Low Cost Hedging Strategies in a Volatile Market

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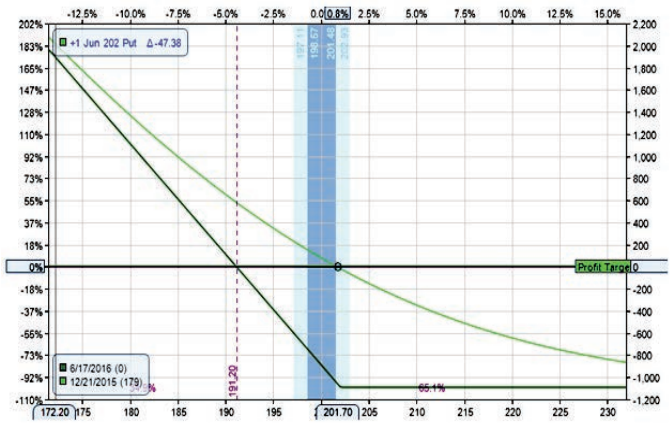
Asset allocators and portfolio managers (PM) have had many sleepless nights in 2015 with the global markets being very volatile. The S&P 500 has been essentially flat for 2015, the bond markets have been under press anticipating a rising interest rate environment, commodities have been under strong downward pressure and Europe is teetering on recession. The question is, where does a PM diversify? Should they reduce market exposure and take money off the table only to watch the market drift higher? Should they stay the course and be fully invested, not worrying about a 2008 type downturn, only to watch their portfolio lose half its value?

What if a manager can have his cake and eat it too; stay fully invested while utilizing low cost hedging techniques that are designed to manage portfolio risk?

A Hammer is Designed to Drive a Nail like an Option is Designed to Protect a Portfolio

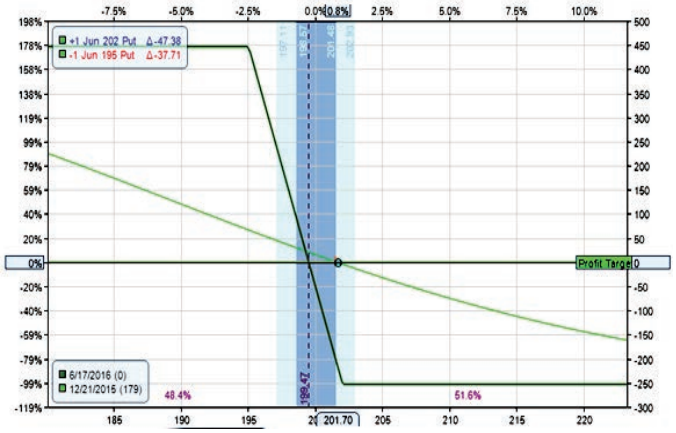
The popularity of exchange traded index options has grown exponentially in the last several years. Protective puts (see Fig. 1) are still a popular way to protect a portfolio; however, the cost of a protective put, especially in volatile markets, makes it prohibitive to be systematically used as a portfolio protection tool.

Figure 1: Protective Put



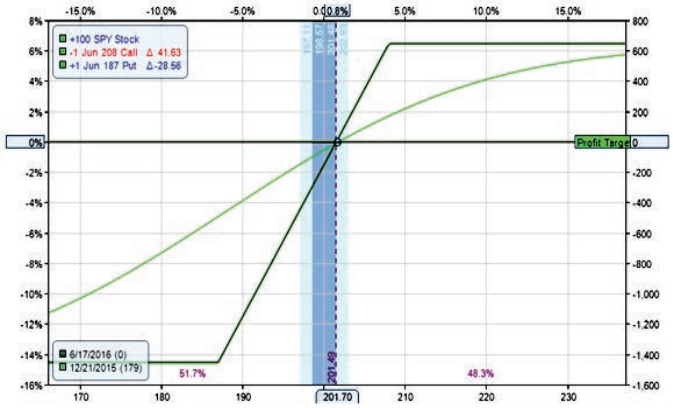
Many PMs reduce the cost of protection by either buying puts out-of-the-money (OTM), buying a put spread (see Fig. 2) or collaring, which is owning the underlying while selling an OTM call and buying a further OTM put (see Fig. 3).

