STANDARD &POOR'S

July 2008

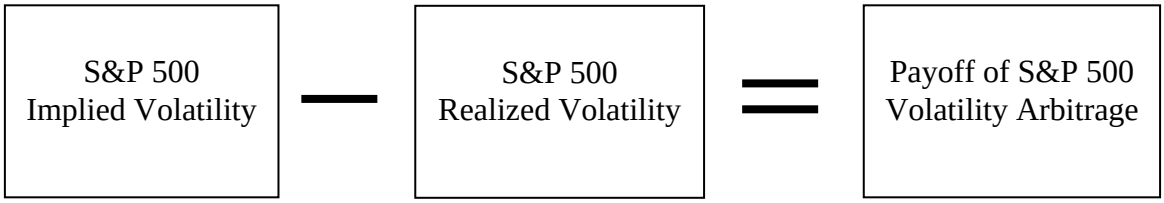
Volatility Arbitrage Indices – A Primer

Keith Loggie
keith_loggie@sandp.com
(212) 438 3552

- Volatility arbitrage is morphing from a niche institutional strategy to mass market, index-linked products.
- Volatility arbitrage strategies attempt to take advantage of the difference between the implied volatility of an asset and its realized volatility.
- Variance swaps are ideally suited to capturing the difference between implied and realized volatility.
- Volatility arbitrage indices, such as the S&P 500 Volatility Arbitrage Index, measure the performance of a tradable short variance swap strategy that is long implied volatility and short realized volatility.
- Since 1990, the S&P 500 Volatility Arbitrage Index has outperformed the S&P 500 at an annualized rate of more than three percentage points while having one-third of benchmark volatility. It has never had a twelve-month negative return period.

Volatility Arbitrage

In broad terms, volatility arbitrage can be used to describe trading strategies based on the difference in volatility between related assets, for instance the implied volatility of two options based on the same underlying asset. However, the term is most commonly used to describe strategies that take advantage of the difference between the forecasted future volatility of an asset and the implied volatility of options based on that asset. This strategy is often implemented through a delta neutral portfolio consisting of an option and its underlying asset. The return on such a portfolio will be based not on the future returns of the underlying asset but rather on the volatility of its future price movements. Buying an option and selling the underlying results in a long volatility position, while selling an option and buying the underlying results in a short volatility position. A long volatility position will be profitable to the extent that the realized volatility on the underlying is ultimately higher than the implied volatility on the option at the time of the trade.

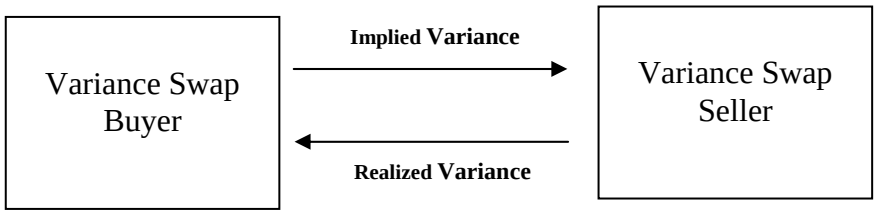


While delta neutral options-based trades provide a means for investing based on a view of future volatility, they do present some drawbacks. Since the delta of an option changes as the price of the underlying changes over time, a portfolio consisting of an option and its underlying that is initially delta neutral will soon no longer be so. At this point, the performance of the portfolio is no longer based solely on volatility of the underlying but also on the performance of the underlying. This can be prevented by continuous delta hedging, or rebalancing of the portfolio to ensure that it is delta neutral. However, this not only creates transaction costs but also is not feasible for traders as they cannot constantly alter their hedge. Thus the position will generally not be solely dependent on volatility and is therefore not an ideal means of trading volatility.

