange (CBOE) was the first to introduce the volatility index for the US markets in 1993. The CBOE VIX is an implied volatility index that measures the market's expectation of 30-day S&P 500 index volatility implicit in the prices of near – term S&P 500 Index Options. The S&P 500 index is the primary U.S. stock market benchmark. Since its inception the CBOE VIX has become an indicator of how market practitioners think about volatility

1.1.7. HISTORY

Here is a timeline of some key events in the history of the VIX Index:

- 1993 - The VIX Index was introduced in a paper by Professor Robert E. Whaley now at Vanderbilt University
- 1993 - The VIX's lowest recorded value (between 1990 and 2008) of 9.31 occurred on Dec 22
- 2003 - Revised, more robust methodology for the VIX Index was introduced. The underlying index is changed from the CBOE S&P 100 Index (OEX) to the CBOE S&P 500 Index (SPX).
- 2004 - On March 26, 2004, the first-ever trading in futures on the VIX Index began on the CBOE Futures Exchange (CFE).
- 2006 - VIX options were launched in February 2006.
- 2008 - On October 24, 2008, the VIX reached an intraday high of 89.53.

Between 1990 and October 2008, the average value of VIX was 19.04.

In 2004 and 2006, VIX Futures and VIX Options were each named *Most Innovative Index Product* (respectively) at the Super Bowl of Indexing Conference.

1.1.8. VOLATILITY INDEX:

Volatility Index is a measure of market's expectation of volatility over the near term. Volatility Index is a measure, of the amount by which an underlying Index is expected to fluctuate, in the near term, (calculated as annualized volatility, denoted

Volatility Index is a good indicator of the investors' perception on how volatile markets are expected to be in the near term. Usually, during periods of market volatility, market moves steeply up or down and the volatility index tends to rise. As volatility subsides, option prices tend to decline, which in turn causes volatility index to decline.

1.1.9. VOLATILITY INDEX IN THE INDIAN CONTEXT:

VIX" is a trademark of Chicago Board Options Exchange, Incorporated ("CBOE") and Standard & Poor's has granted a license to NSE, with permission from CBOE, to use such mark in the name of the India VIX and for purposes relating to the India VIX.

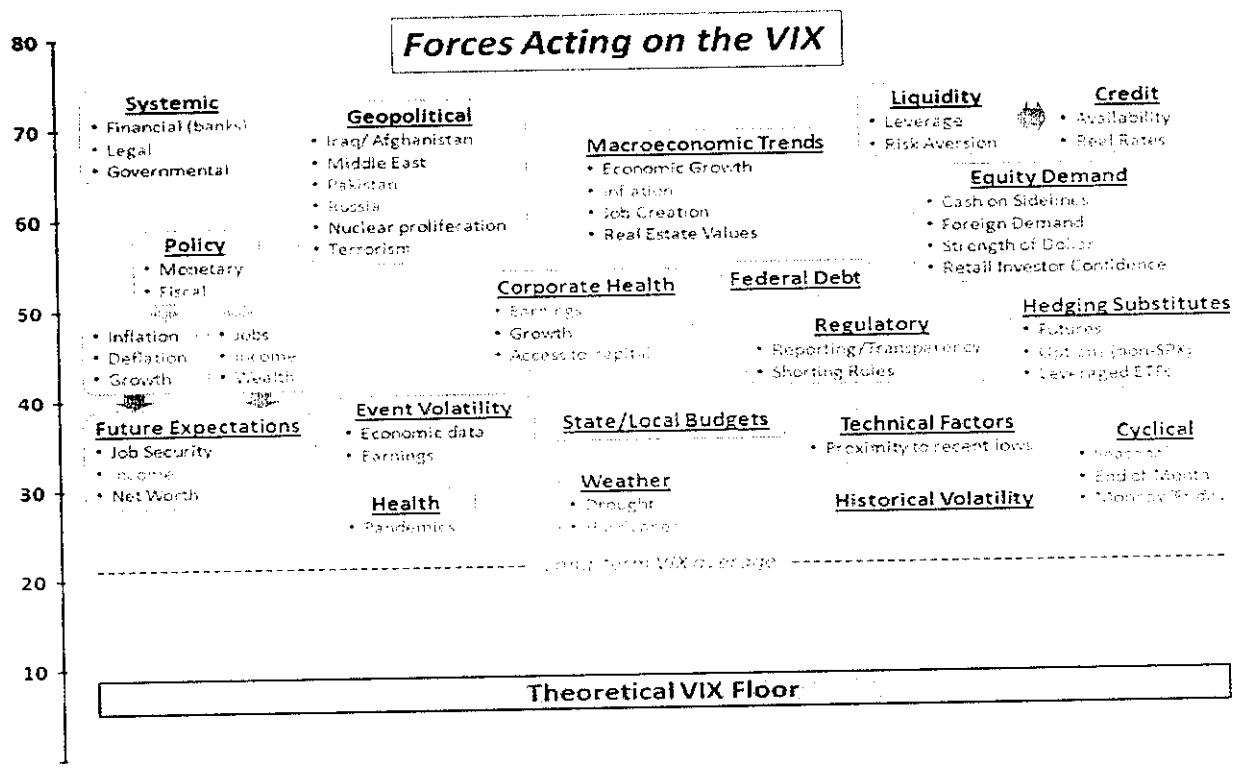
India VIX is a volatility index based on the Nifty 50 Index Option prices. From the best bid-ask prices of near term Nifty 50 Options contracts (which are traded on the F&O segment of NSE), a volatility figure (%) is calculated (detailed calculation methodology enclosed) which indicates the expected market volatility over the next 30 calendar days. Higher the implied volatility higher the India VIX value and vice versa. There are some differences between a price index, such as the Nifty 50 and India VIX. Nifty 50 is calculated based on the price movement of the underlying 50 stocks which comprises the index. India VIX is calculated based on the bid-offer prices of the near and mid month Nifty 50 Index Options. Nifty 50 Index is an absolute number, e.g. 4500, 5000 etc., whereas India VIX is a percentage value (eg. 20%, 30% etc.). Whereas Nifty 50 signifies how the markets have moved directionally, India VIX indicates the expected near term volatility and how the volatility is changing from time to time.

The implied volatility as captured by the volatility index is not about the size of the price swings, but rather the implied risks associated with the stock markets. When the market is range bound or has a mild upside bias, volatility is globally observed to be typically low. On such days, call option buying (a position taken on the view that the market will move higher) generally outnumbers put options buying

This kind of market may indicate lower risk. Conversely, when the selling activity increases significantly, anxiety among investors tends to rise. Investors rush to buy puts, which in turn pushes the price of these options higher. This increased amount investors are willing to pay for put options shows up in higher readings on the volatility index. High readings indicate a higher risk market place. Volatility index can also be used as a contrarian indicator. Various tradable products, such as futures and options contracts are available on the volatility index internationally.

The derivative contracts on Volatility Indices allow investors to trade 'volatility'. Volatility is one among the various factors that affect the options prices. Volatility index isolates expected volatility from other factors affecting options prices, such as changes in the underlying price, dividends, interest rates, time to expiration. As such the volatility index offers a way for investors to buy and sell option volatility directly, without having to deal with other risk factors that would have an impact on the value of an index option position.

1.1.10. FORCES ACTING ON THE VIX



1.1.11. USES OF VOLATILITY INDEX:

Volatility Index offers great advantages in terms of trading, hedging and introducing derivative products on this index. Investors can use volatility index for various purposes as mentioned below:

- Investors' portfolios are exposed to volatility of the market. Investors could hedge their portfolios against volatility with an off-setting position in India VIX futures or options contracts.
- Volatility index depicts the collective consensus of the market on the expected Volatility and being contrarian in nature helps in predicting the direction. Investors therefore could appropriately use this information for taking trading positions.
- Investors could also use the implied volatility information given by the index, in Identifying mis-priced options.
- Short sale positions could expose investors to directional risk. Derivatives on Volatility index could help investors in safeguarding their positions and thus avoid systemic risk for the market.
- Based on the experience gained with the benchmark broad based index, sector specific volatility indices could be constructed to enable hedging by investors in those specific sectors.
- India VIX is a premier barometer of investor consensus of market volatility expressed through option pricing.
- Investors use it to gauge the market volatility and base their investment decisions accordingly.

1.2. REVIEW OF LITERATURE

Sarkar et al[1] investigates volatility in Indian stock markets. Specifically, it looks for the possible volatility transmission channel for the Indian stock market from among Indian sectoral developments as well as developments in the global market. The SENSEX is used as the Indian market index and its response to overseas market indices such as Dow Jones, FTSE, BVSP, MerVal and JKSE is examined. The relationship between the SENSEX and domestic sectoral indices has also been examined. It has been found that the volatility in the developed market indices Granger causes SENSEX volatility, showing strong proof of a global contagion. SENSEX volatility is also related to some extent to the volatility of the Jakarta Stock index, hinting towards some kind of regional contagion. Moreover, as the impulse-response function shows, a shock in Dow Jones, the Jakarta stock index and BVSP has a profound effect on the SENSEX (Dow Jones having the most important one). As for sources from its domestic sectors, capital goods and consumer durables are the most prominent contributors to the volatility of the SENSEX.

S. V. Ramana Rao, Naliniprava Tripathy[2] in their study examined the impact of introduction of index futures derivative and index option derivative on Indian stock market by using ARCH and GARCH model to capture the time varying nature of volatility presence in the data period from October 1995 to July 2006. The results reported that the introduction of index futures and index options on the Nifty has produced no structural changes in the conditional volatility of Nifty but however the market efficiency has been improved after the introduction of the derivative roducts. The study concludes that financial derivative products are not responsible for increase or decrease in spot market volatility, but there could be other market factors which influenced the market volatility.

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[1] Indian stock market volatility in recent years: Transmission from global market, regional market and traditional domestic sectors. By: Sarkar, Amitava; Chakrabarti, Gagari; Sen, Chitrakalpa. Journal of Asset Management, Apr2009, Vol. 10 Issue 1, p63-71

[2] "Impact Of Index Derivatives On Indian Stock Market Volatility-An Application Of ARCH And GARCH Model" by S. V. Ramana Rao , Naliniprava Tripathy, Corporate Ownerrship éj ControC/VoCume 6, Issue 3,

Adrienne A. Kearney and Raymond E. Lombra[3] investigates the dynamic relationship linking the volatility of equity prices with "the news" and the expected path for monetary policy is investigated. Previous results that link the impact of the news about real activity to changes in current and future interest rates are employed in developing a positive link between changes in volatility and the news. Empirically, our results uncover a positive and statistically significant response of the CBOE volatility index, VIX, to unanticipated changes in employment, but not to inflation. Hence, agents' expectations for the policy response to news have an important influence on the expected volatility of stock prices. (JEL E44, E52).

Suchismita Bose[4] in her study examines the characteristics of return volatilities in the equity market and the index futures market in India. Volatility in the NSE Nifty index and that in its futures market are both seen to exhibit features of mean reversion, volatility clustering and a fair degree of volatility persistence, estimates of which give an idea of the impact and duration of a particular information shock to the market. The returns volatility is found to exhibit significant asymmetric response in times of market retreats and advances, with volatility arising in times of market decline being much sharper and more persistent. The study also provides evidence of volatility linkages between the spot and futures markets. Contemporaneous transmission effects across volatilities of the Indian (NSE) Stock and Index futures markets are tested on daily data, using an asymmetric (threshold) GARCH framework. These results have implications for understanding the pattern of information flows between the two markets. The results indicate that the futures market plays a leading role in assimilating information and thus moderating, though to a small extent, the spot market volatility.

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[3] Stock Market Volatility, The News, and Monetary Policy by Adrienne A. Kearney, Raymond E. Lombra, *JOURNAL OF ECONOMICS* 252 *AND FINANCE • Volume 28 • Number 2 • Summer 2004*

M. T. Raju, Anirban Ghosh[5] in their study reports that Volatility estimation is important for several reasons and for different people in the market. Pricing of securities is supposed to be dependent on volatility of each asset. In this paper we not only extend the study period of the earlier paper but also expand coverage in terms of number of countries and statistical techniques. Mature markets / Developed markets continue to provide over long period of time high return with low volatility. Amongst emerging markets except India and China, all other countries exhibited low returns (sometimes negative returns with high volatility). India with long history and China with short history, both provide as high a return as the US and the UK market could provide but the volatility in both countries is higher. The third and fourth order moments exhibit large asymmetry in some of the developed markets. Comparatively, Indian market show less of skewness and Kurtosis. Indian markets have started becoming informational more efficient. Contrary to the popular perception in the recent past, volatility has not gone up. Intraday volatility is also very much under control and has came down compared to past years.

Prabir Mohanty[6] explores the asymmetric nature of volatility in the Indian stock market by considering four broad based market indices, viz., Sensitive index, BSE 100, S&P CNX 500 and S&P CNX Nifty for the period April 1, 1995 through March 31, 2005. In particular, an attempt is made to make a comparison of the asymmetric class of volatility models vis-à- vis the symmetric GARCH model and concludes that Exponential GARCH (EGARCH) is empirically proved as the suitable model to explain the asymmetric behaviour of these indices. The study also traces the news impact curves (NIC) for these indices to decipher the nature of asymmetric volatility.

[5] Stock Market Volatility – An International Comparison by M. T. Raju, Anirban Ghosh, Working Paper Series No. 8, Securities and Exchange Board of India

Sanjay Sehgala and Vijayakumar[7] examined if the Black and Scholes model is a good descriptor of option pricing in the Indian context. We use data for Standard Poor CRISIL NSE Index 50 (S&P CNX Nifty index) options from 1st January, 2004 to 31st December, 2005. We operationalise the Black and Scholes model using two alternative measures of Historical volatility and Weighted implied volatility. Employing the historical volatility measure, we find that both call and put options are fairly priced in India subject to the trading asymmetry condition in the spot market. However, weighted implied volatility measure grossly underestimates option values resulting in large and positive pricing errors. Thus, option pricing in India seems to be conditionally efficient and historical volatility does a good job as a measure of true volatility of the underlying asset. Our work contributes to the options market literature for an emerging market and hence is pertinent for academicians, market practitioners and financial regulators.