Figure 2:Put Spread (Not including underlying asset)



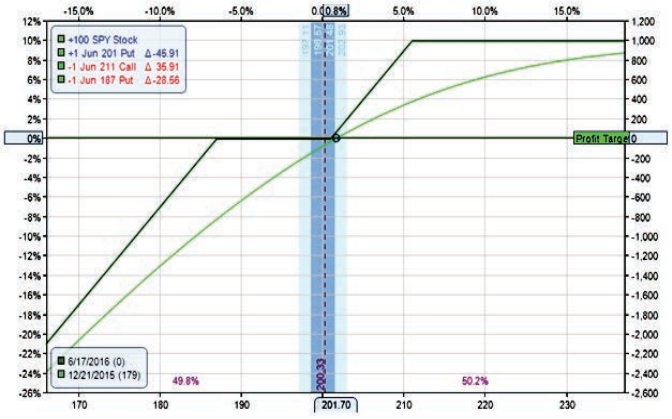
The spread trade, buying a put and selling a further OTM put, is still an expensive proposition and caps the protection.

Figure 3: Collar (with underlying)



The collar can be designed as a zero cost hedge but caps upside potential while the put protection is generally struck further OTM. If you were to combine the put spread with a collar your risk to return profile improves at a zero cost trade (see Fig. 4).

Figure 4: Zero Cost Put Spread Collar (with underlying)



The zero cost put spread collar in a volatile market causes the OTM options to become relatively more expensive. The heightened volatility allows for the selling of further OTM puts and calls to finance an at-the-money (ATM) put giving a better value proposition.

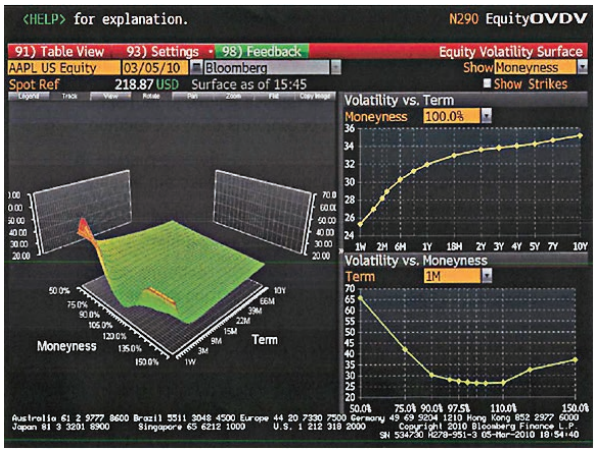
The Volatility Surface Holds the Secret to Low Cost Hedging

The general consensus is that it is cost prohibitive to hedge after market volatility has picked up. The implied volatility rises making options very expensive. The implied volatility is essentially the volatility implied by the demand for any option contract. As the demand of an option rises, the price rises. Can the rise in the price of options actually reduce the cost of hedging? Option prices vary depending on the moneyness of the option, e.g., at-the-money, out-of-the-money or in-the-money (varying strike prices within one expiration), and the expiry or term structure, e.g., 1 week, 1 month, 6 months, 1year (the length of an option contract).

Evaluating changes in the implied volatilities along the vertical (moneyness) and horizontal (expiry or term structure) is called the volatility surface (see Fig. 5) which, if used correctly, can reduce the cost of hedging.

The upper right hand corner of Figure 5 shows the term structure of an ATM option (100% moneyness) going out over time, 1 week, 2 months, 6 months, 1 year (horizontal skew). Implied volatility that rises as time increases is called contango. Contango represents the markets under normal conditions or markets that are not in a high volatility regime or stress. The lower right hand corner of Figure 5 represents the changes in implied volatility of all the options that expire in 1 month (vertical skew). In other words, how the implied volatility of 1-month options varies by its strike price. Implied volatility tends to rise for options struck above or even higher below where the spot is currently trading . This is called the volatility smirk or smile. As markets become more volatile, the implied volatility becomes more pronounced steeping on the wings.

