Montréal Exchange

Trading Volatility Using Historical Volatility Cones

The purpose of this paper is to apply the volatility cone method from Burghardt and Lane (1990) to real life Nortel Networks Corp. (NT) call option data, and to show how volatility traders and investors could use the technique to help identify trading opportunities using volatility. However, users are strongly advised to exercise discretion regarding the risk of using this method in guiding their trading strategies.

Did you know that…

There are essentially two types of trading strategies that can be used by participants in the options market—**position trading**, where trades are based on expectations regarding the direction of the price of the underlying, and **volatility trading**, which involves taking a view on market volatility forecasts that differs from those currently factored into option prices. By keeping a delta-neutral position, volatility trading attempts to eliminate the impact of random events on the market that affect underlying asset prices and to generate a profit if the forecast is realized.

Terminology

When talking about volatility, we need to carefully distinguish between different types of volatilities that could potentially lead to different risk/reward characteristics. **Historical volatilities** are the trading-day underlying price volatilities observed over a specific period. Participants generally use 20-day and 30-day historical volatilities. The Exchange's Web site provides annualized 30-day historical volatilities for most listed options, with the computation formula explained in full detail.

Implied volatility gets its value from current derivatives prices on the market, reflecting how variable option traders expect the underlying asset price to be over the life of the option. To obtain the implied volatility data as well as the graph corresponding to each series of options, click on the given implied volatility of the option series under study on the Option Quotes page [http://www.m-x.ca/cotes_en.php].

Volatility Cones

Taking a position on volatility means that your perception of the underlying price volatility differs from the market consensus. However, the challenge facing volatility traders is how to determine if options are cheap or expensive.

Although a powerful tool for determining the theoretical price of a specific option, the Black-Scholes model actually assumes an option's volatility to be known and constant, whereas in reality it is not. Participants normally turn to historical volatilities and try to discern whether implied volatilities (and resulting options prices), are too high or too low compared with two sets of volatility data.

Unfortunately, this frequently-used method has its shortfalls, primarily because of the time horizon mismatch between these two volatilities. Any reading on an option's implied volatility is in fact a volatility forecast of the underlying over the remaining life of the option. Fixed time periods for computing historical volatilities do not match the varying time to expiry for options with different expiry dates. Volatility cones, initially proposed by Burghardt and Lane, can help us determine current volatility levels relative to historical volatility.

There are two basic ideas behind the volatility cone concept. First, price volatility shows (supported by empirical evidence) an apparent trend called mean reversion, on the basis of which a forecast could be made regarding volatilities in their future movements. Accordingly, volatility cones are constructed as a benchmark to identify whether current implied volatilities are too high or too low. Second, time horizon matching is required while we apply the volatility cone method in practice, i.e. implied volatilities of options with 1 month to expiry are compared with 1-month historical volatilities, while implied volatilities of options with 3 months to expiry are compared with 3-month historical volatilities.

In the following paragraphs, we have compiled historical data on Nortel Networks stock from our Web site, constructed a volatility cone and illustrated the ranges of volatility experience for different time horizons. Since most equity options have less than 1 year to expiry, we have segmented the 1 year span into periods of 1, 3, 6, 9 and 12 months. To include more data samples for the 12-month volatility estimates, we began with 15-month historical NT stock price data and estimated historical volatilities over periods of 1 month. In this case, a 15-month historical stock prices time series can be downloaded from *Yahoo! Finance* at http://finance.yahoo.com by entering the symbol “nt.to”, then clicking the graph and selecting “Historical Prices”.

We estimated the historical volatilities using the following formula:

$$\sigma = \sqrt{\frac{1}{N}\sum_i (X_i - \overline{X})^2} * \sqrt{252}$$

$$X_{i+1} = \ln(S_{i+1} / S_i)$$

where S = stock closing price

N = number of business days in the period under study (e.g. N = 20 for 1 month, 60 for 3 months, etc.)

We multiplied by the square root of 252 (trading days per year) to annualize the historical volatility.

Because we advance in 1-month increments, this procedure produces fifteen 1-month, thirteen 3-month, ten 6-month, seven 9-month and 4 twelve-month historical volatilities. Table I shows the historical volatilities used to construct the volatility cone.