Robert E.Whaley[8] has examined that in the recent weeks of market turmoil, financial news services have begun routinely reporting the level of the CBOE's Market Volatility Index or "VIX", for short. While this new practice is healthy in the sense that investors are asking for more information in helping to assess the state of the current economic environment and to guide through turbulent waters, it is important to understand exactly what the index means in order to fully capture its usefulness to the market and to avoid misunderstanding and misconception. The purpose of paper is to describe them and its history and purpose, and to explain how it fits within the array of indexes that help describe where the economy stands relative to other points in recent decades.

[7] Tests Of Pricing Efficiency Of The Indian Index Options Market by Sanjay Sehgala and Vijayakumar, International Journal Business and Society, Vol. 10 No. 1, 2009, 74 - 86

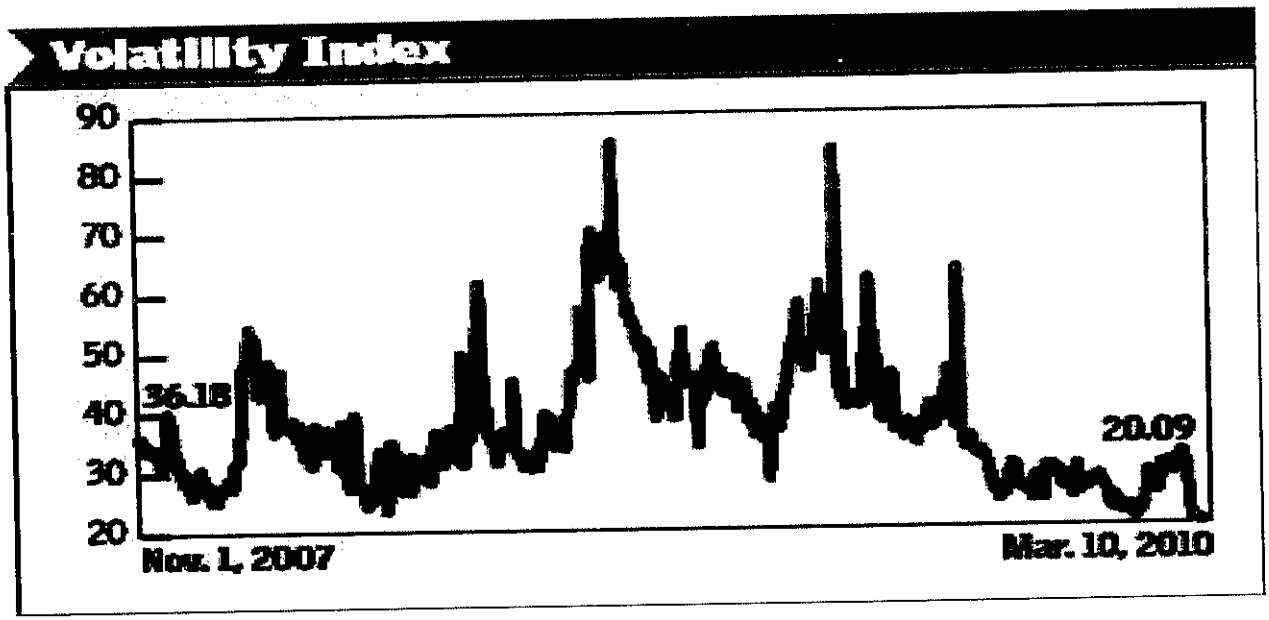
Eirini Konstantinidi and George Skiadopoulos[9] investigates whether volatility futures prices per se can be forecasted by studying the fast growing VIX futures market. To this end, alternative model specifications are employed. Point and interval out-of sample forecasts are constructed and evaluated under various statistical metrics. Next, the economic significance of the obtained forecasts is also assessed by performing trading strategies. Only weak evidence of statistically predictable patterns in the evolution of volatility futures prices is found. No trading strategy yields economically significant profits. Hence, the hypothesis that the VIX volatility futures market is informationally efficient cannot be rejected.

Zhongjin Lv Tsinghua University and Yingzi Zhu Tsinghua University[10] analyzed CBOE VIX futures price time series data from Mar. 2004 to Feb. 2008. We derive a new pricing framework for VIX futures that is convenient to study variance term structure dynamics. Our main contribution to existing literature is the identification of the number of factors implicit in VIX futures term structure. We find that three-factor model is ideal to characterize the variance term structure. We further construct and estimate structured two- and three-factor models to identify the components and find similar results.

[9] Are VIX futures prices predictable? An empirical investigation by Eirini Konstantinidi and George Skiadopoulos. SSRN Electronic copy available at: http://ssrn.com/abstract=1174102

1.3. STATEMENT OF THE PROBLEM

Chart.1.3.1. Movement of the Volatility Index during 2007-2010



The extensive financial literature present today revolves around the uncertainty of asset returns. Predicting the volatility has attracted much research attention since it's a direct function for pricing the risky asset. India volatility Index acronymed as India VIX is considered as a benchmark for forecasting the month-ahead stock market volatility. Many derivative products based on the India VIX are on the anvil. Of recent times, performance of India VIX is being closely monitored by the market participants. Hence a study to assess the performance and composition of India VIX is considered by the researcher as a research problem.

1.4. OBJECTIVES OF THE STUDY

Primary Objective:

- To empirically examine the volatility present in the India options equity market.

Secondary Objective:

- To study the composition of the India Volatility Index.
- To study the performance of the India Volatility Index.

1.5. NEED FOR THE STUDY

The study will be helpful in understanding the Indian stock market volatility during the global recession period since 2008. Through this study, the analyst shall understand the relative influence of one scrip over the other w.r.t. India VIX. The study will also be helpful in understanding the presence / absence of multi-collinearity among the India VIX scrips.

1.6. SCOPE OF THE STUDY

The study is confined to the Indian context with reference to National Stock Exchange and India options equity market.

1.7. RESEAECH METHODOLOGY

1.7.1. Type of study:

Analytical study refers to the statistical evaluation of a hypothesized cause-effect (causal) linkage. The study is considered to be analytical since it involves the application of statistical tools to explain the nature of certain relationships, establish the differences among groups and the impact of the independent variables over the dependent variables in a situation.

1.7.2. Source of Data Collection:

Data is raw fact, which provides information after processing is done. There are two types of data that can be used in a study.

Primary data: It is collected mainly through the questionnaire method and also the interview schedule method.

Secondary data: It is sourced from the second hand information like organization, websites, and books. The secondary sources used for the study include published records of National Stock Exchange and the published records of SEBI. The daily VIX values and the closing prices of the component scrips are used.

1.7.3. Period of study:

The study is carried out using the data considered for a period of 2 years from 01-04-2008 to 30-04-2010.

1.7.4. Tools for Analysis:

The following tools were used for the analysis of the data:

1.7.4.1. Summary Statistics:

In descriptive statistics, summary statistics are used to summarize a set of observations, in order to communicate the largest amount as simply as possible. Statisticians commonly try to describe the observations in

- A measure of location, or central tendency, such as the arithmetic mean, median, mode, or interquartile mean.
- A measure of statistical dispersion like the standard deviation, variance, range, or interquartile range, or absolute deviation.
- A measure of the shape of the distribution like skewness or kurtosis.

1.7.4.2. Test for Auto-Correlation:

The tests for autocorrelation are concerned with the dependence between numbers in a sequence. The test computes the autocorrelation between every m numbers (m is also known as the lag) starting with the ith number (i is also known as the index).

In statistics, the autocorrelation of a random process describes the correlation between values of the process at different points in time, as a function of the two times or of the time difference. Let X be some repeatable process, and i be some point in time after the start of that process. (i may be an integer for a discrete-time process or a real number for a continuous-time process.) Then X_i is the value (or realization) produced by a given run of the process at time i. Suppose that the process is further known to have defined values for mean μ_i and variance σ_i^2 for all times i.

The definition of the autocorrelation between any two time *s* and *t* is

$$R(s,t) = \frac{\mathrm{E}[(X_t - \mu_t)(X_s - \mu_s)]}{\sigma_t \sigma_s},$$

where "E" is the expected value operator. Note that this expression is not well-defined for all time series or processes, because the variance may be zero (for a constant process) or infinite. If the function *R* is well-defined, its value must lie in the range [−1, 1], with 1 indicating perfect correlation and −1 indicating perfect anti-correlation.

1.7.4.3. Step wise multiple Linear Regression Analysis using Ordinary Least Squares (OLS):

The regression is a statistical relationship between two or more variables. Regression analysis includes any techniques for modelling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. When there are two or more independent variables, the analysis that describes such a relationship is multiple regressions.

In multiple regressions, a linear composite of explanatory variables is formed in such a way that it has maximum correlation with an active criterion variable. The main objective of using this technique is to predict the variability of the dependent variable, based on its co-variance with all the independent variables. It is useful to predict the level of dependent phenomenon through multiple regression models, if the level of independent variables were given. The linear multiple regression problem is to estimate coefficients β_1, $\beta 2$,..... β_j, and β_0 such that the expression,

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + ... \beta_j x_k + e$$

provides a good estimate of an individual Y score based on the X scores. where;

- unknown parameters denoted as β;
- Independent variables, X.
- Dependent variable, *Y*.

Step-wise Multiple Regressions is used where the effect of more than one predictor against the criterion variable is to be assessed. In specific, Step-wise multiple regression is applied to know which among the set of predictors are the most important in explaining the variance of the dependent variable.

Ordinary least squares (OLS) is the simplest and thus very common estimator. It is conceptually simple and computationally straightforward. OLS estimates are commonly used to analyze both experimental and observational data. The OLS method minimizes the sum of squared residuals, and leads to a closed-form expression for the estimated value of the unknown parameter β:

1.7.4.4. Test for Multi-collinearity:

Multi-collinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. In this situation the coefficient estimates may change erratically in response to small changes in the model or the data. Multi-collinearity does not reduce the predictive power or reliability of the model as a whole; it only affects calculations regarding individual predictors. That is, a multiple regression model with correlated predictors can indicate how well the entire bundle of predictors predicts the outcome variable, but it may not give valid results about any individual predictor, or about which predictors are redundant with others.

We have perfect multi-collinearity if the correlation between two independent variables is equal to 1 or -1. In practice, we rarely face perfect multi-collinearity in a data set. More commonly, the issue of multi-collinearity arises when there is a high degree of correlation (either positive or negative) between two or more independent variables.

A formal detection-tolerance or the variance inflation factor (VIF) for multi-collinearity:

$$\text{tolerance} = 1 - R^2, \quad \text{VIF} = \frac{1}{\text{tolerance}}.$$

A tolerance of less than 0.20 or 0.10 and/or a VIF of 5 or 10 and above indicates a

1.8. LIMITATIONS

India VIX calculation assumes that the option prices are continuous. In US the difference between the consecutive options strike is 25 while in India it is 50, which is contrary to the continuous strike price assumption. Such factors lead to a calculated VIX value which may be biased due to illiquidity, low volumes and non continuous strike prices

The NSE VIX methodology mentions MIBOR as the risk free rate, however it does not mention the term duration of the MIBOR rate that needs to be used.

CHAPTER – 2

2. ORGANISATION PROFILE

2.1. HISTORY OF THE ORGANISATION:

Doha Brokerage & Financial Services Limited is the Global Brokerage Division for Doha Bank. From retail banking to banc assurance and wealth management products, Doha Bank offers a comprehensive range of financial services for different customer segments. In line with this vision and as a part of its global strategy, Doha Bank acquired stake in an Indian Brokerage namely Select Securities Ltd. in 2007 and renamed it as DBFS Ltd. Today, DBFS represents the brokerage division of Doha Bank across the globe.

Doha Brokerage & Financial Services Limited is a total wealth management solutions provider. DBFS with its subsidiaries and associates is engaged in brokerage and wealth management activities; presently in India and the Middle East. DBFS Ltd. the flagship company of the DBFS group had its origin in 1992 as one the first corporate brokerages in India. Departing from the traditional brokerage, the group pursues a total wealth management and investment centered approach. The group has a network of over 140 branches with presence in India, Dubai and Doha

2.2. MANAGEMENT:

EXECUTIVE MANAGEMENT:

Mr. R Seetharaman, Chairman CEO, Doha Bank

Mr. Prince George Managing Director & CEO

Mr. K V Samuel, Vice Chairman Nominee - Doha Bank

Mr. Binny C. Thomas Director- Dubai

Mr. Shekar M Director

Mr. Suresh Yezhuvath Director

2.3. GROUP COMPANIES:

Doha Brokerage & Financial Services Ltd.

Holding Company and umbrella brand carrier

DBFS Securities Ltd.

Brokerage and wealth management division

DBFS Derivatives & Commodities Ltd

Commodity brokerage

DBFS Commodities DMCC

Commodity and forex trading in the Middle East

DBFS Finance & Leasing (I) Ltd.

Non banking financial services

2.4. PRODUCT PROFILE AND MARKET POTENTIAL:

SERVICE OFFERINGS

Trading in Equities & Derivatives:

DBFS operates in both cash and derivative segments of NSE and BSE.

Commodities Futures Trading:

The group has membership in all premier commodity exchanges in India, namely NCDEX, NMCE and MCX.

Custodial / Depository Services:

DBFS is a Depository Participant with CDSL; the services include electronic holding of securities, Demat, Remat, pledge, unpledge etc.

Portfolio Management:

As a SEBI registered Portfolio Manager, DBFS has a highly professional, experienced and result-oriented research team which has been able to consistently out-perform the bench-mark indices.

Internet Trading - Equities, Derivatives & Commodities:

DBFS has a state-or-the-art internet trading platform with cutting-edge technological excellence.

Distribution of Mutual Funds & Insurance Products:

DBFS distributes Mutual Fund products of almost all major AMCs.

