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STUDY OF IMPLIED VOLATILITY SKEW IN INDIAN STOCK MARKET

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ABSTRACT

The level of Option Implied Volatility Skew has significant predictive ability for the future price of an underlying. Using index Nifty as a proxy for the Indian stock market we compared the returns for the days with low volatility skew and returns for the days for normal skews. Option Implied Skew is described as difference between implied volatility on At The Money (ATM) options and Out of The Money (OTM) options (110 moneyness of implied volatility). T-test has been applied to test the significance of higher skew returns for a period of 10 years from 2006-2015. The results show the presence of information content in volatility skew which is reflected in higher returns on the day of low volatility skew. However, we analyzed only the bullish signal given by the implied volatility skew. This analysis can further be extended in various other ways to test the predictive ability of implied volatility skew.

Keywords: Implied volatility, Implied Volatility Skew, Moneyness, Information content

INTRODUCTION

Implied volatility skew is a measure of implied volatility which tells about the expectation of the investors view for the directions of the market. If the implied volatility skew is high, investors are skewed towards one direction, they either want to buy the underlying or they want to sell the underlying depending upon how the skew has been calculated. Implied volatility can also tell us the investors' steepest view towards buying or selling. Implied volatility skew reflects a little more information than implied volatility only as here the two implied volatilities themselves (call vs. put or ATM vs. OTM) are also compared.

Implied Volatility for Options as a measure to predict returns gained a lot of importance due to its forward looking aspect and time varying property. It is back calculated from the option prices prevailing in the market. Implied volatility contains important information about investors' thought process for the expected returns of the underlying asset as they enter into the options contract for hedging their positions in the underlying from future moves. It is well observed in the literature that the Implied Volatility calculated from the option price is a much better forecast for future volatility than the historical volatility as it has a better predictive ability for stock returns.

According to Fu, Arisoy, Shackleton and Umutlu (2013), Implied volatility is known to have information content about the market which can help determine movement in underlying prices. Due to different signals in distinct stocks or markets, traders grab the relative information and choose to invest or trade in the different assets. Also, Ang, Bali and Cakici (2012) focus on the implied volatility of individual options and document a significant predictive power of implied volatility in predicting cross-section of individual stock returns. More specifically, large increases implied volatility of call or put lead to increase (decrease) in stock returns.

Implied volatility is a value extracted from the Black Scholes formula by putting available values of variables and equating it to the current market price of the option for the underlying instrument. It indicates expected value of future volatility which is different from the historical volatility or realized volatility because the latter is calculated from past prices. Implied volatility indicates the trader expectation of future volatility in the underlying instrument

and hence it contains relevant information about the asset price movement in future. Additionally, it has been observed that Implied Volatilities spike when the stock prices fall and Implied Volatility flattens when the asset prices increase. Furthermore, many times it has been observed that the price of options increase/decrease without change in price of the underlying, time, dividend or risk free rate. This change can be attributed to increase/decrease in demand of those options further leading to change in implied volatility of that option.

When we talk about Implied Volatility and its Performance to predict the returns of the underlying with the Information Content associated with it, we intend to use this to measure movement in underlying assets. It is known empirically that predictability of Implied Volatility can be improved using information available in Option Implied Skew.

Theoretically, for options with the same expiration date, the implied volatility is expected to be equal for any strike price. However, in reality, the Implied Volatility we get is different for various strikes. This disparity is known as the volatility skew. We define the Option Implied volatility skew variable as the difference out of the money puts and at the money calls or at the money call and out-the-money calls.

Volatility Skew is a situation when a pattern is formed due to different implied volatilities for a particular stock option at different strikes. A Situation where one option is overpriced than others reflects the direction. Also, here trading the skew becomes an opportunity as same underlying is being bought and sold and eventually the skew will converge.

Costly options are an indicator of expected changes in price of a stock. And the degree of expensiveness is reflected by volatility of the stock. All the options for a particular stock are expected to give same degree of volatility for the stock. Theoretically also, all the options available for a particular stock should trade at same degree of volatility and ATM calls and puts with same expiration and same strike should have the same price. But this single degree suggests whether the volatility of that stock is high. Direction for the stock's movement cannot be found.

High volumes for a particular option do not necessarily mean people are buying that option people might be selling it. Therefore it is said that disparity in the volumes do not reflect the direction in which the people are trading, it is the disparity in volatility of call options and put options. Here we compare the volatilities of call option and put option, to identify the direction where the market is moving. If the the number of call buyers are higher than the number of put buyers it means there is a skew indicating rise in stock price. That's how skew becomes an important indicator as it shows biases of the option traders towards the stock. It is suggested to check the volatility skew before forming any notion regarding the direction for the stock price.