Variance Swaps

An alternative to options based volatility trading is variance swaps. In a variance swap, one leg is valued based on the released variance (volatility squared) of the underlying asset, as measured by logarithmic returns, while the other leg, the strike, is set at the inception of the swap and is based on the squared amount of the implied volatility of the underlying asset at the time the swap is struck. The strike price of the swap is determined by the implied volatility of the options currently traded in the market based on the underlying asset. Thus a variance swap position is equivalent to a portfolio of options on the underlying and can be hedged in such a manner. A long variance swap position will profit if the realized variance of the underlying asset is greater than the implied variance at the time the swap is struck. A variance swap provides pure exposure to volatility, as, unlike options prices, its value is based solely on changes to volatility.

The payoff of a variance swap is equal to the difference between realized variance and implied variance, multiplied by the number of contract units. The number of contract units is set such that if the realized volatility is one volatility point above the strike the payoff to the receiver of realized volatility will be equal to the notional value of the contract[1].



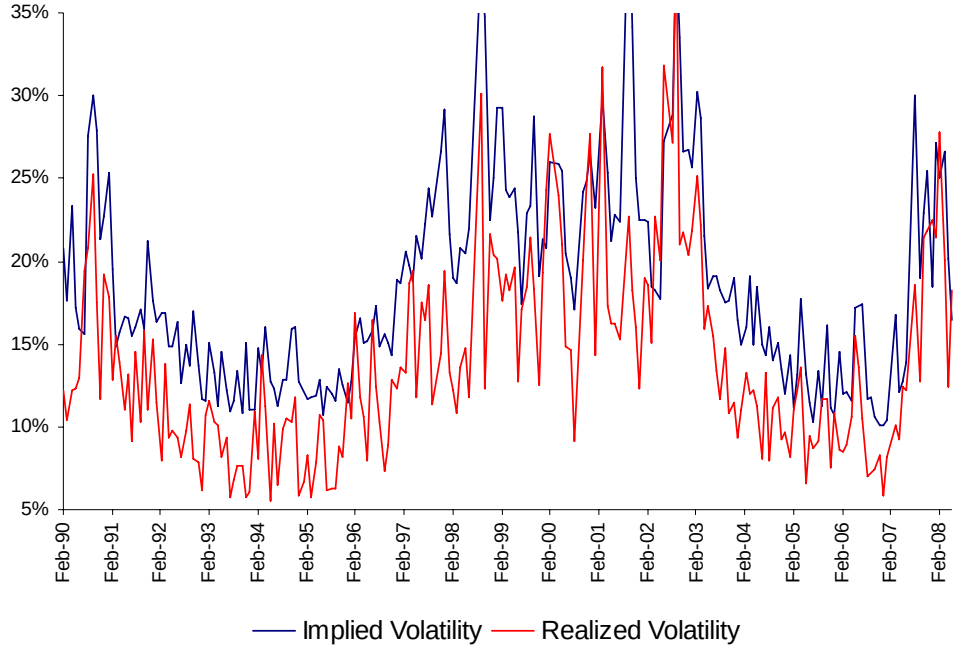
The variance swap market has grown exponentially over the past decade and is among the most liquid equity derivatives contracts in over-the-counter markets. Whereas the most liquid underlying is S&P 500, there is a market in EuroStoxx 50, FTSE 100 and Nikkei 225 as well.

[1] Refer to http://en.wikipedia.org/wiki/Variance_swap for a quick reference to variance swaps. For a detailed explanation, refer to "A Guide to Volatility and Variance Swaps" in the summer 1999 issue of The Journal of Derivatives.

Implied and Realized Volatility

An interesting characteristic of volatility is that for most traded assets, implied volatility tends to be higher than actual realized volatility. This is due to the fact that options are often used as a hedge or insurance. An investor will purchase a put option to hedge against large downward price movements or a call option to hedge against large upward price movements. The options market is in many ways similar to the home insurance market. Investors using options buy protection from changes in prices, much as a homeowner purchases insurance against fire, flood damage, etc. In both cases the provider of the insurance is paid a premium to compensate for the risk that is being taken. Similar to how insurance companies price their policies such that they expect to make a profit based on estimates of their eventual payouts, options writers will only be willing to write options if they can expect a sufficient expected profit to compensate for the risks they are assuming. Thus, options and options-based structures such as variance swaps will tend to be priced at a higher implied volatility than is actually expected to be realized.