Commodities & Forex Trading:

As the trading member of DGCX, Dubai, DBFS Commodities DMCC offers trading in commodities and forex.

Non Banking Financial Services:

DBFS is set to provide non banking financial services including vehicle loans, home loans, consumer finance etc.

2.5. COMPETITIVE STRENGTH OF THE COMPANY

Research and Advisory:

The research team of the group has in-depth knowledge of the financial scenario and is pro-active and diligent in building and managing the financial assets of its customers.

Technology innovations:

Looking at quality and speedy services, the group has invested large amounts in acquiring latest cutting edge technologies for front end trading and back office processing.

Qualified, trained and motivated manpower:

The group has a talented pool of motivated professionals equipped with the necessary skill sets which translates into exemplary service for our customers.

Distribution network:

The group is having a network of over 160 branches spread across India and Middle East and is pursuing an aggressive expansion strategy.

CHAPTER – 3

3. MACRO-MICRO ANALYSIS

India, an emerging economy, has witnessed unprecedented levels of economic expansion, along with countries like China, Russia, Mexico and Brazil. India, being a cost effective and labor intensive economy, has benefited immensely from outsourcing of work from developed countries, and a strong manufacturing and export oriented industrial framework. With the economic pace picking up, global commodity prices have staged a comeback from their lows and global trade has also seen healthy growth over the last two years.

3.1. Economic Prospects for 2010

The global economy seems to be recovering after the recent economic shock. The Indian economy, however, was hit in the latter part of the global recession and the real economic growth witnessed a sharp fall, followed by lower exports, lower capital outflow and corporate restructuring. It is expected that the global economies will continue to sustain in the short-term, as the effect of stimulus programs is yet to bear fruit and tax cuts are working their way through the system in 2010. Due to the strong position of liquidity in the market, large corporations now have access to capital in the corporate credit markets.

3.2. India's financial market

India's financial market began its transformation path in the early 1990s. The banking sector witnessed sweeping changes, including the elimination of interest rate controls, reductions in reserve and liquidity requirements and an overhaul in priority sector lending. Persistent efforts by the Reserve Bank of India (RBI) to put in place effective supervision and prudential norms since then have lifted the country closer to global standards.

Around the same time, India's capital markets also began to stage extensive changes. The Securities and Exchange Board of India (SEBI) was established in 1992 with a mandate to protect investors and usher improvements into the microstructure of capital markets, while the repeal of the Controller of Capital Issues (CCI) in the same year removed the administrative controls over the pricing of new equity issues. India's financial markets also began to embrace technology. Competition in the markets increased with the establishment of the National Stock Exchange (NSE) in 1994, leading to a significant rise in the volume of transactions and to the emergence of new important instruments in financial intermediation.

3.3. India's capital markets

India's capital markets have experienced sweeping changes since the beginning of the last decade. Its market infrastructure has advanced while corporate governance has progressed faster than in many other emerging market economies. But in contrast to several developed countries and Asian economies, India's capital markets are still shallow, implying that further reforms are needed to make India a world-class financial centre. At nearly 40% of GDP, the size of India's government bond segment is comparable to many other emerging market economies. Its corporate bond market, however, remains small and is dwarfed by those of the United States, South Korea and Malaysia. India boasts a dynamic equity market.

The sharp rise in India's stock markets since 2003 reflects its improving macroeconomic fundamentals. However, the large size of insider holdings and the small presence of institutional investors belie these impressive figures. Innovative products such as securitized debt and fund products based on alternative assets are starting to break ground. But an enabling environment is not yet in place and there remains an overriding need to increase domestic investors' knowledge regarding the merits and risks of capital market investing. A vibrant, well-developed capital market has been shown to facilitate investment and economic growth. We believe that persistent reforms in the sector can support India's already impressive growth trend in the coming years.

The international capital market as it has been evolving provides an opportunity for developing countries like India to attract the required capital inflow for accelerating their pace of development, manage their foreign exchange assets and liabilities to their advantage and develop export capabilities in the field of financial services. Active participation in this market would not only improve their access to the market but also indicate the institutional and policy framework essential for developing effective and efficient domestic financial markets. The possibilities of such participation would be enhanced if the developing countries like India take a constructive stand with regard to the multilateral negotiations in respect of trade in services under the Uruguay Round.

3.3.1. Recent situation

Recent financial problems in emerging economies have led to calls for a new international financial architecture. Some of the problems are:

1. Inflation concerns are increasingly taking hold of the international capital markets; there are fears of a repetition of the 1970s, when industrialized countries endured double-digit rates of inflation.
2. Higher energy and food prices, rising wages in emerging markets and the weak US dollar which is driving up US import prices.
3. In emerging markets like India inflation is being driven above all by rising food prices.
4. In recent months oil has breached the 130 US dollar per barrel mark, and thus been a main driver of global inflationary pressure. Declining reserves in the oil producing countries, and low levels of investment and political problems could tighten the supply situation still further, countering any efforts to improve energy efficiency and further develop alternative energy sources. Production will not be able to keep pace with growing demand, especially from Asia. So the oil price is likely to remain high and continue rising in the long term."

5. Still it is believed that there may not be a recession in the USA, but a there may not be a quick recovery either. In the Euro zone we are likely to see a cooling-off of the economy in 2008 and 2009. Emerging markets should be able to decouple further from the US economy and consolidate their growth at a high level.

In the above conditions, International capital flows should not be restricted they benefit entrepreneurs and savers alike, with lower borrowing costs and greater returns. The international flow of capital improves risk management, allows consumption smoothing, improves financial-sector efficiency, and leads to greater overall market discipline. Furthermore, capital flows have a stabilizing effect on financial markets. Restricting international investment denies a country those benefits; the result is slower growth and reduced standards of living.

3.4. Higher volatility, improving performance

Benchmarking the risk/return characteristics of India's equity markets against the world average shows that India's stock market has historically been more volatile (chart 3.4.1), while its returns have, until recently, underperformed. This should not come as a surprise as the past decade witnessed several political and economic uncertainties, undermining business and investor confidence. Only from 2006 has India's stock market begun to outperform the world's index as momentum to liberalise the economy gathered pace and investors began to take notice (see chart 3.4.2).

Chart.3.4.1.Indian Equity Markets Have been Volatile

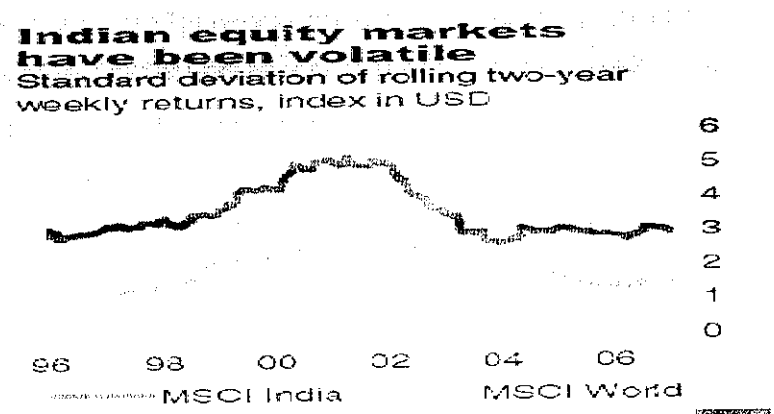
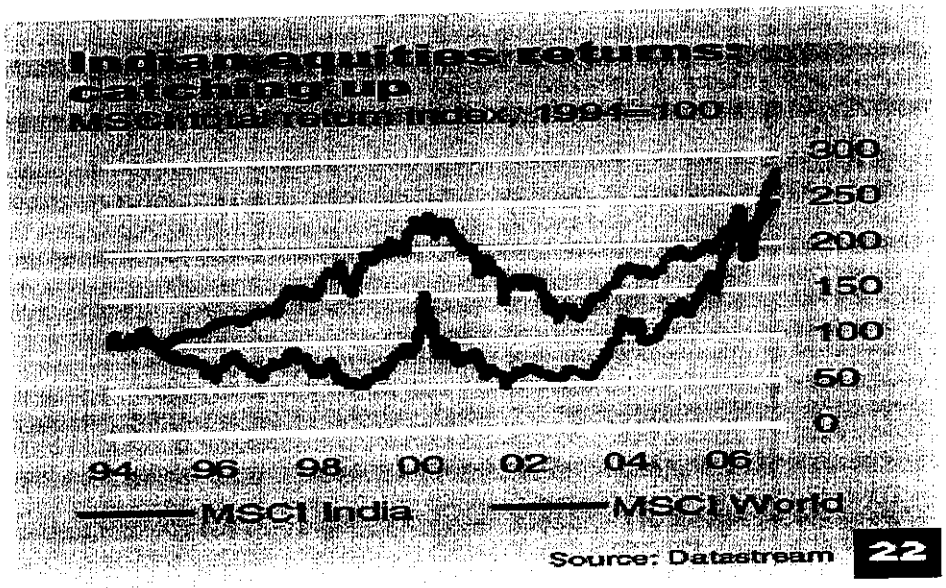
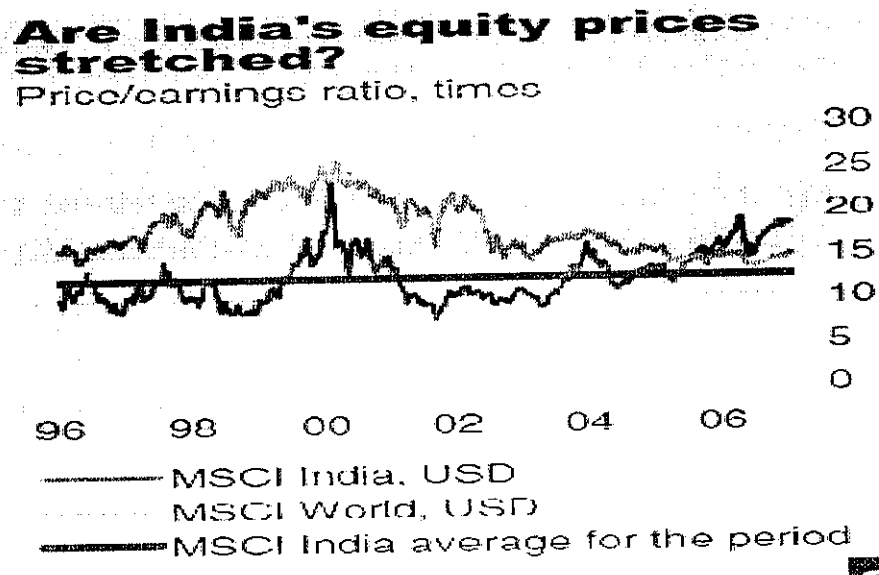


Chart.3.4.2.Indian Equities returns: catching up



Reflecting the recent sharp run-up in equity prices, India's stock markets today rank among the most expensive in the world (see chart 3.4.3), raising concerns over a correction, especially if earnings disappoint. However, sustained economic growth combined with continued market-friendly capital market reforms should prove to be supportive factors for superior returns in the medium run.

Chart.3.4.3. Are India's Equity prices stretched



3.5. Financial derivatives march ahead

While some form of financial derivatives trading in India dates back to the 1870s, exchange traded derivative instruments started only in 2000. Then, stock index futures, with the Sensex 30 and the S&P CNX Nifty indices as the underlying, began trading at the BSE and NSE. Since their inception, the basket of instruments has expanded and now features individual stock futures, and options for stock index and individual stocks.

Comparative Analysis – World Exchanges

Table3.5.1.Top 10 Derivatives Exchanges: Ranked by Number of Contracts traded and/or Cleared.

Rank	Exchange	2009	2008	% Change
1	Korea Exchange	3,102,891,777	2,865,482,319	8.30%
2	Eurex (includes ISE)	2,647,406,849	3,172,704,773	-16.60%
3	CME Group (includes CBOT and Nymex)	2,589,551,487	3,277,645,351	-21.00%
4	NYSE Euro next (includes all EU and US markets)	1,729,965,293	1,675,791,242	3.20%
5	Chicago Board Options Exchange (includes CFE)	1,135,920,178	1,194,516,467	-4.90%
6	BM&F Bovespa	920,377,678	741,889,113	24.10%
7	**National Stock Exchange of India**	**918,507,122**	**601,599,920**	**52.70%**
8	Nasdaq OMX Group (includes all EU and US markets)	814,639,771	722,107,905	12.80%
9	Russian Trading systems stock exchange	474,440,043	238,220,708	99.20%
10	Shanghai Futures Exchange	434,864,068	140,263,185	210.00%

[source: National Stock Exchange of India, Derivatives Update April 2010] * does not

Table3.5.2.Top 10 Equity Index: - A listing of the most actively traded futures and options contracts worldwide ranked by number of contracts traded

Rank	Contract	2009	2008	% Change
1	Kospi 200 Options, KRX	2,920,990,655	2,766,474,404	5.6%
2	E-mini S&P 500 Futures, CME	556,314,143	633,889,466	-12.2%
3	SPDR S&P 500 ETF Options*	347,697,659	321,454,795	8.2%
4	DJ Euro Stoxx 50 Futures, Eurex	333,407,299	432,298,342	-22.9%
5	**S&P CNX Nifty Options, NSE India**	**321,265,217**	**150,916,778**	**112.9%**
6	DJ Euro Stoxx 50 Options, Eurex	300,208,574	400,931,635	-25.1%
7	**S&P CNX Nifty Futures, NSE India**	**195,759,414**	**202,390,223**	**-3.3%**
8	S&P 500 Options, CBOE	154,869,646	179,019,155	-13.5%
9	RTS Index Futures, RTS	150,019,917	87,469,405	71.5%
10	Powershares QQQ ETF Options *	147,839,060	221,801,005	-33.3%

[source: National Stock Exchange of India, Derivatives Update April 2010]

