RealVol®

Strategies

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Demand Derivatives Corp.

$$\sqrt{\frac{252}{n}\sum_{t=1}^{n} R_t^2}$$

Volatility Hedging — Turn Up the Static!

Until the advent of RealVol futures contracts on realized volatility, the only way to offset some of the gamma and vega (also known as kappa) risk of an options book in a listed instrument was to trade more options. For a market-maker, crossing the spread to execute feels like "throwing money away." This is because the essence of market-making is to buy as close to the bid as possible, sell near the offer, and then manage the risk of the book, via hedging, to capture the small perceived advantage.

RealVol futures, as we shall see, can play a role in this hedging activity. To get the best hedge possible, a dynamic adjustment is required. However, dynamically hedging the volatility of an options book may not be possible. Two reasons are that the RealVol futures market are not yet available, and even when launched, may not be liquid enough to execute efficiently, and the investor may not have the time or desire to adjust the position periodically. Regardless, there is a cost to dynamically adjusting volatility exposure and that cost needs to be compared to the cost of doing so on a static basis. A static hedge is one where the initial exposure is calculated and not touched until the RealVol futures contract expires. Here are some reasons a static hedge may be preferable to a dynamic one:

"Static hedging may be the answer."

- Easier to manage (put on the position, then hold until expiration)
- Considerably less costly (no additional transaction fees)
- Guaranteed exit (expiration)
- Placing a simple limit order often stimulates other market participants interested in taking the other side

Obviously, there is a trade-off. If one is unable or unwilling to adjust the hedge as needed, the result is a hedge that is less than optimal. The question becomes: how much less than optimal?

Warning

As of this writing, RealVol futures on equity indices have not yet begun trading. All results are hypothetical and historical. The hypothetical results derive from a pricing model. All models have assumptions that may or may not be valid. Actual market prices, had they been available, may not have coincided with the model's calculations. In addition, even if the model's prices had been available in the marketplace, historical performance is not an indication of future results.

"RealVol Futures ... are designed to hedge both the vega and gamma risk of an options book."

Delta-Hedging

It is a well-known and practiced technique to hedge the directional exposure of an options book with the underlying. Known as delta-neutral hedging, the strategy involves calculating the net delta of all positions in the book and then offsetting that value with an equivalent and opposite delta position in futures.

Options prices, with respect to the underlying market value, are represented by a curved function, while futures prices vary linearly. Calculating the delta is, therefore, equivalent to establishing the tangent to the curve. But, that "perfect" hedge is available only at one point on the curve. As soon as the market moves, there is a new tangent line that no longer matches the perfect hedge that was established earlier.

Gamma

Obviously, if the options curve is nearly flat, or linear, then the hedge can remain over a wide range of underlying prices, without adjustments. However, if the curve is more pronounced, frequent adjustments to the hedge may be required. The measurement of the amount of potential adjustments needed is the gamma. Gamma cannot be hedged with the underlying.

Vega

Another risk factor is the tendency of the entire curve itself, or specific portions of the curve, to rise or fall with a change in the estimate of future volatility. This exposure is known as the vega — the change in the price of options due to a change in implied volatility. Thus, gamma is the rate of change of the tangent to the curve (the delta), while vega is the shifting of the curve up or down, as options prices vary with implied volatility. Vega cannot be hedged with the underlying either.

RealVol Futures

RealVol futures come to the rescue! These instruments are designed to help hedge both the vega and gamma risk of an options book.

Simulation

With the above terms defined, let us now consider the results of a simulation to determine how well RealVol futures can hedge the risk of an options book. We first examine the basic parameters and various scenarios of the study, and then consider some further assumptions.

Basic Parameters

In this simulation, we assume that a market-maker gets filled on 800 offers to sell options in SPY (SPDR® S&P® 500 Trust, symbol SPY) with approximately one month remaining until expiration. The 800 options come from selling 100 each of four different strikes in both calls and puts. The strikes are at increments of 2.50, two up and two down. For example, if the index is 240.50, the nearest multiples-of-2.50 strikes are 240.00 and 242.50, and the next set outward are at 137.50 and 145.00. The researcher repeats this hypothetical process every month historically from 1990 through 2012.

Three Scenarios

The first scenario is to delta hedge the options book. Nearly every options market-maker delta hedges in order to reduce the directional-risk component of outright options positions. This will serve as our baseline portfolio (yellow plots).