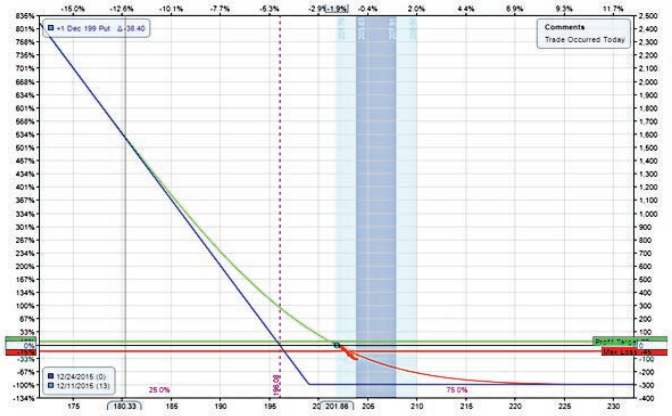
Figure 5: Volatility Surface of AAPL 03/05/2010



Creating Low Cost Hedging Trades when Volatility Rises

When markets become volatile interesting things happen to the volatility surface that makes hedging at a low cost very favorable. Figure 6 shows the purchase of a SPY 199 strike put option expiring on December 24th, 2015 (13 days) on Friday, December 11th, 2015. This protective put would provide a PM with a hedge for any potential volatility surrounding the Fed rate hike decision on December 16th. The SPY dropped 1.94% on Friday, December 11th to 201.86 causing the 199 protective put to cost $2.99 1.48% for two weeks of protection , which annualized would be 34.21%, far too costly for short term protection.

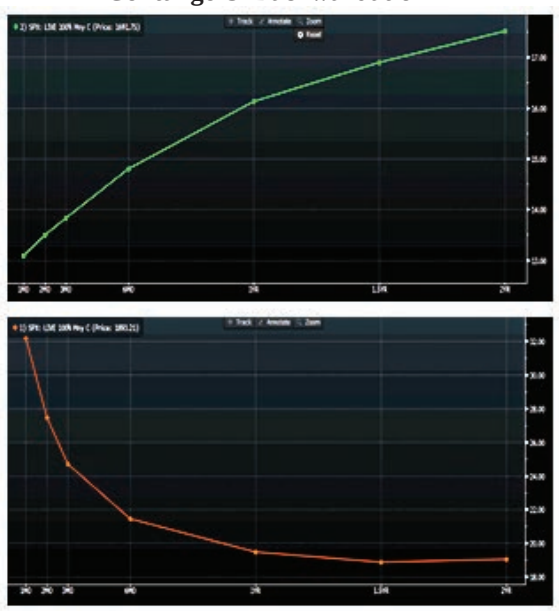
Figure 6: SPY Dec 24 199 Long Protective Put



The 1.95% drawdown in the S&P 500 (SPY) on the Friday before the Fed announcement caused the volatility surface or, more specifically, the term structure to change from contango to backwardation (see Fig. 7). What this means is the shorter term options are relatively

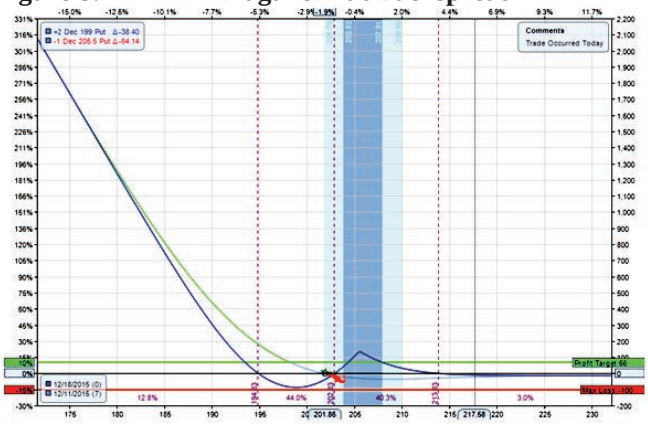
more expensive (implied volatility) than longer dated options.

Figure 7: Term Structure of Volatility Contango & Backwardation



If we were to take advantage of this and use the overpriced short term option to pay for a longer term hedge, on Dec. 11th we could sell a SPY Dec 19 205.5 put for $5.85 (6 days til expiration) and buy two SPY Dec 24 199 puts (13 days til expiration) for $2.99 each, resulting in a net cost per contract of $0.13 (see Fig. 8). This represents 0.064% for two weeks of protection or 1.78% annualized. This trade takes advantage of the horizontal skew present in the market by selling the relatively expensive option and buying the relatively cheap options, in implied volatility terms.