**Traded on multiple U.S. options exchanges*

3.6. Futures & Options Segment - NSE

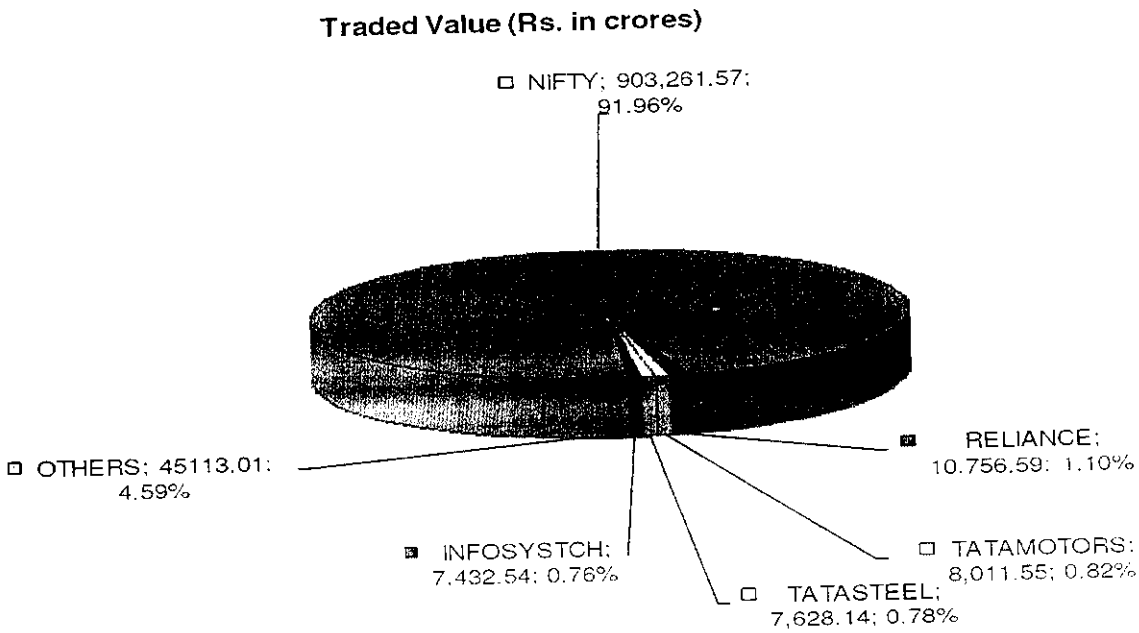
The National Stock Exchange of India Limited (NSE) commenced trading in derivatives with the launch of index futures on June 12, 2000. The futures contracts are based on the popular benchmark S&P CNX Nifty Index.

The Exchange introduced trading in Index Options (also based on Nifty) on June 4, 2001. NSE also became the first exchange to launch trading in options on individual securities from July 2, 2001. Futures on individual securities were introduced on November 9, 2001. Futures and Options on individual securities are available on 196 securities stipulated by SEBI.

The Exchange has also introduced trading in Futures and Options contracts based on CNX-IT, BANK NIFTY, and NIFTY MIDCAP 50 indices.

3.7. OPTIONS SEGMENT (April 2010)

Chart: 3.7.1. Top 5 Traded Symbols



[source: National Stock Exchange of India, Derivatives Update April 2010]

Table: 3.7.2. Top 5 most active Options contracts

Sr. No.	Contract Descriptor	No. of Contracts	Traded Value (Rs. In crs)	Percentage of contracts to total contracts
1	NIFTY APRIL CE 5300	5,042,905	134,915.59	14.00
2	NIFTY APRIL PE 5300	4,777,544	128,108.58	13.26
3	NIFTY APRIL PE 5200	4,501,444	117,762.02	12.49
4	NIFTY APRIL CE 5400	3,951,116	107,295.62	10.97
5	NIFTY APRIL CE 5200	2,246,665	59,351.74	6.24
	OTHERS	15,506,533	434,769.59	43.04
	TOTAL	36,026,207	982,203.14	100.00

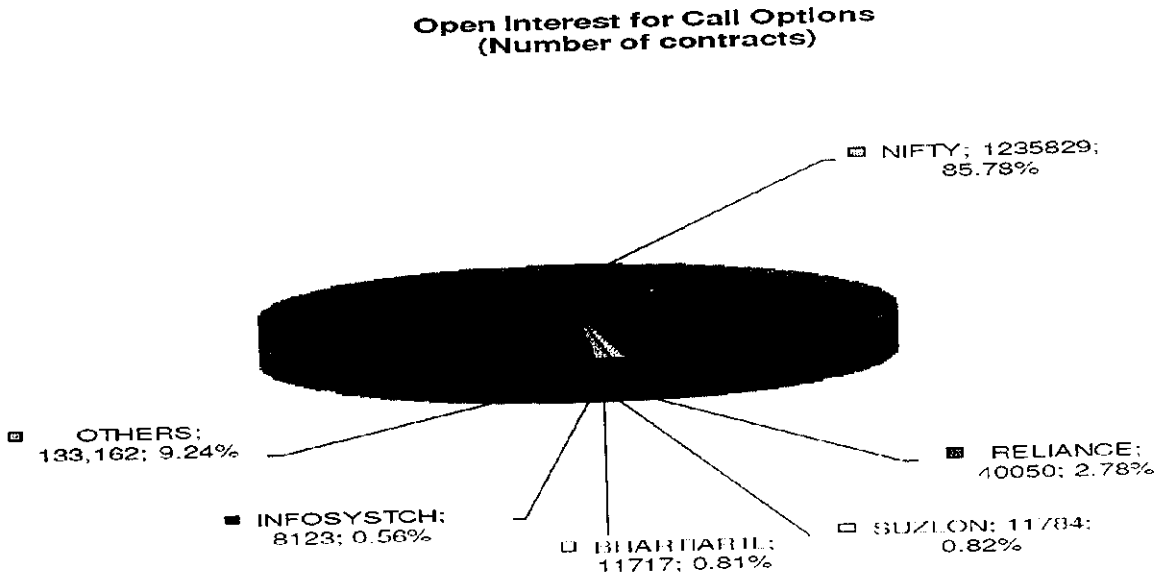
[source: National Stock Exchange of India, Derivatives Update April 2010]

Table: 3.7.3. Option Exercises – Analysis (Contract Month April 2010)

Underlying	Option Type		Total No. of contracts exercised	% to Total
	Call	Put		
Nifty(NIFTY/MINIFTY)	45394	60646	106040	66.64%
Other Indices	2823	53	2876	1.81%
Stocks	27582	22620	50202	31.55%
Total	75799	83319	159118	100%

[source: National Stock Exchange of India, Derivatives Update April 2010]

Chart: 3.7.4. Top 5 Symbols by Open Interest (number of contracts on April 29th, 2010) – CALL OPTIONS



[Source: National Stock Exchange of India, Derivatives Update April 2010]

Chart: 3.7.5. Top 5 Symbols by Open Interest (number of contracts on April 29th, 2010) – PUT OPTIONS

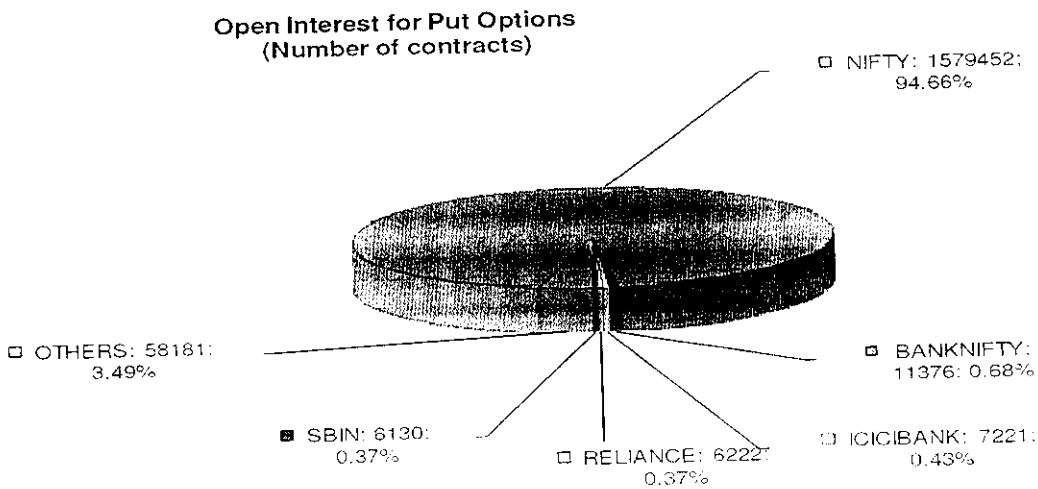


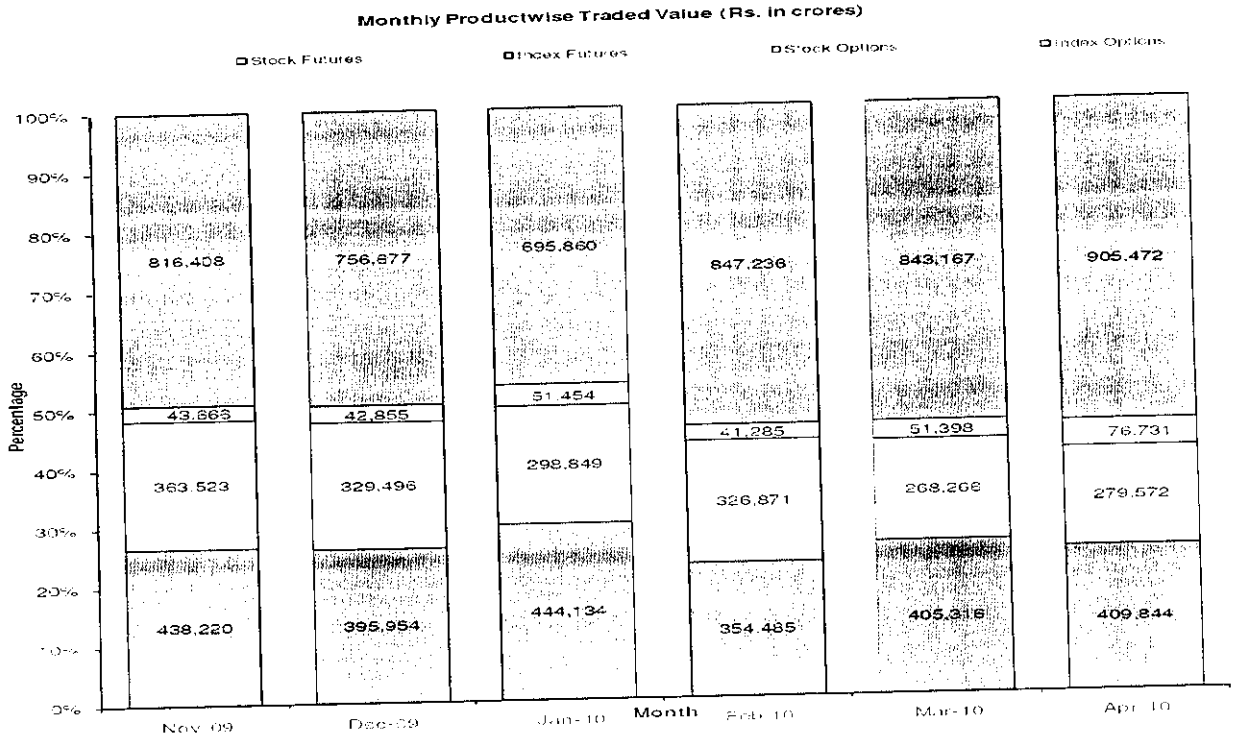
Table: 3.7.6. Records Achieved in the F&O Segment

Product	Traded Value	(Rs. in crores) Date
ndex Futures	36,745	27-Jan-10
Stock Futures	71,195	1-Nov-07
ndex Options	86,733	22-Apr-10
Stock Options	5,777	22-Apr-10
Total F&O Traded Value	1,66,193	28-Jan-10
Open Interest on Contract Expiry (number of contracts)	5089466	29-Apr-10

[Source: National Stock Exchange of India, Derivatives Update April 2010]

Chart: 3.7.7. Month wise Product wise Traded Value Analysis

A graphical representation of the month wise product wise turnover in the F&O Segment for the period November 2009 to April 2010 is as below:



.8. VOLATILITY INDEX:

The volatility index will increase the understanding among people. Once that appens, we will be ready to launch products based on it.

C.B Bhave, Chairman of SEBI

In India, VIX was launched in April, 2008 by National stock exchange (NSE). The VIX index of India is based on the Nifty 50 Index Option prices. The methodology of calculating the VIX index is same as that for CBOE VIX index. The current focus on the VIX is due to its inherent property of negative correlation with the underlying price index, and its usefulness for predicting the direction of the price index.

3.9. Volatility Trading

VIX options are an excellent tool for traders who want to take a position on expected implied volatility. Just like traditional stock options, they can be traded during normal stock market hours through a securities broker. The features of volatility trading are that they are non directional in nature, and that the view taken by a trader is that of whether the underlying asset will be more volatile in the future or not. The traditional way to implement such a view without incurring directional risks would be to use non-vanilla options like straddles, strangles or through variance swaps. However, with the introduction of VIX derivatives, such views can be simply implemented, with the advantage of having a standardized implied volatility calculation. Furthermore, such index based VIX derivatives, would enable implementation of complex strategies like volatility arbitrage. However, in India, the trading on VIX is not allowed as of now and the VIX is used just to gauge volatility in the market.

3.10. PERFORMANCE OF THE INDIA VIX:

3.10.1. Satyam, Fraud, and the India VIX, Wednesday, January 7, 2009

The announcement that Satyam (SAY), the Indian outsourcing giant, has been engaged in a massive accounting fraud over the course of several years sent Satyam down 78% in local trading and dragged the Bombay Sensex down 7.3%. There was a relatively small spike in the India VIX, which jumped 14.5% to close at 44.36.