Exhibit 1: Implied and Realized Volatility of S&P 500



Source: Standard & Poor's, CBOE.

Based on above discussion, writers of options and investors who take a short volatility position in a variance swap or similar product should profit over time. Historical data bears this out. The most popular underlying for variance swaps is the S&P 500. The implied volatility of the S&P 500 is measured by VIX, the CBOE Volatility Index. It measures the implied volatility of the S&P 500 based on the entire strip of S&P 500 options contracts. It uses the near term and next term options to calculate the implied volatility of the S&P 500 over the next 30 calendar days. Exhibit 1 tracks implied volatility of the S&P 500 as measured by VIX against the actual realized volatility for the following one month period. The start and end dates of each monthly period are determined by the expiration date of VIX options, generally the third Friday of each month. One can see that in general the implied volatility is higher than realized volatility.

The trend for implied volatility to be higher than realized volatility is quite consistent. Exhibit 2 shows that implied volatility exceeds realized volatility in 86% of the months. Furthermore, the average and median differences where implied exceeds realized is more than the months where realized exceeds implied.

Exhibit 2: One-Month Implied versus Realized Volatility

	Implied Exceeds Realized	Realized Exceeds Implied
Number (%) of Observations	190 (86.36%)	30 (13.64%)
Average Monthly Difference	5.34%	-3.63%
Median Monthly Difference	5.00%	-3.13%

Source: Standard & Poor's. Data from February 1990 to June 2008.

Indexation of Volatility Arbitrage

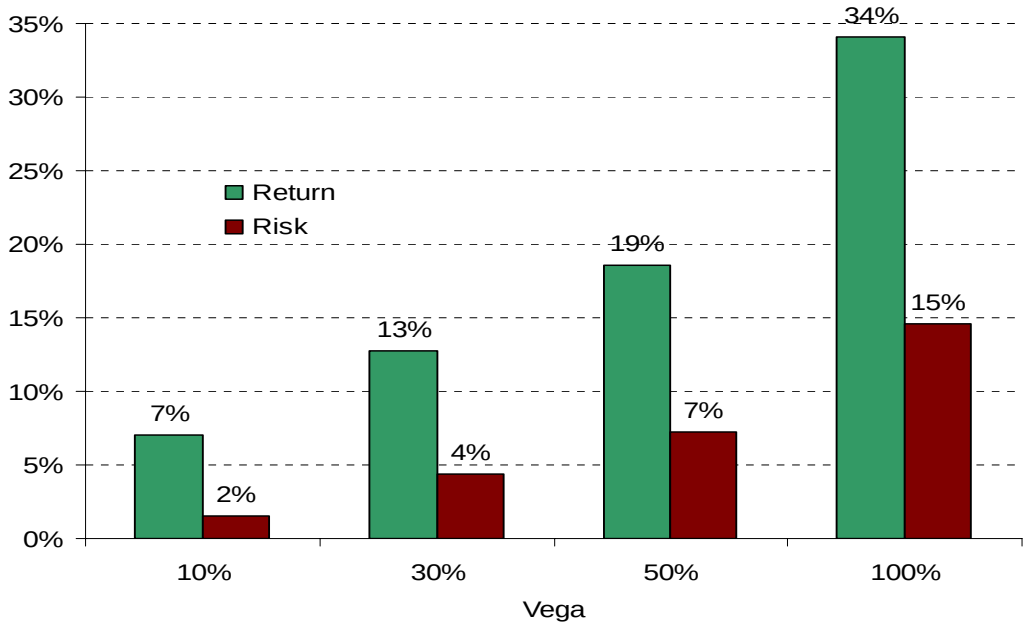
Over the past year, transparent indexation of volatility arbitrage has been introduced to serve as benchmarks for volatility arbitrage strategies and to serve as underlyings for index-linked products. The S&P 500 Volatility Arbitrage Index measures the performance of a variance swap strategy that consists of receiving the implied variance of the S&P 500 and paying the realized variance of the S&P 500. The index assumes a one-month variance swap is entered into on the third Friday of a given month and is held until the third Friday of the following month, at which time the position is rolled over. The index is calculated on a price return (unfunded) and total return (funded) basis. The total return index includes interest accrual on the notional value of the index based on the one-month U.S. Dollar LIBOR rate.