Figure 8: Diaganol Put Backspread



If the market should drop toward the 199 strike, by expiration your loss would be greater than the initial outlay of $0.13. In-light-of-the-fact this trade has a positive vega of 18.65, as the market drops towards the 199 strike, vega will rise, moving the expiration profit and loss (P/L) toward a breakeven. Figure 9 shows how a 4-point rise in implied volatility turns the P/L into a breakeven under the assumption that the implied volatility of each option contract rose by 4 vol points.

Figure 9: SPY Diaganol Put Backspread (4pt Imp Vol Increase)

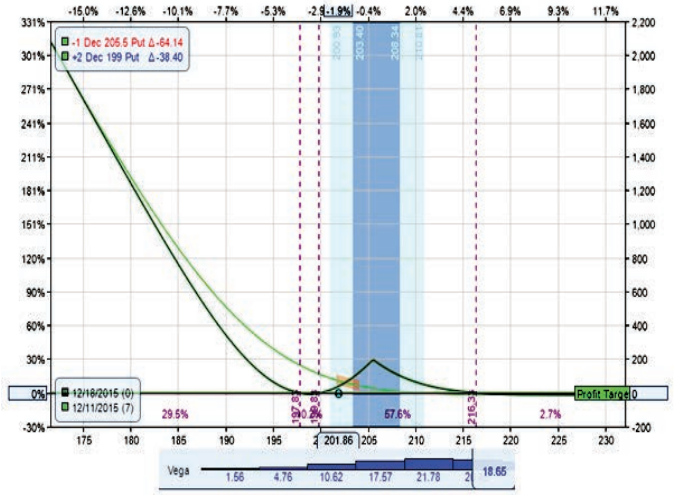
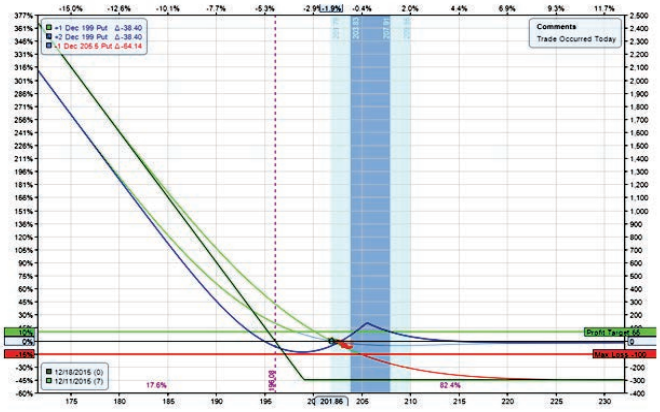


Figure 10 shows a comparison of a protective put versus a diagonal put backspread. The cost to carry a hedge with a protective put at 34.21% annually compared to diagonal put backspread at 1.78% annualy is very reasonable in volatile markets making this hedge much better for a PM.

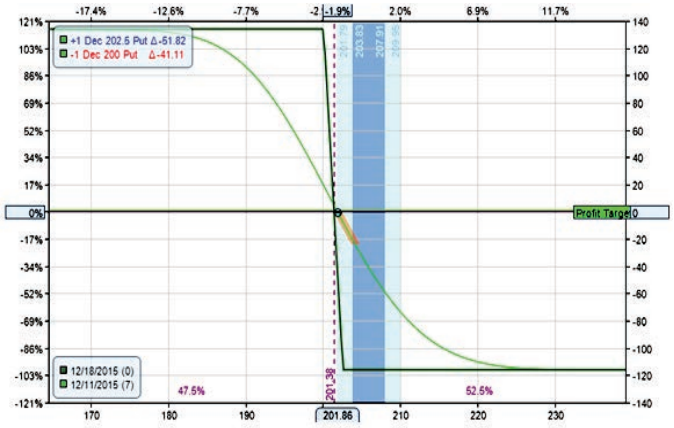
Figure 10: Protective Put vs. Put Diaganol Backspread



Another very popular hedge strategy is a put bear spread as it reduces the cost of the hedge by selling away the potential for unlimited gains on the hedge (see Fig. 11). On Dec. 11th a SPY Dec 19 202.5/200 put spread (7 days til expiration) was purchased for $1.16 which represents a cost 0.57% or 25.96% annually. The hedge potential is $1.34 profit. A PM would need to invest $1.16 to make $1.34.