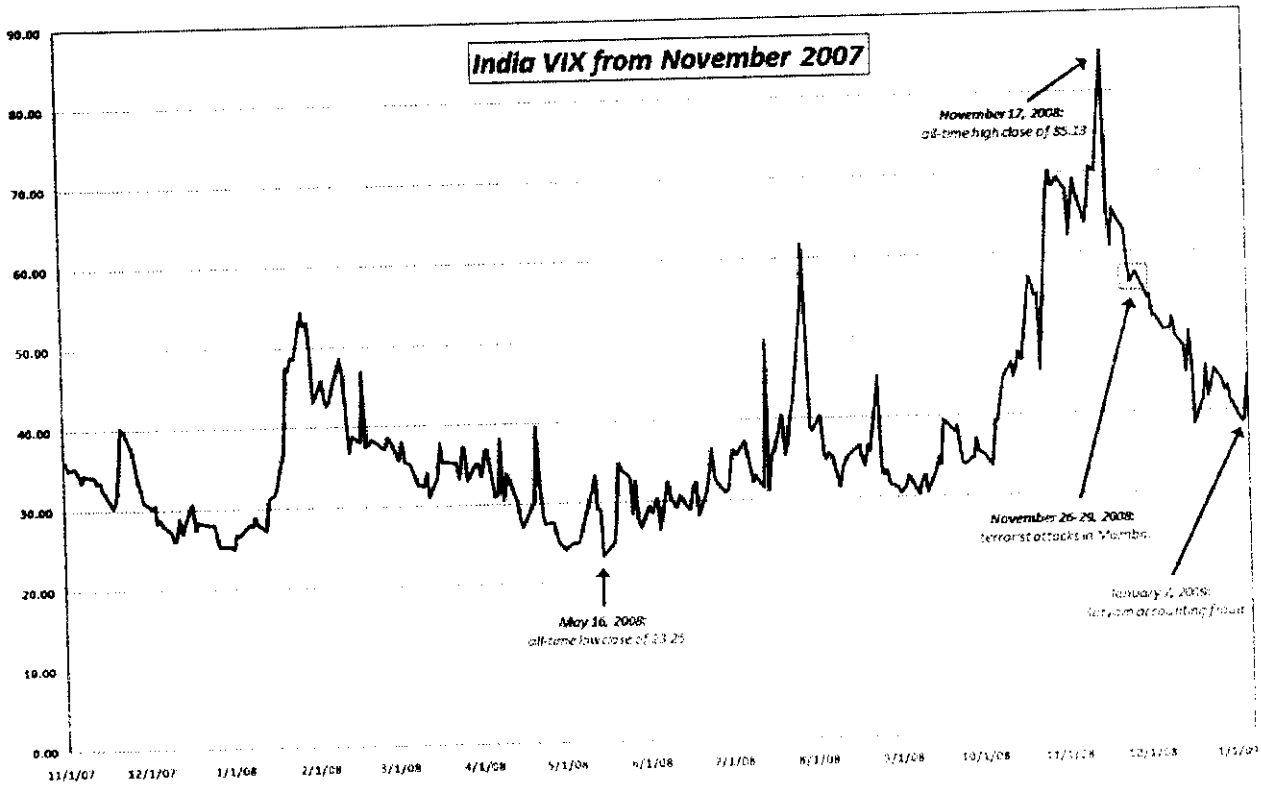
The chart below shows the course of the India VIX since November 2007 (the index launched in April 2008, but historical data has been reconstructed extending back another six months.) It is interesting to know that the scale of the India VIX is not that much different than that of its U.S. counterpart. It shows that the global financial crisis in October 2008 was responsible for the peak in the volatility index, while the Mumbai terrorist attacks the following month barely register as a blip on the chart.

VIX has dropped to 19-20% — the lowest since it was launched in April 2008 (data is available since November 2007) from 26-27%, post Union Budget on February 26. The India VIX fell below 20 last Friday to 19.73 on Friday, its lowest since inception.

VIX and the prices of underlying financial assets move in opposite directions. The lower prices that traders pay to buy protection against volatility using NSE's Nifty options get reflected in lower VIX levels, which at this point of time suggest traders may be getting complacent.

India's VIX rose to its highest of 85.13 in November 2008, after the global financial crisis that triggered the Lehman bankruptcy and precipitated the slide in equity markets world-wide.

Chart: 3.10.1.1.Course of the India VIX since November 2007



[source: National Stock Exchange of India, VIX and More]

http://vixandmore.blogspot.com/2009/01/satyam-fraud-and-india-vix.html

Chart: 3.10.2. NIFTY INDEX VALUE (01-04-2008 TO 30-04-2010)

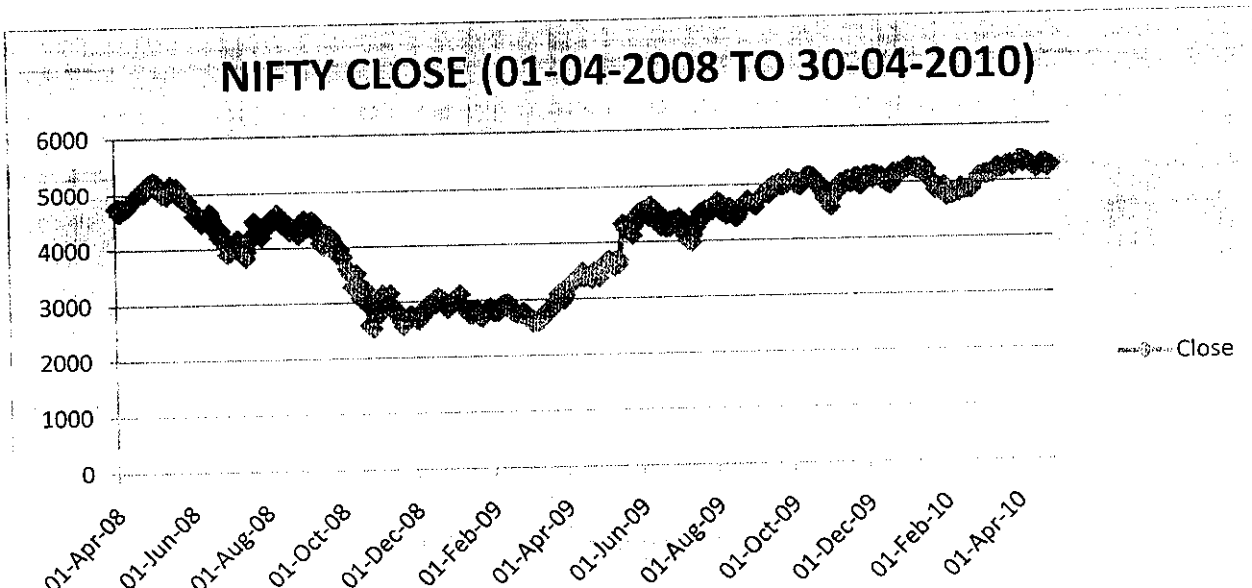
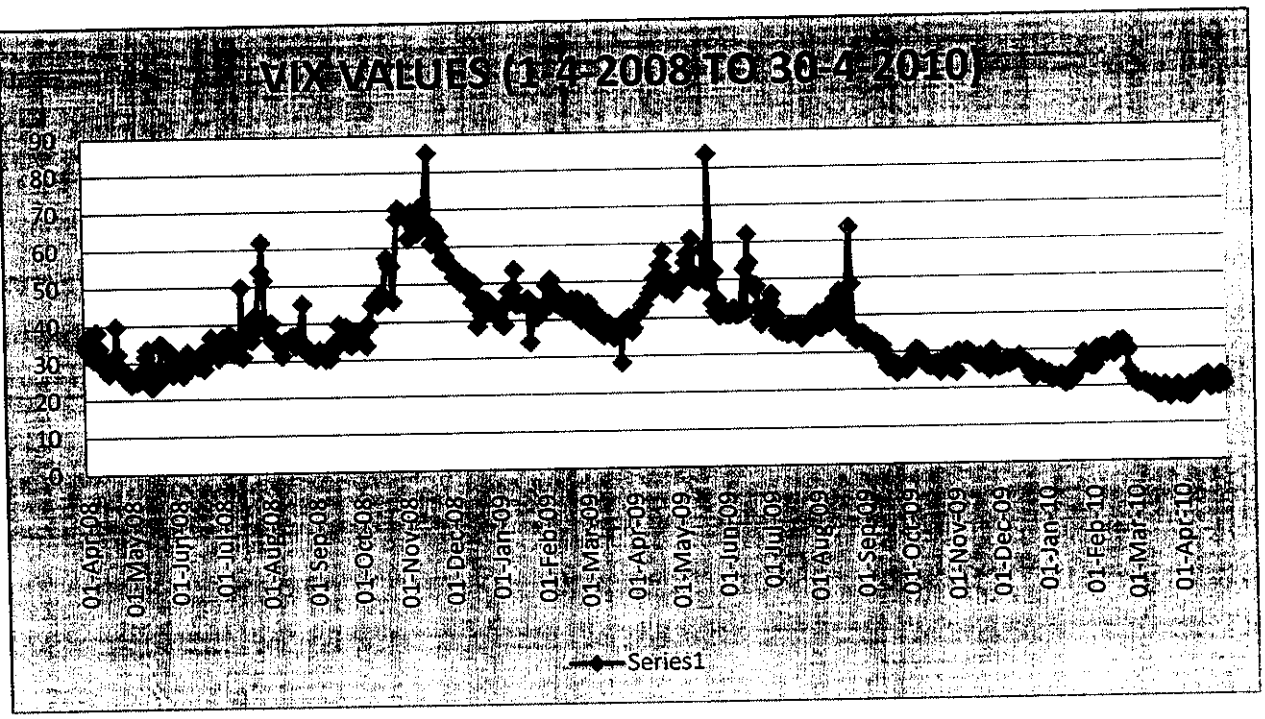


Chart: 3.10.3. VIX VALUES (01-04-2008 TO 30-04-2010)



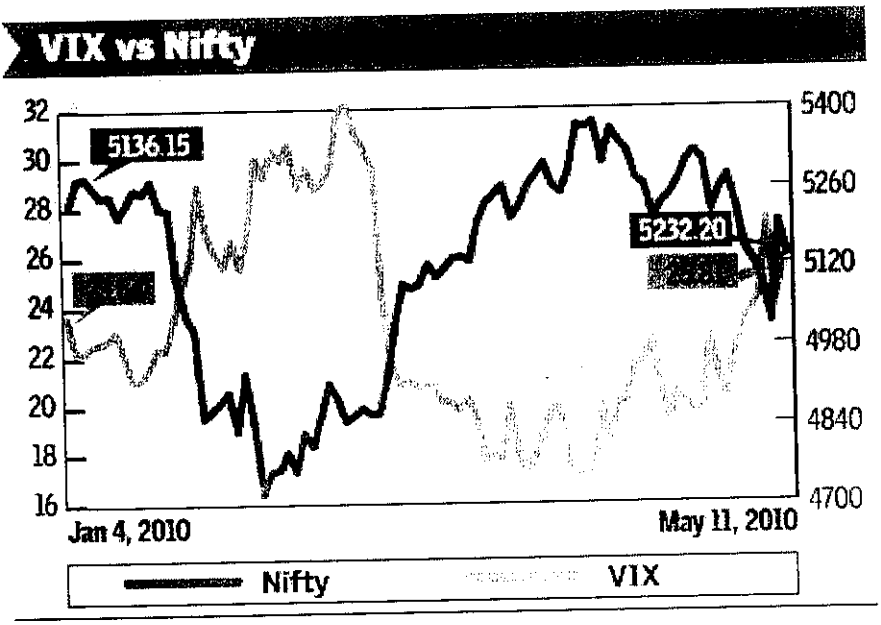
3.10.4. Business Daily from THE HINDU group of publications, Wednesday, Apr 28, 2010

Securities and Exchange Board of India on Tuesday gave a go-ahead to the stock exchanges to introduce derivative contracts on Volatility Index (VI). The exchanges before introducing such contracts have been directed to submit contract specifications, the economic purpose it is intended to serve, details of settlement procedures and systems along with other related details. Exchanges have to also submit details of back testing of the margin calculation for a period of one year.

3.10.5. Business Daily from THE HINDU group of publications Wednesday, May 12, 2010

Watch out, volatility index is on the rise

Chart: 3.10.5.1. Movement of VIX vs. Nifty



India VIX or volatility index has been rising since start of May and currently ruling near its three-month high level. This clearly reflects the nervousness and fear among traders. NSE's volatility index captures the expected movement - upside or downside - of the underlying index over the near term.

The volatility index snapped its six-day rally after the European Union and IMF announced massive package for Greece.

But it again resumed the climb on Tuesday to close 25.81 against the previous day's close of 24.14.

The India VIX has hit a all-time low of 8.7 in May 2008, during intra-day trading. On a closing day basis, the low was 17.05, recorded on March 25. The fear gauge touched a high of 92.53 on November 14, 2008, when the bear market was at

3.11. The road ahead

India's regulators have been active in seeking ways to develop the country's financial markets, and a culture of introducing greater risk management is starting to set in. The main challenge ahead is to strengthen the political will to further ease regulations in the capital markets and the limits prescribed to market participants.

India's economy is expected to benefit enormously from the process of gradual capital market liberalisation. Empirical evidence has shown that emerging market economies that have heralded changes in their financial markets experienced higher growth and investment. India is no exception, with per-capita GDP and domestic investment rising post-liberalisation. Economies which pursued deeper financial market reforms, and whose per-capita incomes were roughly similar to India's prior to their liberalisation periods, not surprisingly experienced even greater rewards. Drawing from these countries' experiences, India's growth potential can experience a sustained pick-up if it stays on the path of reforming its capital markets.

CHAPTER – 4 DATA ANALYSIS & INTERPRETATION

CHAPTER – 4

4. DATA ANALYSIS & INTERPRETATION

4.1. India VIX calculation methodology

India VIX is calculated using the methodology adopted by CBOE currently for computing VIX on S&P 500 options. This method does not use any option pricing model such as Black and Scholes to calculate the VIX. Simply put, it derives the implied or expected volatility from the near and mid month options bid and offer prices of the Nifty 50 index options. From the options bid and offer prices an indicator can be derived as to what is the volatility the investors are expecting in the market. This volatility figure, denoted in percentage, is the India VIX value. The actual computation methodology is given below.

