

## Volatility Indices- A leading Market indicator.

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### What is a Volatility index?

Options traders have long used the volatility indices to help them determine market direction. The computation of volatility index may sound complex. But drawing references from the movement of volatility index is as simple and realistic as reading any stock market index like the Nifty. Off late the Volatility indices have gained lot of attention and momentum. Today it is another leading market indicator which every trader watches closely.

Volatility is a measure of fluctuations in share price (crudely: an indicator of the share's *up/downness*). One well known conclusion of empirical studies pertaining to security markets is that the volatility of asset returns tends to change over time. While changing volatility is apparent in most markets, it is perhaps most evident in stock markets. There are two fundamentally different approaches for the determination of volatility. On one hand, it is possible to determine the historical volatility by measuring the (standard deviation) prices for any particular security or index over a given period of time. On the other hand, one might look for the volatility which is currently implied by option prices, i.e. the implied volatility, based on the assumptions of the trades involved. The term *implied volatility* is obviously self-explanatory - that level of volatility that will calculate a fair value actually equal to the current trading option price. The implied volatility can be regarded as a measure of an option's "expensiveness" in the market.

The computation of a volatility index is based on the second assumption that the future or current trend in the market can be captured by the current level of implied volatility in the options market. Volatility index is calculated by taking a weighted average of the implied volatility from calls and puts traded on an underlying. Very often put and call option contracts on a broad stock index as underlying is chosen for the computation.

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## **Major volatility indices**

Two of the world's most popular measures of investors' expectations about future stock market volatility are the CBOE Volatility Index (VIX) and the CBOE Nasdaq Volatility Index (VXN). The CBOE VIX and VXN index prices of both are designed to reflect the implied volatilities of certain index options contracts; VIX is based on the prices of eight S&P 100® (OEX®) index puts and calls, while VXN is based on the prices of Nasdaq-100® (NDX<sup>SM</sup>) options prices.

The prevalence of volatility fluctuations has prompted the CBOE to introduce, in February 1993, a Market Volatility Index, the VIX, to assist investors in tracking the volatility risk in the stock market. Since the introduction of the VIX, exchanges in several other countries have also launched volatility indices. An example is the VDAX index disseminated by the Deutsche Borse which calculates the implied volatility using the prices of option contracts on the German stock index DAX.

## **Computation Methodology**

To put it in one sentence, what the computation method of a volatility index does is, the implied volatilities of selected option contracts are calculated and these are weighted in such a manner that the volatility index represents the implied volatility of a hypothetical thirty-calendar day (twenty-two-trading day), at-the-money index option contract. The number thus calculated is compared with the base or previous day's value to ascertain whether the implied volatility in the market has risen /fallen or remained the same.

Without going into a great deal of detail, suffice to say that an approximation method is used for calculating the implied volatilities of the option contract.

We need a couple of definitions before we proceed with the computation of a volatility index. To be more precise and specific let's take the computation methodology used in

CBOE's volatility indices computation. As stated above, the volatility index is constructed from the implied volatilities of the eight near-the-money, nearby, and second nearby index option series. The nearby series are defined as the front-month series<sup>1</sup>. The second nearby series uses the contract month following the nearby series.

That definition alone can be confusing, so let's simplify it with an example. If we are currently on the 8<sup>th</sup> of January 2003 ; 22 calendar days away from January expiration, ( taking 30<sup>th</sup> JAN as the expiry date) the nearby month would be defined as January and the second nearby would be defined as February.

For setting the at-the-money level of the index options at the current cash-settled value of the index, we would then pick a Put and a Call just above that level and just below that level for each of the expiration months for a total of 8 options -- 2 January calls, 2 January puts, 2 February calls and 2 February puts. That is the basis for the calculation. So taking the current value of the Index at 1085, here are the options we would use for the calculation:

January - 1080 Call, 1080 Put, 1090 Call and 1090 Put

February - 1080 Call, 1080 Put, 1090 Call, and 1090 Put

The first step in the calculation involves averaging the implied volatilities in each of the 4 groups of options as follows:

$$IV1 = (IV \text{ of the JAN } 1080 \text{ Call} + IV \text{ of the JAN } 1080 \text{ Put})/2$$

$$IV2 = (IV \text{ of the FEB } 1080 \text{ Call} + IV \text{ of the FEB } 1080 \text{ Put})/2$$

$$IV3 = (IV \text{ of the JAN } 1090 \text{ Call} + IV \text{ of the JAN } 1090 \text{ Put})/2$$

$$IV4 = (IV \text{ of the FEB } 1090 \text{ Call} + IV \text{ of the FEB } 1090 \text{ Put})/2$$

IV here stands for implied volatility

The remainder of the calculation involves interpolation<sup>2</sup> between the nearby implied volatilities (IV1 and IV3) and the second nearby implied volatilities (IV2 and IV4) to create hypothetical "at-the-money" implied volatilities for each expiration month.