1.The example shows the volatility surface for AAPL on 03/05/2010. A volatility surface can be extrapolated for any optionable equity or ETF with sufficient liquidity and expirations/strikes.
2. For example, if AAPL market price (spot) is at 218.87, a 110% moneyness option would represent the 240.76 strike call option and a 90% moneyness option would represent 196.98 strike put option. These are not actual listed option strikes.
3.This % cost represents the cost of the hedge (2.99) divided by the price of the underlying (201.86), from here on out any % costs will follow this methodology. The annualized costs consists of extrapolating this cost for the duration of the trade over the course of a year.

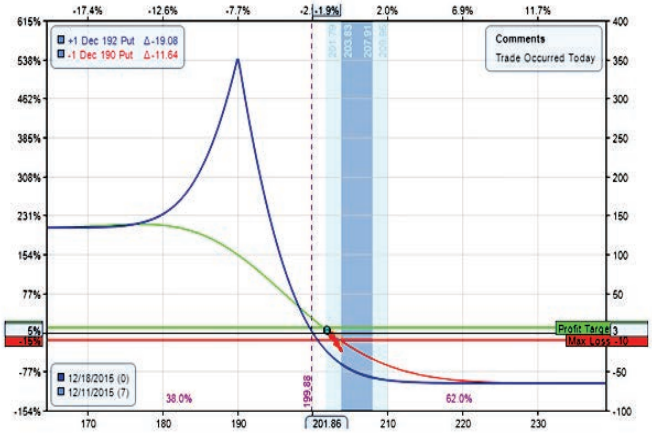
Figure 11: Bear Put Spread



By utilizing the changes in the volatility surface when markets turn down we can utilize the expensive front week option to finance a longer dated option. By taking advantage of the elevated implied volatility both horizontally and vertically, a better hedge can be constructed. Comparing the implied volatilities of all the options within the same expiration is called the vertical skew. Comparing the implied volatilities of all the options of the same strike at different expirations is called the horizontal skew.

Let's use these elevated skews to create a better hedge position. Figure 12 shows that on Friday Dec. 11th a SPY Dec 19 190 put (7 days til expiration) was sold for $0.65 at an implied volatility of 37.51% while simultaneously buying a SPY Dec 24 192 put (13 days til expiration) at an implied volatility of 31.45% which created a very favorable risk/return profile.

Figure 12: Diaganol Put Bear Spread



Comparing a traditional put bear spread with a diagonal put bear spread is a much better hedge position. The trade would have cost $0.65 versus $1.16 for a traditional put bear spread.

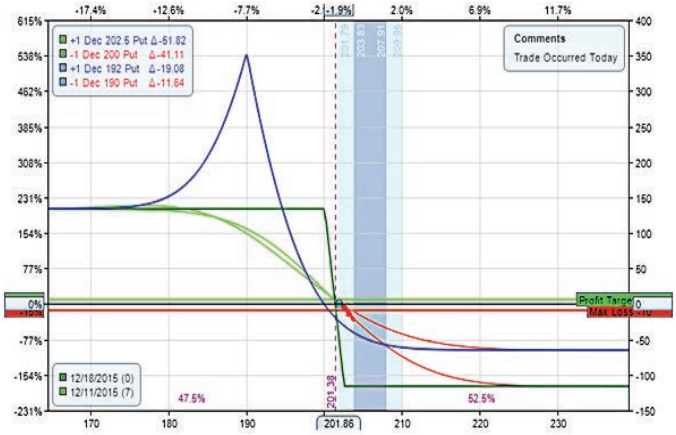
Analysis	Margin	Cost	P/L	P/L%	Delta	Gamma	Theta	Vega
Position	65.00	-65.00	3.50	5.38%	-7.43	0.40	2.14	4.89
Model	116.00	-116.00	0.00	0.00%	-10.71	0.16	-0.29	0.27

The trade cost $0.65 or 0.32% for a two-week hedge which comes to 8.61% annually versus a more expensive put bear spread which would cost 0.57% for a one week hedge, or 14.92% annually. The maximum return on the hedge is $1.34 on $0.65 invested which is a much better risk/return ratio; however, if the market should settle at 190 on 12/19/15 the profit jumps to $3.36.

Figure 13 shows a comparison between a diagonal put bear spread versus a traditional put bear spread. By utilizing the changes in the volatility surface as markets become volatile low cost hedging opportunities arise.