India VIX Computation methodology:

The generalized formula used in the VIX calculation[§] is:

$$\sigma^2 = \frac{2}{T}\sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T}\left[\frac{F}{K_0} - 1\right]^2 \qquad (1)$$

WHERE...

σ is	$VIX/100 \Rightarrow \text{VIX} = \sigma \times 100$
T	Time to expiration
F	Forward index level derived from index option prices
K_0	First strike below the forward index level, F
K_i	Strike price of i^{th} out-of-the-money option; a call if $K_i > K_0$ and a put if $K_i < K_0$; both put and call if $K_i = K_0$.
ΔK_i	Interval between strike prices – half the difference between the strike on either side of K_i: $\Delta K_i = \frac{K_{i+1} - K_{i-1}}{2}$ (*Note*: ΔK for the lowest strike is simply the difference between the lowest strike and the next higher strike. Likewise, ΔK for the highest strike is the difference between the highest strike and the next lower strike.)
R	Risk-free interest rate to expiration
$Q(K_i)$	The midpoint of the bid-ask spread for each option with strike K_i.

The INDIA VIX generally uses put and call options in the two nearest-month expiration in order to bracket a 30-day calendar period. However, with 8 days left to expiry, the INDIA VIX "rolls" to the mid and far month. The options used in this hypothetical example have 14 days and 42 days to expiration, respectively.

The INDIA VIX calculation measures the time to expiration, T, in minutes rather than days.
The time to expiration is given by the following expression:

T = {MCurrent day + MSettlement day + MOther days}/ Minutes in a year
Where,
MCurrent day = Number of minutes remaining until midnight of the current day
MSettlement day = Number of minutes from midnight until 3:30 p.m. on expiry day
MOther days = Total number of minutes in the days between current day and expiry day

Time to expiration for the near month and next month options, T1 and T2, respectively, is:
T1 = {510 + 930 + 18720) / 525,600 = **0.038356**
T2 = {510+ 930 + 59040) / 525,600 = **0.115068**
The NSE mibor rate is being considered as risk-free interest rate.

2. Computation of forward index level, F

For **Near** contract month:
a) Determine the forward index level, F, based on at-the-money option prices. The at-the money strike is the strike price at which the difference between the call and put prices is smallest. As shown in the following table, the difference between the call and put prices is smallest at the **5950** strike in both the near and next month.

b) The formula used to calculate the forward index level is:

F = Strike Price + eRT (Call Price – Put Price)

Near month options							
	CALL			PUT			
Nifty 50 strike	Bid	Ask	Mid Call Price	Bid	Ask	Mid Put price	Difference
5600	365.15	376.00	370.58	65.00	98.00	81.50	289.08
5650	328.00	345.00	336.50	66.25	73.00	69.63	266.88
5700	290.00	298.00	294.00	75.00	90.00	82.50	211.50
5750	216.20	290.00	253.10	83.00	99.90	91.45	161.65
5800	225.00	309.80	267.40	93.00	102.00	97.50	169.90
5850	193.55	209.35	201.45	124.00	137.95	130.98	70.48
5900	196.00	206.00	201.00	142.00	154.00	148.00	53.00
5950	**138.00**	**148.00**	**143.00**	**153.10**	**189.95**	**171.53**	**28.53**
6000	135.00	150.00	142.50	190.00	252.20	221.10	78.60
6050	120.00	131.90	125.95	200.00	296.95	248.48	122.53
6100	94.00	105.00	99.50	240.00	270.00	255.00	155.50
6150	70.00	72.00	71.00	223.00	396.00	309.50	238.50
6200	55.00	60.00	57.50	306.15	375.00	340.58	283.08

Using the 5950 call and put mid prices, the forward index prices, F1 for the near month options, respectively, are:

F1 = 5950 + e(0.0781 * 0.038356) (143.00-171.53) = **5921.39**

3. Computation of K0

Determine **K**0 - the strike price immediately below the forward index level,

F1 = 5921.39.

In this example, **K**0 **= 5900** for near month expiry

4. Selection of options to be used in the calculation*:

a) Sort all of the options in ascending order by strike price. Select call options that have strike prices greater than K0 and a **non-zero** bid price. After encountering two Consecutive calls with a bid price of zero, do not select any other calls.

b) Next, select put options that have strike prices less than K0 and a **non-zero** bid price. After encountering two consecutive puts with a bid price of zero, do not select any other put. In the example:

Near Month Options			
Nifty 50 strike	Mid Call price	Mid Put price	Q(K)
5600		81.50	81.50
5650		69.63	69.63
5700		82.50	82.50
5750		91.45	91.45
5800		97.50	97.50
5850		130.98	130.98
5900	201.00	148.00	174.50
5950	143.00		143.00
6000	142.50		142.50
6050	125.95		125.95
6100	99.50		99.50
6150	71.00		71.00
6200	57.50		57.50

c) Select **both** the put and call with strike price K0.Then average the quoted bid-ask prices for each option. Notice that two options are selected at K0, while a single option, either a put or a call, is used for every other strike price. This is done to centre the strip of options on K0. In order to avoid double counting, however, the put and call prices at K0 are averaged to arrive at a single value.

The price used for the 5900 strike in the near term is, therefore, (201 + 148)/2 = 174.50

Repeat step 2 to 4 for next month

Repeat step 2 to 4 for next month

The options selected for the next month are,

Next month options							
	CALL			PUT			
Nifty 50 strike	Bid	Ask	Mid Call price	Bid	Ask	Mid Put price	Difference
5700	375.00	578.90	476.95	191.20	212.90	202.05	274.90
5750	321.10	486.55	403.83	100.00	170.00	135.00	268.83
5800	310.15	351.00	330.58	226.20	255.00	240.60	89.98
5850	254.70	491.95	373.33	172.60	261.00	216.80	156.53
5900	271.00	286.75	278.88	225.05	290.00	257.53	21.35
5950	207.75	442.00	324.88	210.00	230.00	220.00	104.88
6000	225.30	231.90	228.60	309.00	370.00	339.50	110.90
6050	180.50	268.65	224.58	220.00	242.00	231.00	6.43
6100	177.00	190.00	183.50	268.20	742.00	505.10	321.60
6150	130.00	221.40	175.70	285.00	806.00	545.50	369.80
6200	145.30	153.50	149.40	311.10	699.50	505.30	355.90

F2 = 6050 + e(0.0823 * 0.115068) * (224.58 – 231.00) = 6043.51

K0 = 6000

Eligible strike for computation of mid month volatility are,

Next Month Options			
Nifty 50 strike	Mid Call price	Mid Put price	Q(K)
5700		202.05	202.05
5750		135.00	135.00
5800		240.60	240.60
5850		216.80	216.80
5900		257.53	257.53
5950		220.00	220.00
6000	228.60	339.50	284.05
6050	224.58		224.58
6100	183.50		183.50
6150	175.70		175.70

Calculate volatility for both near month and next month options

Applying the formula for calculating the INDIA VIX to the near month and next month options with time to expiration of T1 and T2, respectively.

$$\sigma^2_1 = \frac{2}{T_1}\sum_i \frac{\Delta K_i}{K_i^2} e^{RT_1} Q(K_i) - \frac{1}{T_1}\left[\frac{F_1}{K_0} - 1\right]^2$$

$$\sigma^2_2 = \frac{2}{T_2}\sum_i \frac{\Delta K_i}{K_i^2} e^{RT_2} Q(K_i) - \frac{1}{T_2}\left[\frac{F_2}{K_0} - 1\right]^2$$

The INDIA VIX is an amalgam of the information reflected in the prices of all of the options used. The contribution of a single option to the INDIA VIX value is proportional to the price of that option and inversely proportional to the option's strike price. For example, the contribution of the near month 5600 Put is given by

$$\frac{\Delta K_{5600\ PUT}}{K^2_{5600\ PUT}} e^{RT} Q(5600\ PUT)$$

Generally,□ Ki is half the distance between the strike on either side of Ki, but at the upper and lower edges of any given strip of options, □Ki is simply the difference between Ki and the adjacent strike price. In this case, 5600 is the lowest strike in the strip of near month options and 5650 happens to be the adjacent strike. Therefore, □ K5600 PUT = 50 (i.e.5650 – 5600), and

$$\frac{\Delta K_{5600\ PUT}}{K^2_{5600\ PUT}} e^{RT} Q(5600\ PUT) = \frac{50}{5600^2} * e^{(0.0781 * 0.038356)} * (81.5) = 0.000130$$

A similar calculation is performed for each option. The resulting values for the near month options are then summed and multiplied by 2/T1. The table below summarizes the results for each strike of options.

Near month Nifty 50 Strike	Option Type	Mid-quote Price	Contribution by strike
5600	Put	81.50	0.000130
5650	Put	69.63	0.000109
5700	Put	82.50	0.000127
5750	Put	91.45	0.000139
5800	Put	97.50	0.000145
5850	Put	130.98	0.000192
5900	Put Average	174.50	0.000251
5950	Call	143.00	0.000203
6000	Call	142.50	0.000199
6050	Call	125.95	0.000173
6100	Call	99.50	0.000134
6150	Call	71.00	0.000094
6200	Call	57.50	0.000075
$\sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i)$			0.001971

We compute the volatility for the near month as,

$$\sigma^2_1 = \frac{2}{T_1} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T_1} \left[\frac{F_1}{K_0} - 1 \right]^2$$

$$\sigma_1^2 = 0.001971 * 21.038356 - 0.000343 = 0.1024$$

Similarly we get for next month,

Next month Nifty 50 strike	Option Type	Mid-quote Price	Contribution by strike
5700	Put	202.05	0.000314
5750	Put	135.00	0.000206
5800	Put	240.60	0.000361
5850	Put	216.80	0.000320
5900	Put	257.53	0.000373
5950	Put	220.00	0.000314
[illegible]	[illegible] Put Average	[illegible]	[illegible]
6050	Call	224.58	0.000310
6100	Call	183.50	0.000249
6150	Call	175.70	0.000234
6200	Call	149.40	0.000196
$\sum \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i)$			0.003275

$$\sigma^2_2 = \frac{2}{T_2} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT_2} Q(K_i) - \frac{1}{T_2}\left[\frac{F_2}{K_0} - 1\right]^2$$

$$\sigma_2^2 = 0.0564$$

***Step 3** – Interpolate*

σ_1 *and* σ_2 to arrive at a single value with a constant maturity of 30 days to expiration. Then take the square root of that value and multiply by 100 to get INDIA VIX.

$$\sigma = \sqrt{\left\{T_1\sigma_1^2\left[\frac{N_{T_2} - N_{30}}{N_{T_2} - N_{T_1}}\right] + T_2\sigma_2^2\left[\frac{N_{30} - N_{T_1}}{N_{T_2} - N_{T_1}}\right]\right\} \times \frac{N_{365}}{N_{30}}}$$

Where,

NT1 = number of minutes to expiration of the near month options

NT2 = number of minutes to expiration of the next month options

N30 = number of minutes in 30 days

N365 = number of minutes in a 365-day year

$\sigma = 0.2561$

INDIA VIX = 100 * σ = 25.61

INDIA VIX = 100 X σ = 25.61

4.2. SUMMARY STATISTICS:

Purpose:

Summary statistics is used to summarize a set of observations, in order to communicate the largest amount as simply as possible. Here the India VIX values for the 2 year period (01-04-20008 to 30-04-2008) are summarized under the various statistical measures.

Table:

The following is the summary statistics of the India VIX Values based on the Nifty 50 Index Option prices .The daily returns on 50 underlying shares currently included in Nifty were used to arrive at the Summary statistics.

Table 4.2.1: Summary Statistics of India VIX Values for the overall study period April 2008 – April 2010

CLOSE Valid N (list wise)	VALUES
N Statistic	508
Range Statistic	68.08
Minimum Statistic	17.05
Maximum Statistic	85.13
Sum Statistic	1.854
Mean Statistic	36.3668
Mean Std. Error	.51826
Std. Deviation Statistic	11.68103
Variance Statistic	136.446
Skewness Statistic	.902
Skewness Std. Error	.108
Kurtosis Statistic	1.024
Kurtosis Std. Error	.216

Table 4.2.2: Summary Statistics of India VIX Values on a half yearly basis for the period April 2008 – April 2010

SUMMARY STATISTICS	April 2008 – September 2008 (125)	October 2008 – March 2009 (118)	April 2009 – September 2009 (123)	October 2009 – March 2010 (142)
Mean	33.3443	48.0007	41.7689	24.6804
Std. Error of Mean	.50668	.95778	.82398	.33524
Median	32.8000	44.8100	40.6700	25.5150
Mode	29.02[a]	44.30	37.59[a]	26.69
Std. Deviation	5.66489	1.04041	9.13842	3.99488
Variance	32.091	108.246	83.511	15.959
Skewness	1.758	1.055	.931	-.202
Std. Error of Skewness	.217	.223	.218	.203
Kurtosis	6.186	.713	2.724	-1.132
Std. Error of Kurtosis	.430	.442	.433	.404
Range	38.48	56.95	59.35	15.08
Minimum	23.25	28.18	24.36	17.05
Maximum	61.73	85.13	83.71	32.13
Sum	4168.04	5664.08	5137.58	3504.61

a. Multiple modes exist. The smallest value is shown

Interpretation:

The average of the returns is positive implying the fact that price series have increased over the period. The statistics show that returns are positively skewed although the skewness statistics are not large. The positive skewness implies that the return distributions of the shares traded in our markets have a higher probability of earning positive returns. The fourth part in the half-yearly representation shows negative skewness coefficient, i.e., -.202 which indicates that the frequency distribution of the return series has longer tail to the left. The value of the kurtosis is greater than 3 in first part of the half-yearly representation, meaning that they have a heavier tail than the standard normal distribution and hence leptokurtic, whereas the second and third quarter have a smaller tail than the standard normal distribution and hence platykurtic. The daily returns are, thus, not normally distributed — a conclusion which is confirmed by Kurtosis Values. The values range between as low as 15.08 to a maximum of 59.35 during the overall study period. The maximum and

Inference:

It is inferred from the above analysis that the returns have been positive during the period of 2 years. The returns in most cases have been positively skewed except for the last part implying that returns for the 2 year period have been positive in most cases. The kurtosis values confirm that the daily returns are not normally distributed.