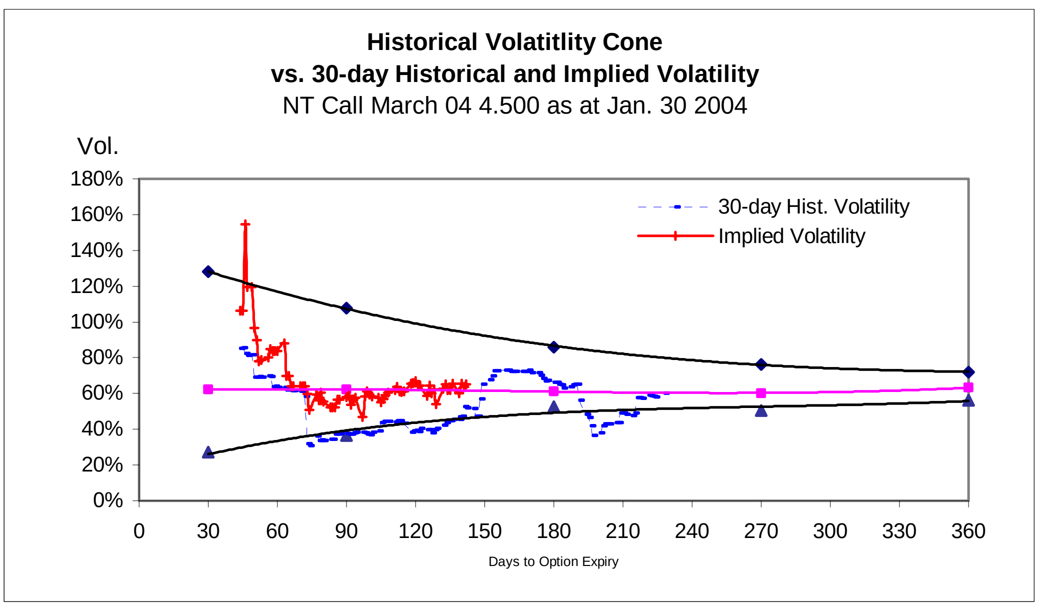
By plotting historical volatilities with different time horizons over days to option expiry, we obtained the volatility cone of NT stock for the period starting today to one year forward, as shown in Figure I. Note that the period runs from right to left. We have also overlaid the 30-day historical volatilities and NT March 03 4.500 call option implied volatilities on the graph to compare the current volatility level with the corresponding historical volatility performance for exactly the same time to expiry. Typically, implied volatilities are taken from at-the-money options.

Table I - Nortel Networks Stock Historical Volatilities

Period ending*	1-Month	3-Month	6-Month	9-Month	12-Month
Jan-04	92.62%				
Dec-03	27.11%				
Nov-03	41.42%	65.09%			
Oct-03	39.05%	36.43%			
Sep-03	84.88%	59.36%			
Aug-03	30.83%	57.11%	61.30%		
Jul-03	64.66%	64.65%	52.65%		
Jun-03	45.01%	50.33%	55.10%		
May-04	41.04%	52.62%	54.98%	58.67%	
Apr-03	46.63%	45.86%	56.14%	50.50%	
Mar-03	46.63%	45.86%	56.14%	50.50%	
Feb-03	60.17%	54.50%	53.56%	54.87%	57.76%
Jan-03	86.30%	71.07%	59.81%	61.53%	56.33%
Dec-02	127.96%	97.76%	76.60%	69.13%	66.83%
Nov-02	98.12%	107.87%	86.00%	76.40%	72.07%
Days to EXPIRY	30	90	180	270	360
Maximum	127.96%	107.87%	86.00%	76.40%	72.07%
Mean	62.16%	62.19%	61.23%	60.23%	63.25%
Minimum	27.11%	36.43%	52.65%	50.50%	56.33%

* Period ends on the last trading day of each month

Figure I - Historical Volatility Cone of Nortel Networks as at January 2003
30-day Historical Volatilities vs. Implied Volatility



Time period for historical cone: January 2004 back through November 2002
Implied volatilities end on February 5, 2004

Intuitively, the volatility cone gets its name from the shape of the volatility boundaries. One of the most important implications of the volatility cone is that short-term volatilities tend to fluctuate within a much wider range around its mean than do long-term volatilities. In this case, we find NT 1-month historical volatilities varied dramatically within a range of 100% (Max. - Min. = 127.96% - 27.11%), while 9-month historical volatilities varied within a range of 26% (76.40% - 50.50%).

From an options trader's perspective, however, the biggest concern when using volatility cones is deciding whether the options are cheap or expensive. Experience indicates that traders are accustomed to comparing implied volatilities with 20- or 30-day historical volatilities to identify investment opportunities. This could be misleading; for example, implied volatilities for the period of late October 2003 to early January 2004 run well above historical volatilities for a considerable time. However, this does not mean current implied volatilities are excessively high. In fact, implied volatilities are lying around their normal mean.

Conversely, based on the cone, one might feel that the volatility level for the period of late January 2004 and early February is higher than normal, representing trading opportunities for taking short volatility positions. In this case, traders would be at least more confident using volatility cones in making their decisions, rather than simply comparing implied volatility with historical volatility data.

Although volatility cones provide traders with a useful and potentially profitable tool in determining whether options volatilities are too high or too low, investors should nonetheless check whether substantial changes in the government's economic policies or a company's capital structure are significantly affecting the long-term volatility dynamics that drive the options market.

Conclusion

We have applied the volatility cone to a practical real-life case using Nortel Networks stock options to show that traders can use a well-recognized volatility analysis technique to identify potentially profitable trading opportunities.

Time horizon matching is crucial to make an appropriate comparison between implied and historical volatilities. Time periods for computing historical volatilities should precisely match the remaining life of the options under analysis.

Volatility mean reversion is another valuable characteristic that we observed from empirical evidence and which we combined with a historical volatility data set to forecast volatility trends for different times to expiry.

References:
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