The implied variance used for the index, equivalent to the strike price of a corresponding variance swap, is measured based on the average level of VIX between 12.00 PM and 1.00 PM on the roll date, less one percent to account for implementation slippage. The performance of the index is calculated based on the difference in the implied variance less the realized variance of the S&P 500 from the prior rebalancing date through the current date. This difference is multiplied by the variance notional, equal to vega (a volatility exposure modifier) divided by twice the strike price (which converts volatility points into dollar amounts).[2] The choice of vega is an important determinant, and probably the principal qualitative element in design of volatility arbitrage indices. As Exhibit 3 shows, the higher the vega, the higher the expected return and risk from the index. For the S&P 500 Volatility Arbitrage index, the vega is set at a level of 30%.

Alternative formulations of volatility arbitrage indices could use a different variance swap tenor (for example one-month instead of three-months), a different source of the strike (traders' variance swap quotes instead of VIX), and a different vega.

[2] For more details, please refer to the methodology document at the link below:
http://www2.standardandpoors.com/spf/pdf/index/SP_Volatility_Arbitrage_Index_Methodology_Web.pdf

Exhibit 3: Impact of Vega on Volatility Arbitrage Index Returns



Source: Standard & Poor's. Data from February 1990 to June 2008.

The S&P 500 Volatility Arbitrage Index has history back to February 1990. The strategy has outperformed the U.S. equity market as measured by the S&P 500 by more than 300 basis points per year. More importantly the strategy has resulted in consistent positive returns. It has a very low annualized standard deviation of 4.38% versus 14.75% for the S&P 500. Out of 220 monthly observations it has had a negative return in only 31 months. The strategy has yet negative return for any twelve month period and has a much lower maximum drawdown.

Exhibit 3: Return and Risk Characteristics of S&P 500 Volatility Arbitrage Index

	S&P 500 Volatility Arbitrage		***S&P 500***	
	Annualized Return	**Standard Deviation**	**Annualized Return**	**Standard Deviation**
3 Year	8.26%	4.44%	4.69%	13.02%
5 Year	10.31%	3.66%	7.75%	11.94%
10 Year	11.49%	4.94%	3.49%	17.36%
Since Inception	12.72%	4.38%	9.21%	14.75%
Correlation with S&P 500	0.478		1.000	
Correlation with Lehman Aggregate	-0.029		0.013	
Percent of Months Positive	85.91%		61.36%	
Largest Drawdown	-6.35%		-41.71%	

Source: Standard & Poor's. Data from February 1990 to June 2008.

Conclusions

Volatility arbitrage is morphing from a niche institutional strategy to mass market, index-linked products. Volatility arbitrage indices, such as the S&P 500 Volatility Arbitrage Index, have shown consistent positive performance and low volatility. As with any arbitrage strategy that gains in popularity, increase in arbitrageurs may tighten the spreads between implied and realized volatilities in the future. However, as long as there is an insurance premium in the options market, there will be room for volatility arbitrage. The key issue that will drive returns in the future will be the size of the protection seeker market versus the size of the arbitrageur market.

Disclaimer

The S&P 500 Volatility Arbitrage Index was officially launched on January 17, 2008. The returns of the index from February 20, 1990 to January 17, 2008 are back-tested by applying the published index methodology.