VOLATILITY SMILE

If the Implied volatilities are plotted against different strikes we get a smile like curve. Volatility Smile shows that demand is higher for options which are in-the-money or out-of-the-money. The volatility smile pattern is mostly seen in options in the forex market as in forex markets one's call is anothers' put and vice-versa and also in near-term equity options.

REVERSE SKEW

Reverse skew is a more common Skew pattern also known as Volatility Smirk. Volatility Smirk commonly appears for index options and longer term equity options. Here, the Implied Volatility for options with lower strike price is higher than the Implied Volatility at higher strikes. This pattern tells us that out-of-the-money puts and in-the-money calls are more expensive as compared to in-the-money puts and out-of-the-money calls.

The explanation for the phenomenon of Volatility Smirk or the reverse volatility skew is that the investors are worried about market crashes and want to buy puts for their protection from the crashes. One piece of attestation for this indication is the fact that the volatility smirk did not show up for options in equity until the 1987 Crash.

FORWARD SKEW

In this pattern, the Implied Volatility for options at the lower strike prices are lower than the Implied Volatility at higher strikes. This explains that in- the-money puts and out-of-the-money calls have higher demand as compared to out-of-the-money puts and in-the-money calls.

The forward skew pattern can be commonly observed for options in the commodities market. When supply is an issue, businessman would choose to pay more to secure supply than rather risk the supply side. Like in case of weather reports indicating a heightened possibility of an approaching freeze, fear of supply disruption will make businessman to buy options for securing their supplies, which will lead to higher demand for out-of-the-money calls.

Volatility skew, which is affected by expectations of the investors and the supply/demand relationship, provides information on whether investors or fund managers prefer to write/buy calls or puts. The volatility skew contains three levels of information: the likelihood of a price jump, the expected level of the price jump, and the premium that incorporates investors for both the risk of a jump and that it could be large a large one too.

The information embedded in volatility skews is related to future earnings shocks, in the sense that firms with the steepest volatility skews have the worst earnings surprises. The steepest volatility skews are those experiencing the worst earnings shocks in subsequent months, suggesting that the information embedded in the shape of the volatility smirk is related to firm fundamentals. Finally, in order to analyze the pace at which markets adjust to public information, traders develop trading strategies based on past volatility skews and examine risk-adjusted returns of these trading strategies for different time of holding periods.

This research aims to study whether the option implied volatility measure Volatility Skew is significant in predicting directions for Nifty, an indexby the National Stock Exchange of India. Can implied volatility skew act as a predictor to outperform the market returns? Volatility Skew over here is taken as the difference between At The Money call option and Out of The Money put option for the purpose of analysis for this research. Data for a period of 10 years has been taken for the study which comprises of the european Crisis period too. We analyse returns for two (low skew and normal skew) types of skews and see how Volatility Skews can work to predict future equity returns. Also, we show what information we can get out of the volatility skews to make it work as a signal for trading.

REVIEW OF THE LITERATURE

Black and Scholes (1973) in their research paper entitled ‘Options and Corporate Liabilities’ set a trend which reoriented the price mechanism and option trading. Before which Bachelier (1900), Samuelson (1952 and 1965) and Merton (1973) in their research assumed that the volatility is constant for pricing an option and it is very simple and polished. Rather it was found that volatility is exposed to pricing inclination with respect to time to maturity and moneyness (strike price), after the Crash of 1987. Although Fama (1965) challenged the assumptions of constant volatility and lognormal distribution in black scholes model along with a host of researchers around twenty years prior to that.

Volatility Skew came in the question of research after the Crash of 1987 which took the level of knowledge of information content in implied volatility levels above. There is an abundant research that has reviewed volatility skew (volatility smile) and several avenues have been proposed to describe it and model it.

Bates (1991) suggested that the matrix of index call and put option prices across all exercise prices give an indication of market participants’ subjective disbursement of future price realizations directly. Therefore, OTM puts become unusually expensive when compared to ATM calls, and volatility smirks become prominent especially before big falls in price levels, for instance, the year preceding the 1987 stock market crash.

Rubinstein (1994) suggested that the smile effect is related to (i) hikes in price in the underlying asset, (ii) market deficiencies and fragility like illiquidity, transaction cost and other restrictions on trading. Regarding the market deficiencies and fragilities, analysis of Longstaff(1995) and Figlewski (1989) found that transaction costs can be a major factor for the disparities in implied volatility over strike prices. Constantinides (1997) also mentioned that the equilibrium prices of assets are affected by transaction costs. And, for analysis of the presence of hikes in the price

of the underlying asset, Hafner and Wallmeier (2001) in their research about hikes in the price of the underlying indicated that assessment of the market participants about the risk of a crash affects the volatility smile in the Danish Market. Traders set a level which is higher than the previous one for volatility to work as a risk premium for an unexpected movement in the price of a underlying.