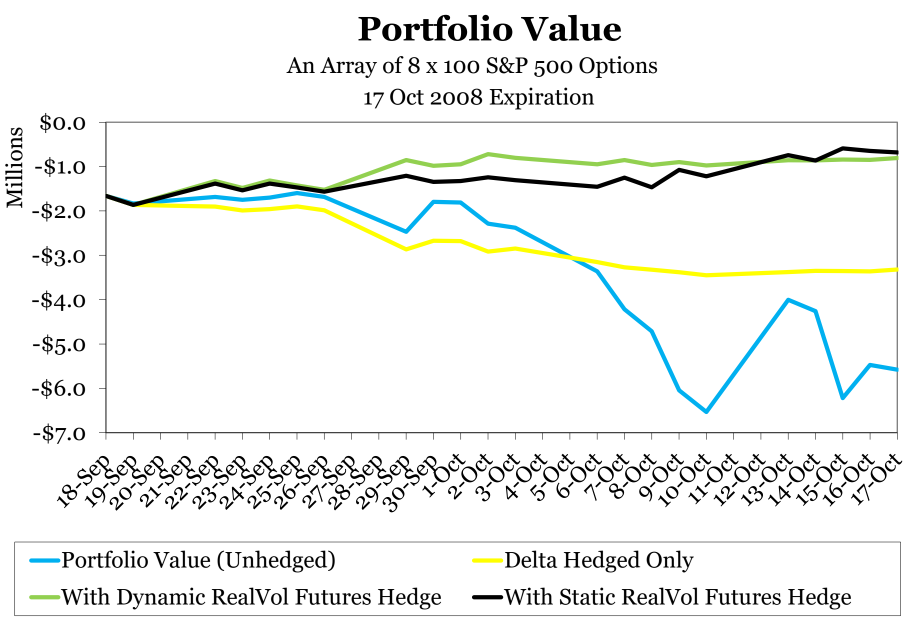
Scenario number two is to hedge both the vega and gamma risk of that book with RealVol futures in a dynamic process that adjusts the number of contracts each day at the close in response to the changing market conditions. In theory, this should be the optimal hedging scenario (green plots).

The third scenario is to enter into a volatility hedge using a *static* number of RealVol futures. Obviously, the vega and gamma hedges will no longer be as effective as they would be if the "perfect" hedge were recalculated, and readjusted, on a daily basis. Thus, it is clear that, if an optimal hedge is not implemented each day, the overall hedge to the options books is diminished. The question is, by how much? And the answer, of course, is "it depends," as each specific market scenario leads to its own unique set of results. However, running the simulation over a number of years provides historical data that should give the trader some insight into the historical effectiveness of the static hedge (black plots).

"The third scenario is to enter into a volatility hedge using a *static* number of RealVol Futures."

Further Assumptions

Theoretical value of the RealVol futures is the root-mean-square of the to-date realized volatility (the Partial Realized Volatility, or PVOL™) and theoretical price of a RealVol futures. The Heston model is used for this exercise. It is also assumed that all positions are held to expiration; that is, the market-maker cannot trade in or out of the options positions, but must manage the exposure with only the underlying futures and the new RealVol futures on a daily basis.