4.3. AUTO CORRELATION TEST:

Purpose:

The Autocorrelation test is conducted to know if there is correlation within a series of data. The autocorrelation of a random process describes the correlation between values of the process at different points in time, as a function of the two times or of the time difference. Here the test for Autocorrelation is applied to know whether the't-1' values of India VIX have a impact over the't' values.

Table:

The following table's shows the result of the Auto Correlation test conducted on the India VIX values assuming a lag of 10 days as the first case.

Table 4.3.1: Autocorrelation test for the VIX Values for the overall study period April 2008 – April 2010 with a lag of 10 days

Lag	Auto Correlation
1	.922
2	.899
3	.879
4	.861
5	.847
6	.835
7	.817
8	.796
9	.783
10	.770

Interpretation:

The table 4.3.1.shows the autocorrelation coefficient values for the India VIX for the overall study period assuming a lag of 10 days. The coefficient values are all positive and range from 0.9 to 0.7. The coefficient values indicate that there is high correlation between the India VIX values at different point of time. It shows that India VIX't-1' values have an impact over the't' values. The coefficient values show a downward sloping trend indicating that't-2' values have more influence over the't' values than the 't-10' values. The values are tested for their significance using the T-test and only the values that satisfy the significance criteria are considered.

Inference:

It is inferred from the above analysis that there exists correlation within the series of data and the't-10' values have an influence over the't' values of the India VIX.

Chart 4.3.1.1: Autocorrelation test for the VIX Values for the overall study period April 2008 – April 2010 with a lag of 10 days

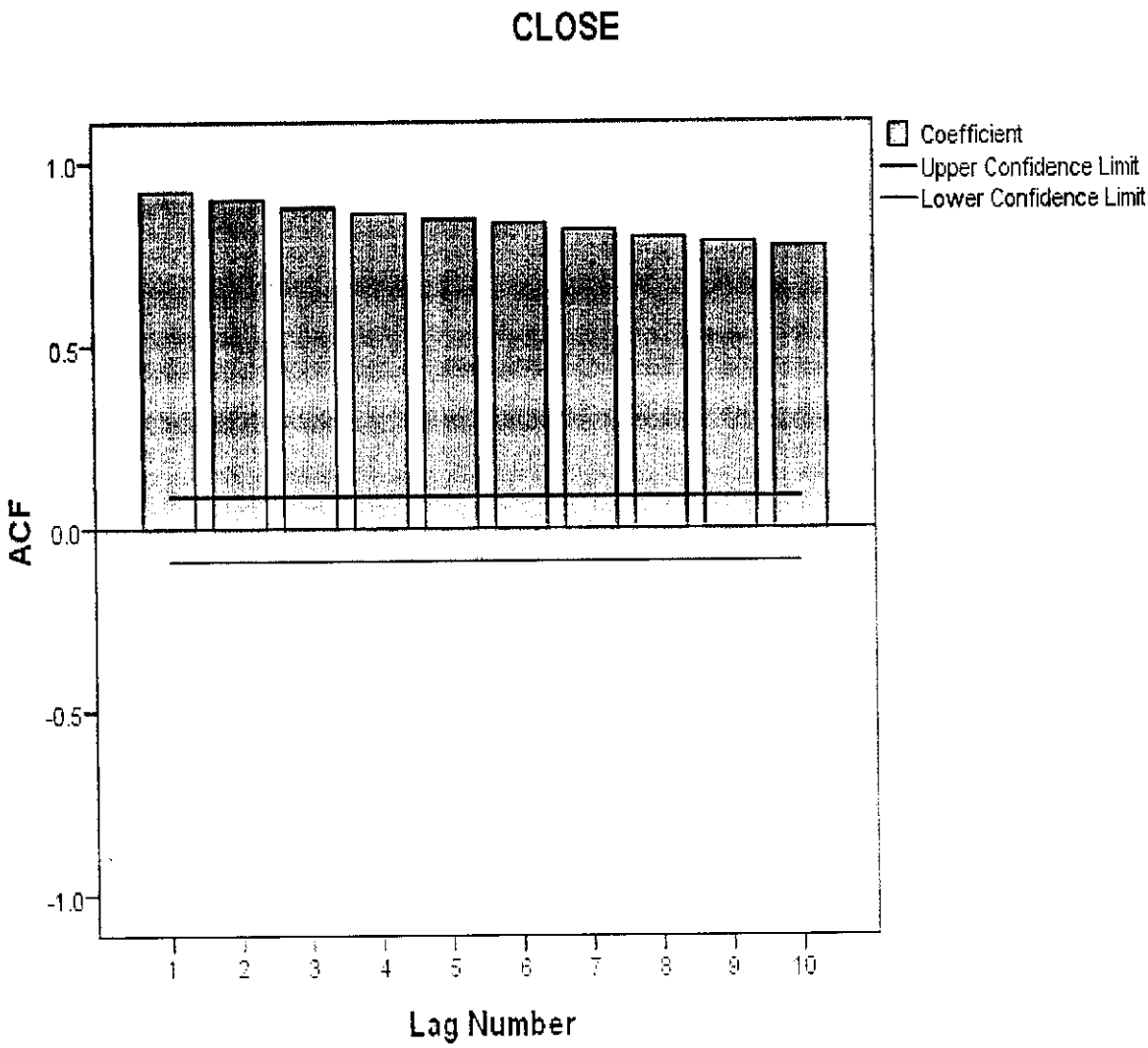


Table:

The following table's shows the result of the Auto Correlation test conducted on the India VIX values assuming a lag of 30 days as the second case.

Table 4.3.2: Autocorrelation test for the VIX Values for the overall study period April 2008 – April 2010 with a lag of 30 days

Lag	Auto Correlation
1	.922
2	.899
3	.879
4	.861
5	.847
6	.835
7	.817
8	.796
9	.783
10	.770
11	.755
12	.729
13	.708
14	.686
15	.665
16	.658
17	.636
18	.628
19	.601
20	.586
21	.563
22	.542
23	.521

25	.482
26	.468
27	.453
28	.450
29	.437
30	.424

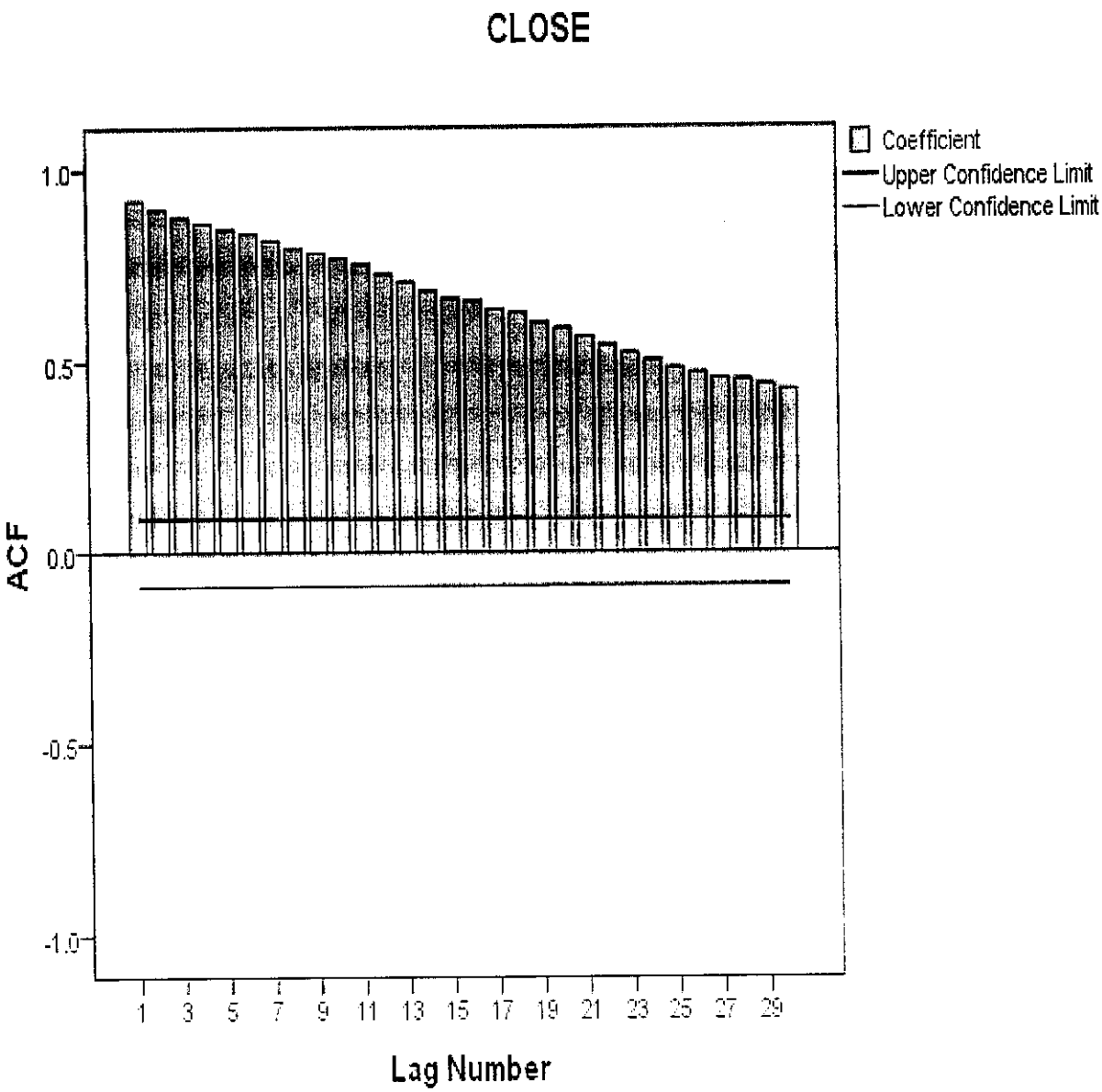
Interpretation:

The above table shows the autocorrelation coefficient values for the India VIX for the overall study period assuming a lag of 30 days. The coefficient values are all positive and range from 0.9 to 0.4. The coefficient values indicate that there is high correlation between the India VIX values at different point of time. It shows that India VIX't-1' values have an impact over the't' values. The coefficient values show a downward sloping trend indicating that't-2' values have more influence over the't' values than the 't-30' values. The values are tested for their significance using the T-test and only the values that satisfy the significance criteria are considered.

Inference:

It is inferred from the above analysis that there exists correlation within the series of data and the't-30' values have an influence over the't' values of the India VIX.

Chart 4.3.2.1: Autocorrelation test for the VIX Values for the overall study period April 2008 – April 2010 with a lag of 30 days



4.4. STEPWISE MULTIPLE REGRESSIONS:

Step-wise Multiple Regression is used where the effect of more than one predictor against the criterion variable is to assessed. Under this model the regressed effect of the independent variables on the dependent variable is determined. In specific, Step-wise multiple regression is applied to know which among the set of predictors are the most important in explaining the variance of the dependent variable.

4.4.1. MODEL SUMMARY:

Purpose:

The Model summary is worked out to know the magnitude of the variance caused by the independent variables over the dependent variable.

Table:

The following table shows the model summary of the NIFTY 50 scrips considered as the independent variables and the dependent variable, India VIX:

Table.No:4.4.1.1; Table showing the model summary of the NIFTY 50 scrips and the VIX

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
25	.908*	.825	.818	4.97885	.001	4.122	1	487	.043	1.010

***Predictors:** CAIRN, KOTAKBANK, HINDUNILVR, GAIL, HEROHONDA, CIPLA, JINDALSTEL, NTPC, RANBAXY, ABB, SIEMENS, RCOM, IDEA, ONGC, IDFC, SUNPHARMA, UNITECH, MARUTI, HINDALCO

Interpretation:

The above table shows the result of the Step-wise Multiple Regression. Of the 50 scrips that constitute the NIFTY Index, only 19 variables satisfy the condition and are entered into the model. The R Square value of .825, indicate that the 19 independent variables that have entered the model, together have a regressed effect to the extent of 82.5% on the dependent variables. The Durbin–Watson statistic is a test statistic used to detect the presence of autocorrelation in the residuals from a regression analysis . Since the Durbin–Watson is more than 1.0, it shows the absence of Autocorrelation.

Inference:

It is inferred from the above analysis that, of the independent variables,i.e;50 scrips, only 19 scrips constitute a major portion (82.5%) of the variance of the dependent variable, India VIX.

4.4.2. REGRESSION COEFFICIENT TABLE:

The following table shows the coefficient values of the independent variables that have entered the model.

Table.No:4.4.2.1 Table shows the coefficient values of the independent variables

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	93.285	6.912	13.496	.000
CAIRN	-.143	.018	-7.950	.000
KOTAKBANK	.020	.008	2.529	.012
HINDUNILVR	-.079	.022	-3.602	.000
GAIL	-.091	.013	-7.064	.000
HEROHONDA	-.031	.005	-6.810	.000
CIPLA	.088	.024	3.734	.000
JINDALSTEL	.003	.001	4.809	.000
NTPC	-.108	.028	-3.904	.000
RANBAXY	-.030	.006	-4.663	.000
ABB	-.028	.006	-4.413	.000
SIEMENS	.032	.008	3.836	.000
RCOM	.057	.011	5.401	.000
IDEA	-.134	.068	-1.961	.050
ONGC	.014	.006	2.431	.015
IDFC	.163	.032	5.051	.000
SUNPHARMA	.020	.004	5.064	.000
UNITECH	-.063	.020	-3.207	.001
MARUTI	.010	.004	2.651	.008
HINDALCO	-.064	.032	-2.030	.043

Interpretation:

The above table shows the slope and the intercept of the 19 independent variables that have entered the model. The standard error values, the t-test values and the test of significance are all calculated.