While these researchers were explaining the reasons for volatility skew or smirk, Amin and Victor (1993), Derman and Kani, (1994), Duan, (1996), Backus et al (1997), Heston and Nandi (2000) constrained by wrong assumptions for distributions and its ramification, concentrated on determining a different model for explaining the volatility or volatility smile adjusted with non lognormal assumptions for distribution of Black-Scholes.

Then another research focused on the importance of volatility skew as a predictor of movements in the price of the underlying. The performance of volatility skew as a predictor is given by the researchers as follows: Bruno et al. (2001) said conditioning on skewness increases the predictive power of the volatility spread and that coefficient estimates accord with theory. Pan (2002) amalgamates both types of risks: first, a jump risk premium and second, a volatility risk premium which shows that investors' aversion toward negative jumps is the driving force for the presence of Volatility Smirks. For Out of The Money put options, the premium for hike in prices risk makes 80% of premium for total risk where the premium is only 30% for Out of The Money calls. Put differently, investors tend to choose Out of The Money puts out of worries concerning possible negative jumps in future leading to expensive Out of The Money puts before the large negative jumps, which can be taken as an input (indication) for entering into trades.

Peter Carra, Liuren Wu (2009) suggested that skew models strongly outperform traditional stochastic volatility models based on jump diffusion, both in sample and out of the sample. Xing, Zhang and Zhao(2010) record the existence of volatility smirks in individual stock options. More than 90% of the firms with listed options showed positive volatility smirks for a period of 10 years from 1996 to 2005, with a median difference between At The Money call and Out of The Money put, implied volatilities being approximately 5%. Also, they demonstrated that the implied volatility smirks give statistically significant predictability for future stock returns.

This Literature attempts to flesh out what is believed to be some fundamental aspects that describe the volatility smile and gives a structure that associates these fundamentals to the theories at an actual market analysis. The fundamentals of volatility smile make it a good predictor of future movements. We can also observe from the above literature that most of the researchers have focused on predicting the fall in returns of the underlying when the level of volatility skew is high. The present research attempts to focus on a new consideration which specifically intends to test the rise in returns when the volatility skew is low. Whether the fundamentals work in a similar way in predicting the market returns when the volatility skew is low or not? To fulfill this intention we follow the Methodology mentioned below.

DATA AND METHODOLOGY

Daily closing price data of Nifty and option implied volatility has been downloaded from Bloomberg Database for a period of 10 years from 2006 to 2015. The daily returns for Nifty are calculated as $R_t = (P_t - P_{(t-1)})/ P_{(t-1)} * 100$, where P_t is the today's index price and $P_{(t-1)}$ is the previous days index price. To construct the Implied Volatility Skew, we find the difference between the implied volatility generated from out of the money put options and the implied volatility generated from at the money call options, proposed by Xing, Zhang, and Zhao (2010).

To test whether the returns for a low skew (defined above) are significantly higher than the returns on normal skew days, a comparative analysis has been done. Firstly, relationship between Nifty prices and implied volatility skew is analyzed. Yearly and year wise comparison for the return on low skew days and returns from normal skew days for Nifty is done thereafter. In order to compare the 1 week returns in case of low skew and rolling returns over the period of normal skew, we conduct a T test analysis where the null hypothesis is $\mu=0$ and the alternative hypothesis is $\mu>0$, where μ is the difference in the average returns of the two samples (relatively low normalized volatility skew and returns over the period of normal skew). The test has been performed in SPSS. And to validate the test results by SPSS where the solution is given for two tailed test, normality has been checked so to do the calculations for a one tailed test.