An ancillary benefit of the diagonal put bear spread is by selling a short term put to finance the long term put, when the markets move higher in anticipation of a favorable Fed decision, you could have let the short put expire worthless, leaving you with an inexpensive long put going into years' end.

Figure 13: Diaganol Put Bear Spread vs. Put Bear Spread



In conclusion, If the volatility surface is evaluated both on the vertical and horizontal skew, there are opportunities that can be deployed in periods when the market volatility picks up that actually can reduce the cost of hedging. This paper examines short term hedges around a pending Fed decision however the same concept can used for longer dated hedges with favorable results when the market volatility rises and the term structure moves into backwardation.

4.Vega is a measure of an options change in price caused by a 1 point change in the implied volatility of the option

The Perfect Imperfect Hedge

Using VIX to hedge a portfolio is difficult in light of the fact that you are using volatility to hedge a portfolio instead of buying a protective put which is analogous to shorting stock. Volatility tends to rise when markets fall which makes investing in volatility an attractive alternative to buying puts, however volatility is an imperfect hedge and can be said to be more of a behavioral effect, which measures fear. No fear, no response. Volatility is an indirect or cross asset hedge which

at times can contain a degree of tracking error. There are times when volatility is less expensive than buying protective puts and times when it is more expensive. "A Study in Portfolio Diversification" , is a white paper that illustrates how to systematically buy volatility to hedge your portfolio. This section discusses using active hedging as opposed to systematically hedging a portfolio using volatility. The CBOE developed a product to invest in volatility called VIX. Although spot VIX isn't directly investable, options on the VIX futures are available as well as a number of exchange traded products (ETP's) in the market place. An ETP is an easy way to hedge with volatility however, the value proposition just isn't there for low cost hedging.

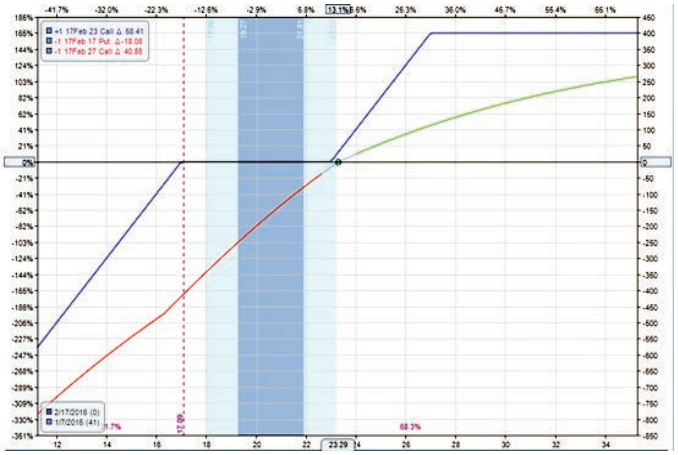
Zero Cost Hedge using VIX

On January 07, 2016, after a 7% drop in the S&P 500, one might have thought it was too late to purchase some form of protection. It wasn't! The market was offering a no cost hedge using monthly February VIX options.

Here is how we would have constructed the trade:

- Sell a Feb monthly VIX 17 Call at $ 0.72
- Buy a Feb monthly VIX 23 Call at $ 2.42
- Sell a Feb monthly VIX 27 Call at $ 1.70

Figure 14: VIX Risk Reversal Call Spread



As shown in Figure 14, this hedge costs $0 to enter with a potential max profit of $400 at expiration.

If markets were to rally and volatility were to mean revert at expiration, this hedge wouldn't be in danger of incurring losses until VIX reaches the 17 mark. VIX is highly kurtotic and positively skewed which means fear lingers. In volatile markets, VIX tends to have a higher floor. During the October 2015 rally the front month VIX future didn't go below 15, and that was with an 8% rally, which was a nice problem to have. This tactical hedge would help offset losses from an equity portfolio with exposure to the S&P 500.