<sup>1</sup> The nearby series are defined as the front-month series provided there are at least 8 calendar days until expiration. <sup>2</sup> Occasionally it may require to extrapolate if the required strikes are not available

The formula for interpolation in this case can be put down as the following

The at the money January implied volatility is

$$IV \text{ JAN} = IV1 \left( \frac{(1090-1085)}{(1090-1080)} \right) + IV3 \left( \frac{(1085-1080)}{(1090-1080)} \right)$$

The at the money FEBRUARY implied volatility is

$$IV \text{ FEB} = IV2 \left( \frac{(1090-1085)}{(1090-1080)} \right) + IV4 \left( \frac{(1085-1080)}{(1090-1080)} \right)$$

The final step is to interpolate between the IV-JAN and IV-FEB implied volatilities to create a thirty calendar-day (or 22 trading day) implied volatility.

$$\text{Volatility index} = IV \text{ of JAN} \left( \frac{(N_{t2} - 22)}{(N_{t2} - N_{t1})} \right) + IV \text{ of FEB} \left( \frac{(22 - N_{t1})}{(N_{t2} - N_{t1})} \right)$$

$N_{t1}$  is the number of trading days to expiration of the nearby contract, and  $N_{t2}$  is the number of trading days to expiration of the second nearby contract. That is 16 trading days for Jan expiry and 36 trading days for Feb expiry (expiry dates being 30 Jan and 27<sup>th</sup> Feb respectively).

$$; \text{Volatility index} = IV \text{ of JAN} \left( \frac{(36 - 22)}{(36 - 16)} \right) + IV \text{ of FEB} \left( \frac{(22 - 16)}{(36 - 16)} \right)$$

This will give the final volatility index number.

### **Relevance and applications of volatility indices**

A simple analogy, if you were a farmer in an area in which the forecast for coming months was for an unusually severe period of drought and cyclones, you might find that insurers would like to raise the premiums that local farmers there are required to pay for insurance against damage of crops. A long-term index of the general trends in the costs of insurance (or options) premiums could provide useful information to buyers and sellers of

those products. If you are an owner of a portfolio of stocks and are interested in seeing a measure of the general trends in the cost to protect that portfolio with index options, the volatility indices can give a general idea of the relative cost of protection. For example, if volatility index value is relatively high, the index options premiums' prices would be at relatively high levels and the options buyer would be required to pay a relatively high price for the options to the options seller. In this scenario, the buyer might be willing to pay the higher price in a time of market stress.

Since the introduction of the VIX by CBOE, exchanges in several other countries have also launched volatility indices. The usefulness of such indices is predicated on the understanding of the risk of changing volatility in financial assets' returns, risk that may not be measured correctly by asset returns. As a result, positions in these assets, or in derivative products based on these assets, may not be sufficient to hedge away all the uncertainty embedded in volatility. Contingent claims on the volatility of assets may well be needed to increase the set of hedging instruments available to investors. This is perhaps what prompted several exchanges around the world to consider introducing derivatives written on volatility indices. The CBOE and the AMEX, for instance, have pending options on volatility. The German Futures and Options Exchange have already innovated and market a futures contract on the VDAX.

Options traders have long used the volatility indices to help them determine market direction. A low volatility index indicates that traders have become somewhat uninterested in the market and generally is the forerunner to a sell off. One need to be careful while deciding the underlying that there is sufficient liquidity in the contracts traded on them or else the volatility index created on this may not be a good indicator of market direction. A good description of the volatility indices is that it has an inverse relationship to the market. The value of a volatility index normally increases as the market goes down and decreases when the market moves in an upward direction. A rising stock market is viewed as less risky and a declining stock market more risky. The higher the perceived risk is in stocks, the higher the implied volatility and the more expensive the associated options, especially puts. Hence, implied volatility is not about the size of

the price swings, but rather the implied risk associated with the stock market. When the market declines, the demand for puts usually increases. Increased demand means higher put prices and higher implied volatilities. However the reverse does not happen when there is Bull Run. One possible explanation for this is that in times of market turmoil, investors buy index put options as portfolio insurance. The excess demand for index puts drive prices (and hence the volatility index) upward. The converse is not true, however.