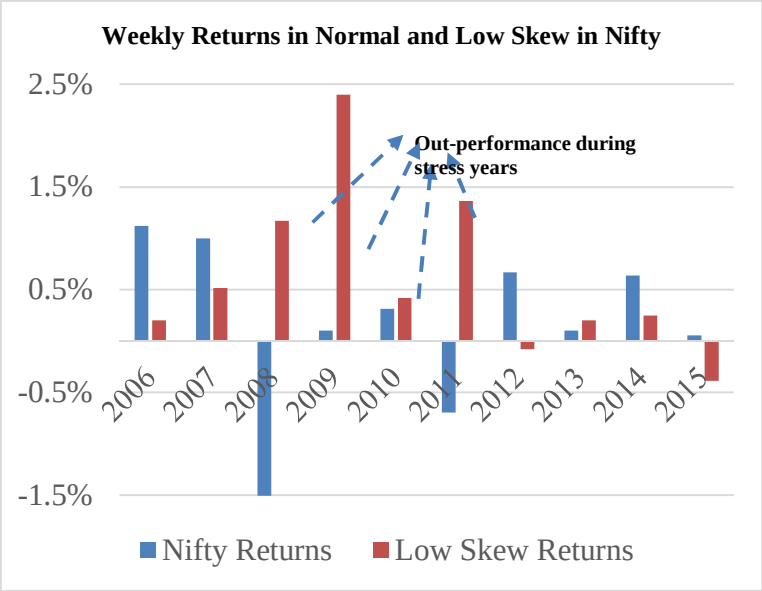
ANALYSIS

When we talk about analyzing skew, we got to be playing with the Moneyness of implied volatility. Moneyness tells us about the forces of supply and demand at different levels of the price of the underlying by presenting different values of implied volatility at different moneyness which in turn gives different information about the trends and expectations for the underlying in the market.

As change in 110% Implied Volatility represent call option activity, any increase in the Normalized Option Implied Skew represent relative decrease in the 110% Moneyness Implied Volatility whereas any decrease in the Normalized Option Implied Skew represent relative increase in the 110% Moneyness Implied Volatility. Intuitively, increase in 110% Moneyness indicate increase in call option activity indicating increase in bullish signals whereas decrease in 110% Moneyness indicates fall in call option activity indicating increase in bearish signal in the underlying.

First, we segregate the returns on the basis of different levels of normalized implied volatility skew. Two set of returns are described, 1st: rolling returns for the days when there is normal skew and 2nd: weekly returns for the days when the skew is low (less than 10 percentile value in 100 days). Secondly, the average returns for the above two sets are compared to test whether the returns on the days of low skew are significantly higher or not.

The relationship between Nifty and its implied volatility skew for the period of 10 years is as given in the literature. Prices of Nifty and Volatility Skew of Nifty show a negative relation. Whenever the Average Skew is high the market is falling and vice versa. So to analysis further we calculated the average weekly return for the relatively low normalized volatility skew defined as less than 10 percentile value in 100 days in the methodology and the average of rolling returns over the period of normal skew. The values for the two come out to be 0.20% and 0.62% respectively. Then we calculated the annualized weekly returns for the two series. It can be seen that the returns from the low skew strategy are much higher than the returns of Nifty itself. Which means if one would have invested according to the directions provided by implied volatility skew would have gained almost thrice as much as by investing in Nifty itself, in a year.



Then the year wise weekly comparative analysis of the two series is given by the graph above for a period of 10 years. This shows a very interesting picture, especially in the period of crisis; weekly returns on the low skew strategy were much higher than the normal skew days of nifty. This picture somewhat answers our question that the implied volatility skew can act as a predictor to outperform the market returns.

To test the statistical significance of the higher weekly return at the time of low skew, t test is conducted in SPSS. It was observed that the difference between the two means of the series was 0.00505. P value for the two tailed hypothesis came out to be 0.0495. With such a low p value, we reject the null hypothesis which says there is no difference in the two series as such and accept the alternative hypothesis that the returns on the days of low skew are significantly higher than the ones on the normal skew days. Hence, we can suggest that low implied volatility skew signals bullish trend in the underlying as it reflects the expectations of the investors.

CONCLUSION

In this research paper, we focused on the relationship between stock returns and a measure of implied volatility known as Normalized Implied Volatility Skew. A negative relationship between the two series can be seen from the analysis. There were prominent times to highlight the negative relationship between the two. Returns on Nifty were higher at the times of low skew and vice versa. The relationship was analyzed and it found that Annualized weekly returns for low skew days were much higher than the annualized returns of Nifty. Also, yearly analysis of the returns showed prominence of the relationship between the indicator and the returns, and reflected directions in stress period as well. To validate the relationship the statistical test was performed and the outcomes of the t test analysis confirm the statistical significance for higher returns on the low skew days. Therefore, putting it in other words to interpret the Volatility skew in future, we can say that a low option skew implies an increase in 110% moneyness which in turn implies either a no bearish signal or a bullish signal. Similarly, higher normalized option skew implies a decrease in 110% moneyness which in turn implies either a no bullish signal or a bearish signal. After the comprehensive analysis it can be concluded that Implied Volatility Skew can work as a predictor to outperform the market.

Hence, we can say that the implied volatility reflects the information about the major moves or the moves of the major traders, investors, etc, which can be used to enter into a contract and make money out of it in the stock market. Measures like Skew can be derived from implied volatility which takes care of such information so that they can be used as input signals for making a trade or investment decision.

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