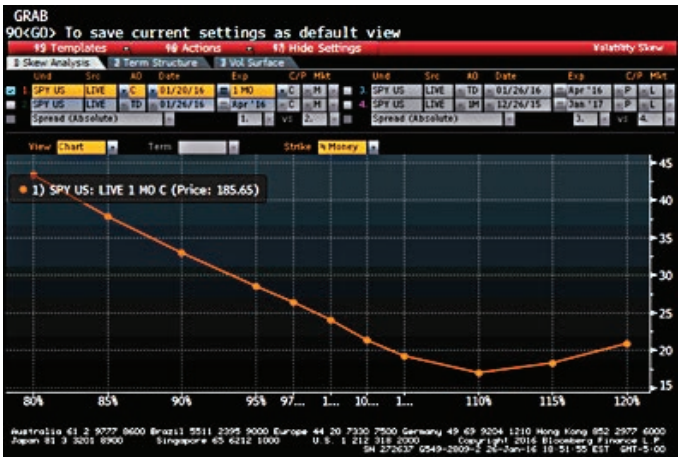
Delta Neutral Hedge

A proper hedge goes up as the market goes down however a hedge causes delta drag as the market goes up, causing the portfolio to underperform. The question is can you construct a hedge that goes up as the market goes down and does not drag should the market rebound, initially anyway? Think of this as a zero cost synthetic straddle.

On January 20, 2015 the S&P 500 (SPX) closed at 1859.48 down 1.16% from the open. The skew on the SPX was trading very steep, while the volatility of the VIX was relatively cheap VVIX/VIX.

The January 2016 selloff caused the SPX skew to steepen (the implied volatility of OTM puts)

Figure 15: SPX Skew



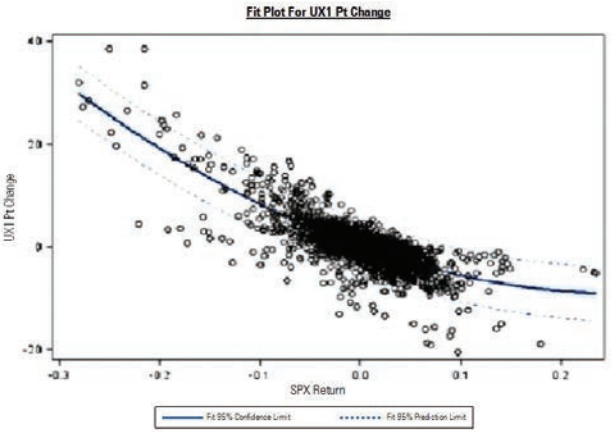
At the same time the skew on the VIX (VVIX/VIX, volatility of the VIX/VIX) actually dropped.

Figure 16: VVIX/VIX

This dispersion between two highly correlated assets would allow a portfolio manager to sell an OTM SPX put to buy a proper amount of VIX calls. If constructed properly, the cross asset hedge could be premium and delta neutral at inception. The idea of this trade is that

the historical relationship between the percentage change of the S&P 500 (SPX) to a one-point change in the VIX futures has a polynomial relationship (see Fig. 17).

Figure 17: Fit Plot For UX1 Point Change



In other words, the beta is not liner and increases exponentially as the market sells off. The rise of the VIX future increases as the S&P 500 runs down . On this historical regression, if the market should sell off, the long VIX call will make more than the loss from the short SPX put adding to a portfolio hedge and if the market should rally, the loss from the VIX call will lose less than the gain from the SPX put minimizing delta drag.

If we regress a point move in the S&P 500 (SPY) to a point move in the VIX over the last year we come up with a raw beta of -.475. At the close on January 20th you could have sold a February (Feb) monthly 170 SPY for $1.36 and purchased 32.5 Feb VIX call for $1.35 resulting in a credit of $0.01.

The 170 SPY had a delta of 15.52 while the 32.5 Feb VIX monthly had a delta of 35.74. In-light of the fact that delta represents equivalent share position, you can surmise that the trade isn't delta neutral (15.52/35.74). When you adjust VIX delta to SPY delta it becomes evident the trade is essentially delta neutral. Based on the beta between the SPY/VIX of -.475, you can convert the VIX deltas to SPY deltas by multiplying (-.475 beta) X (VIX delta 35.74) = 16.97 equivalent SPY deltas. At this point the trade is long 15.52 delta's and short 16.97 equivalent SPY delta's essentially making the trade delta neutral. The beauty of this trade is the convex relationship between SPY/VIX (see Fig. 17). The trade will be adding more negative delta (VIX) if the market drops and adding more positive delta's (SPY) if the market rises. This trade is similar to a synthetic zero cost straddle and great zero cost hedge.

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5. Beta is the rise in the dependent variable over the run of the independent variable
6. SPY represents the iShares exchange traded fund on the S&P 500