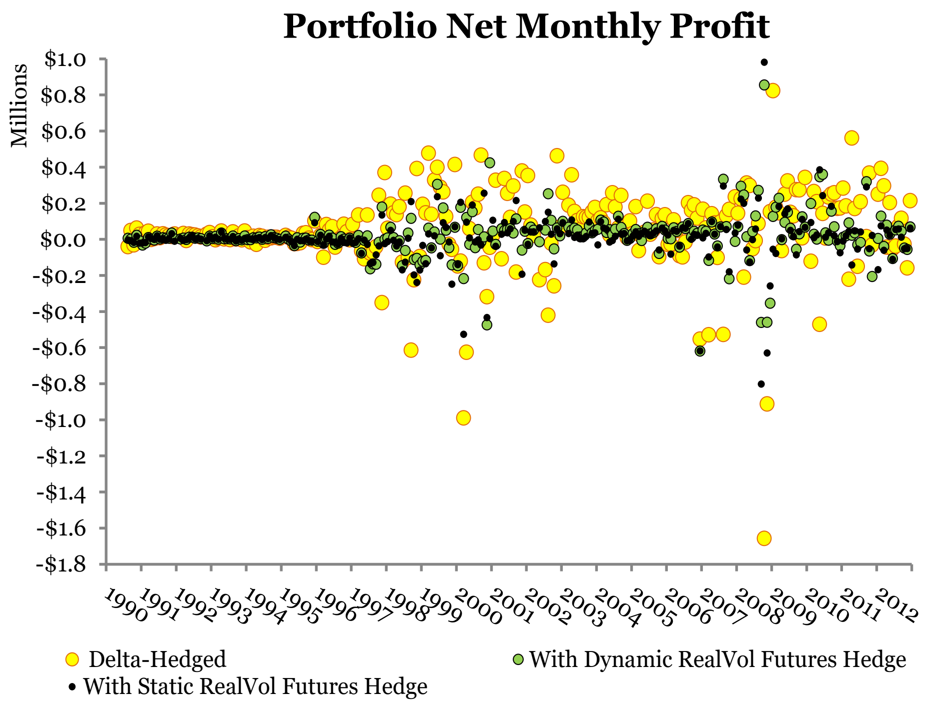


During the market break of 2008, significant losses occurred to those not hedging, or even delta hedging, a short options portfolio.

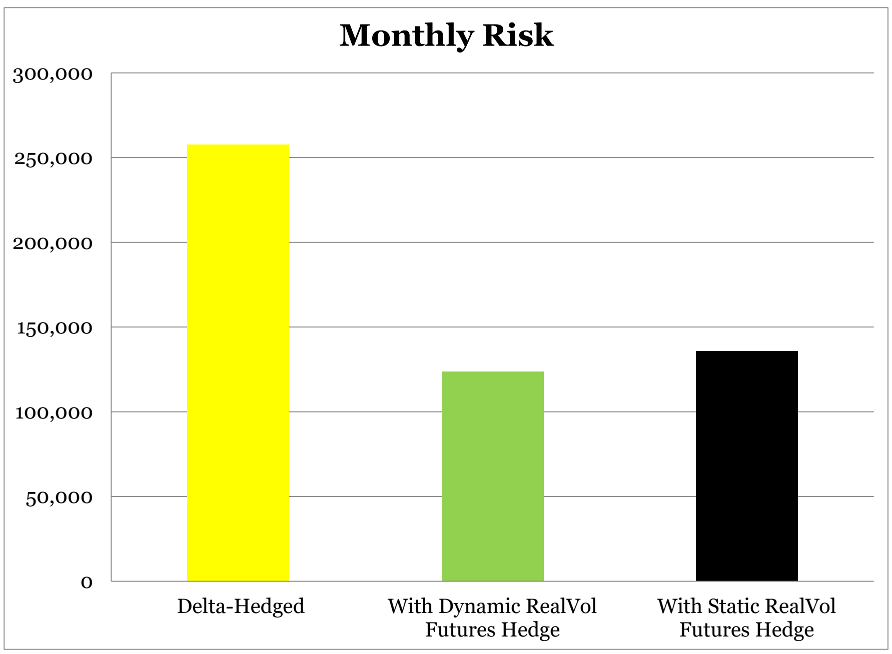
The chart above shows the changing portfolio value for four scenarios using the market break of 2008 as an example of a market under stress — the Oct 2008 expiration. Notice how a non-hedged and even delta-hedged portfolio incurred significant losses, in this example — over $3.9m and $1.7m, respectively. The dynamic RealVol futures hedge, in this example, gained $855k, and the static RealVol futures hedge gained $980k. The standard deviation (s.d.) for the unhedged portfolio was $878k per day. The delta-hedged-only portfolio was $225k, while the dynamic and static RealVol futures overlay hedges had a daily s.d. of $218k and $229k, respectively.

Of course, the value of a RealVol futures hedge during an extremely volatile market period, such as the one just studied, should be expected. But how will the strategy fare during other, less chaotic, periods? The two charts displayed on this page consider 23 years of data. The results are impressive.

To the right, and above, the net monthly profits of the total portfolios are displayed. Note the considerable dispersion of results around zero for the delta-hedged-only options book, compared to the more stable results obtained via the RealVol futures hedge. Options market-makers should take some solace in a methodology that could so effectively smooth out the P&L swings of their books.



Finally, consider, in bar-graph form below, the monthly portfolio risks. An original portfolio of 800 options, representing on average $927k of sold time premium, was established in each of the months. The monthly s.d. of the non-hedged portfolio (not shown) was $526k. The monthly s.d. for delta hedged was $258k for a 51% reduction in risk. Adding a dynamic or static RealVol Futures hedge on top of the delta-hedge portfolio had an s.d. of $124k and $136k, respectively. This means that a further risk reduction (from just delta hedging) of 52% and 47%, respectively, was achieved over the life of the study when RealVol futures were employed.



The bottom line is that, over the life of this study, adding a RealVol futures hedge on top of a delta-hedged options book effectively doubled the risk reduction compared to delta hedging alone.

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