### The history of the VIX<sup>3</sup>

*The VIX measures the volatility of the U.S. equity market. Many investors say that if the VIX goes above 35 it signals a bottom in the stock market.*

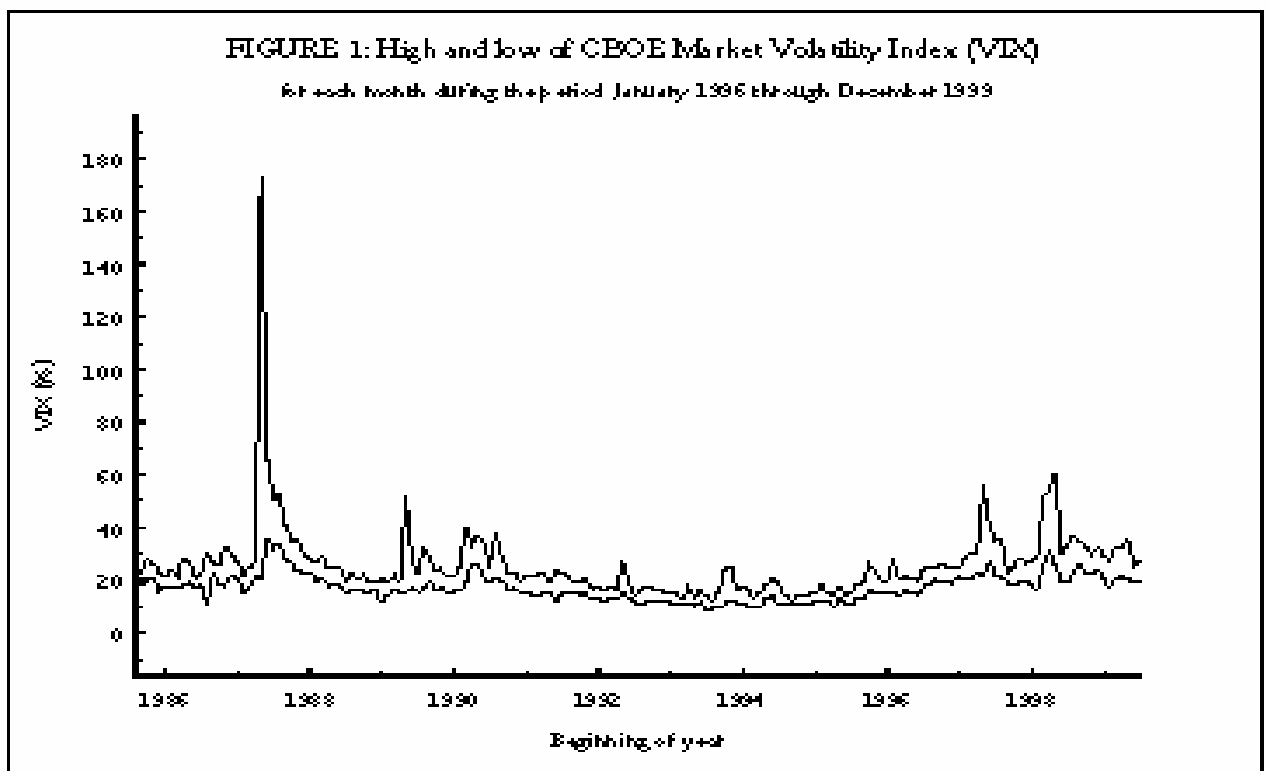


Figure 1

The relevance of a volatility index can be further established by looking at the historical values of the VIX computed by CBOE. The Figure above plots the monthly high and low values of the VIX from January 1986 though December 1999. The most interesting

<sup>3</sup> Taken from the article “The Investor Fear Gauge” by Robert E. Whaley Feb 2000

fact coming out of the figure above is that the monthly high level of VIX has had periodic spikes. For example at the time of the Market Crash in October 1987, VIX reached its recorded level. The jump in mid-1990 occurred when Iraq invaded Kuwait; and the jump in early 1991 corresponds to UN forces attacking Iraq. Then two sharp spikes occurred one in October 1997 and one in October 1998. The October 1997 spike occurred following a stock market sell-off in which the DJIA fell 555 points. The October 1998 spike occurred in a period with general nervousness in the stock market. The VIX then returned to more normal levels in 1999.

### **Summary**

Volatility index by definition is a measure of market risk. Historically, the volatility index has acted reliably as a fear measure. High levels of volatility indices are coincident with high degrees of market turmoil, whether the turmoil is attributable to stock market decline, the threat of war, unexpected change in interest rates, or a number of other newsworthy events. Volatility index can be computed by anyone who has the trade data with him and this can act as a good benchmark in assessing the risk management policies of the institution. Many broking firms and institutions already have their own volatility indices as part of their Risk management kit.