Inference:

The slope and the intercept values of the independent values are fitted in the model to arrive at the regression equation. The Regression model with the slope and the intercept values are shown below:

MODEL FIT:

Y= a+bX+e

India VIX= 93.285 -.143(CAIRN) **+.020**(KOTAKBANK) **-.079**(HINDUNILVR) **-.091**(GAIL) **-.031** (HEROHONDA) **+.088**(CIPLA) **+.003**(JINDALSTEL) **-.108**(NTPC) **-.030**(RANBAXY) **-.028**(ABB) **+.032**(SIEMENS) **+.057**(RCOM) **-.134**(IDEA) **+.014**(ONGC) **+.163**(IDFC) **+.020**(SUNPHARMA) **- .063**(UNITECH) **+.010**(MARUTI) **-.064**(HINDALCO)

4.4.3. EXCLUDED VARIABLES:

The following table shows the independent variables that are excluded from the model as they do not satisfy the selection criteria.

Table.No:4.4.3.1; Table shows the excluded independent variables

MODEL	SCRIPS
1	ACC Ltd
2	Ambuja Cements Ltd
3	Axis Bank Ltd
4	Bharat Heavy Electricals Ltd.
5	Bharat Petroleum Corporation Ltd
6	Bharti Airtel Ltd
7	DLF Ltd
8	HCL Technologies Ltd
9	HDFC Bank Ltd
10	Housing Development Finance Corporation Ltd
11	ITC Ltd
12	ICICI Bank Ltd
13	Infosys Technologies Ltd
14	Jaiprakash Associates Ltd
15	Larsen & Toubro Ltd
16	Mahindra & Mahindra Ltd
17	Power Grid Corporation of India Ltd
18	Punjab National Bank
19	Reliance Capital Ltd
20	Reliance Industries Ltd
21	Reliance Infrastructure Ltd

23	State Bank of India
24	Steel Authority of India Ltd
25	Sterlite Industries (India) Ltd
26	Suzlon Energy Ltd
27	Tata Consultancy Services Ltd
28	Tata Motors Ltd
29	Tata Power Co. Ltd
30	Tata Steel Ltd
31	Wipro Ltd.

***Predictors:** CAIRN, KOTAKBANK, HINDUNILVR, GAIL, HEROHONDA, CIPLA, JINDALSTEL, NTPC, RANBAXY, ABB, SIEMENS, RCOM, IDEA, ONGC, IDFC, SUNPHARMA, UNITECH, MARUTI, HINDALCO

Interpretation:

The above table shows the variables that are excluded from the model as they do not satisfy the condition. The Independent variables that are included in the model account to 19, leaving the remaining 31 independent variables excluded from the model. All the 31 scrips that are not included in the model have no explanatory variance over the dependent variables.

Inference:

It is inferred from the above analysis that only 19 of the independent variables have a regressed effect over the dependent variable leaving the remaining 31 scrips excluded from the model.

4.5. COLLINEARITY STATISTICS:

Purpose:

Collinearity is correlation among the predictors in a regression. Multi-collinearity is correlation among multiple predictors. The test for multi-collinearity is conducted to know if multi-collinearity exists among the independent variables that have entered the model. Here the multi-collinearity test is conducted to know if the R Square value is caused by the correlation that exists within the variable or is independent of the correlation effect of the independent variables. Hence to find the true R Square value that does have the effect of multi-collinearity, the multi-collinearity test is conducted.

Table:

The following table shows the collinearity statistics for the data, the tolerance value and Variance Inflation Factor (VIF):

Table.No:4.5.1; Table showing the multi-collinearity Statistics of the predictors

Model	Collinearity Statistics	
	Tolerance Factor	VIF
CAIRN	.061	16.379
KOTAKBANK	.025	40.572
HINDUNILVR	.302	3.310
GAIL	.045	22.443
HEROHONDA	.013	74.124
CIPLA	.032	31.379
JINDALSTEL	.177	5.658
NTPC	.141	7.073
RANBAXY	.074	13.510
ABB	.032	31.515
SIEMENS	.030	33.412

RCOM	.027	36.878
IDEA	.031	32.622
ONGC	.045	22.382
IDFC	.027	37.288
SUNPHARMA	.091	10.988
UNITECH	.028	35.606
MARUTI	.023	44.286
HINDALCO	.022	46.025

Interpretation:

The above table shows the tolerance and VIF values of the independent variables that have entered the model. Of the 19 scrips, 16 scrips show a tolerance value of <.10 and a VIF value of >10 indicating that multi-collinearity does exists among the independent variables. Whereas the remaining 3 scrips (HINDUNILVR, JINDALSTEL, NTPC) show a tolerance value of >.10 and their corresponding VIF values also <10, indicating that multi-collinearity does not exists among the 3 independent variables. The multi-collinearity result suggests that the R Square value is due to the correlation effect within the variables and it does not a give a true picture of the regressed effect of the Independent variables. Only the 3 independent variables does not have the multi-collinearity effect.

Inference:

It is inferred from the above analysis that only 3 (HINDUNILVR, JINDALSTEL, NTPC) of the independent variables show a tolerance value of >.10 and a VIF value of <10, indicating that multi-collinearity does not exists.

4.6.1. MULTIPLE REGRESSION ANALYSIS:

Purpose:

Multiple Regression is useful to predict the level of dependent phenomenon through multiple regression models, if the level of independent variables were given. The main purpose of using this technique here is to examine the regressed effect of the 3 independent scrips that have free from the effect of Multi-collinearity. The 3 independent variables that are analysed here give a reliable estimate of their individual regression coefficient.

Table:

The following table shows the model summary of the 3 scrips considered as the independent variables and the dependent variable, India VIX:

Table.No:4.6.1.; Table showing the model summary of the 3 scrips and the India VIX

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig.F Change	
25	.578a*	.334	.330	9.55249	.334	84.101	3	503	.000	1.010

a. Predictors: (Constant), NTPC, JINDALSTEL, HINDUNILVR

Interpretation:

The above table shows the result of the Multiple Regression of the 3 independent scrips that have resulted from the multi-collinearity test. The R Square value of .334, indicate that the 3 independent variables considered, together have a regressed effect to the extent of 33.4% on the dependent variables. The Durbin–Watson statistic is a test statistic used to detect the presence of autocorrelation in the residuals from a regression analysis . Since the Durbin–Watson is more than 1.0,

Inference:

It is inferred from the above analysis that the 3 (NTPC, JINDALSTEL, HINDUNILVR) independent variables account for 33.4% of the variance of the dependent variable, India VIX.

4.6.2. REGRESSION COEFFICIENT TABLE:

The following table shows the coefficient values of the 3 independent variables that are considered for the analysis:

Table.No:4.6.2.; Table shows the coefficient values of the 3 independent variables

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	73.174	5.853	12.502	.000
HINDUNILVR	.110	.028	3.943	.000
JINDALSTEL	. 002	.001	3.775	.000
NTPC	-.350	.024	-14.638	.000

Interpretation:

The above table shows the slope and the intercept of the 3 independent variables that have been considered for the study. The standard error values, the t-test values and the test of significance are all calculated.

Inference:

The slope and the intercept values of the independent values are fitted in the model to arrive at the regression equation. The Regression model with the slope and the intercept values are shown below:

MODEL FIT:

Y= a+bX+e

India VIX= 73.174 +.110(HINDUNILVR) **+.002** (JINDALSTEL) **-.350** (NTPC)

4.6.3. COLLINEARITY STATISTICS:

Purpose:

The test for multi-collinearity is conducted to know if multi-collinearity exists among the independent variables that have entered the model. Here the multi-collinearity test is conducted to know if the R Square value is caused by the correlation that exists within the variable or is independent of the correlation effect of the independent variables. Hence to find the true R Square value that does have the effect of multi-collinearity, the multi-collinearity test is conducted.

Table:

The following table shows the collinearity statistics for the data, the tolerance value and Variance Inflation Factor (VIF):

Table.No:4.6.3; Table showing the multi-collinearity Statistics of the final 3 predictors

Model	Collinearity Statistics	
	Tolerance Factor	VIF
HINDUNILVR	.692	1.446
JINDALSTEL	.998	1.002
NTPC	.693	1.443

Interpretation:

The above table shows the tolerance and VIF values of the independent variables that are considered for the analysis. All the 3 scrips (HINDUNILVR, JINDALSTEL, NTPC) show a tolerance value of >.10 and their corresponding VIF values also <10, indicating that multi-collinearity does not exists among the 3 independent variables. Thus the R Square value is independent of multi-collinearity and thus show a true regressed effect towards the dependent variables.

nference:

It is inferred from the above analysis that all the 3 (HINDUNILVR, JINDALSTEL, NTPC) independent variables show a tolerance value of >.10 and a VIF value of <10, indicating that multi-collinearity does not exists among the ndependent variables.

CONCLUSION

CHAPTER 5

FINDINGS, SUGGESTIONS AND CONCLUSION

5.1. RESULTS & DISCUSSION:

- It is found from the analysis that the returns have been positive during the period of 2 years. The returns in most cases have been positively skewed except for the last part implying that returns for the 2 year period have been positive in most cases. The kurtosis values confirm that the daily returns are not normally distributed.
- Correlation exists within the series of data of India VIX and the't-10' values have an influence over the't' values of the India VIX.
- Correlation exists within the series of data of India VIX and the't-30' values have an influence over the't' values of the India VIX.
- Of the 50 independent variables,i.e;NIFTY scrips, only 19 scrips constitute a major portion (82.5%) of the variance of the dependent variable, India VIX.
- **MODEL FIT:**

  Y= a+bX+e

  India VIX= 93.285 -.143(CAIRN) **+.020**(KOTAKBANK) **-.079**(HINDUNILVR) **-.091**(GAIL) **-.031** (HEROHONDA) **+.088**(CIPLA) **+.003**(JINDALSTEL) **-.108**(NTPC) **-.030**(RANBAXY) **-.028**(ABB) **+.032**(SIEMENS) **+.057**(RCOM) **-.134**(IDEA) **+.014**(ONGC) **+.163**(IDFC) **+.020**(SUNPHARMA) **-.063**(UNITECH) **+.010**(MARUTI) **-.064**(HINDALCO)

- Only 19 of the independent variables have a regressed effect over the

- It is known from the multi-collinearity analysis that only 3 (HINDUNILVR, JINDALSTEL, NTPC) of the independent variables show a tolerance value of >.10 and a VIF value of <10, indicating that multi-collinearity does not exists.
- The Multiple Regression analysis indicate that the 3 (NTPC, JINDALSTEL, HINDUNILVR) independent variables account for 33.4% of the variance of the dependent variable, India VIX.
- **MODEL FIT:**

  Y= a+bX+e

  India VIX= 73.174 +.110(HINDUNILVR) **+.002** (JINDALSTEL) **-.350** (NTPC)
- The test for Multi-collinearity show that all the 3 (HINDUNILVR, JINDALSTEL, NTPC) independent variables show a tolerance value of >.10 and a VIF value of <10, indicating that multi-collinearity does not exists among these independent variables.

5.2. CONCLUSION:

In this paper an empirical study of the volatility in the Indian options equity market was analyzed with reference to the India VIX. The results show that the market has been highly volatile during the two year period. The high sensitivity of the India VIX to the market events is evident from the changes in the India VIX values during the periods of market turbulence. The sensitivity of the India VIX is observed from the changes in the value of the India VIX during the times of Satyam scam, Mumbai terror attack and the European Union and IMF announcement of massive package for Greece. India VIX has been a performance indicator and has been useful to gauge the volatility in the market.

India VIX is calculated using the methodology adopted by CBOE currently for computing VIX on S&P 500 options. India VIX, based on the Nifty 50 Index Option prices is calculated from the best bid-ask prices of near term Nifty 50 Options contracts, which are traded on the F&O segment of NSE. It is represented in (%), a volatility figure which indicates the expected market volatility over the next 30 calendar days. India VIX takes into consideration the factors such as bid price, ask price, interest rate, time to expiration and these factors constitute the India VIX. Volatility index isolates expected volatility from other factors affecting options prices, such as changes in the underlying price, dividends, interest rates, time to expiration.

The India VIX values since its introduction by the NSE has on an average shown positive returns implying that the price series were on an increasing trend. The returns for the two year period have been positively skewed in most cases and from the kurtosis values it is proved that the daily returns are not normally distributed. The time series data, India VIX is tested for the effect of autocorrelation. The data reveal the presence of autocorrelation indicating that there exists correlation between the values at different points in time. The Autocorrelation Factor when represented in a chart shows a downward slope indicating that the values at a closer range seem to have more influence then the values at a time-distant range.

The option prices are affected by many factors of which the underlying price is an important factor. The underlying price though not in a direct way, but indirectly influence the India VIX. The constituents of the underlying index NIFTY, i.e; Nifty 50 scrips have an influence over the India VIX, though not all scrips have an influence over the India VIX. The regressed effect caused by the scrips on the India VIX is quite high (82.5%), not considering the element of multi-collinearity. The test for multi-collinearity was carried out to provide a reliable estimate of the individual regression coefficient. The results show that only three scrips have an influence over the India VIX to the extent of one-third of the total influence caused.

India VIX has thus been a performance indicator by clearly reflecting the nervousness and fear among traders and also capturing the expected movement - upside or downside - of the underlying index over the near term with respect to the market events. Securities and Exchange Board of India have given a go-ahead to the stock exchanges to introduce derivative contracts on Volatility Index (VI) and as such the volatility index will offer a way for investors to buy and sell option volatility directly, without having to deal with other risk factors that would have an impact on the value of an index option position. Thus the relevance and the role of the India VIX will be more prominent in the futures to come with its gaining importance in the present scenario.

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