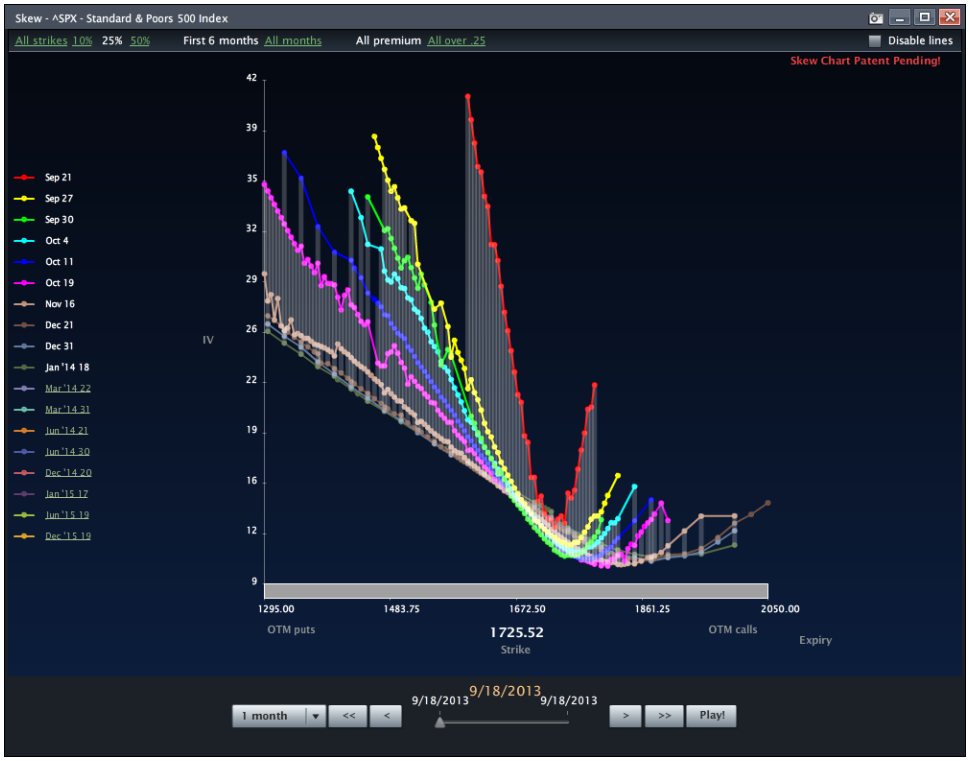
Isolating Index Skew

Vol Edge Trading

Adam M. Singh
adam@voledgetrading.com
(480) 862-9330

In this paper I will outline a method to price and analyze index skew using option premium. This is an alternative to the commonly used risk-reversal. Equity indices, such as the S&P 500, exhibit a unimodal, negative volatility skew. Meaning that implied volatilities for out-of-the-money put options (downside) are greater than OTM call volatilities. This phenomenon is primarily due to the market's heightened concern about left-tail risk, and thus the demand for downside protection inflates the implied volatilities of OTM put options. Below is an example of SPX skew:



Although the shape of the curve for index option volatilities is relatively persistent throughout time (well, since 1987), the slope differs from time-to-time depending on market sentiment, and hedge levels. When trading options, it is often beneficial to be aware of the prevailing level of skew. Furthermore, the ability to price and analyze skew can lead to potential trade setups.

Let's begin by looking at the at-the-money 30-day SPX straddle. We can see below that the spot price of the SPX is currently 1725. Therefore, we will take the quoted premium for the 1725 straddle that expires on October 18. By adding the mid-prices (fair values) of the 1725 call and put, we arrive at a premium of 47.70 for the ATM straddle.

**I would like to thank Becket Strom for the original "Pitch-fork" concept.*

^SPX	1,725.52	20.76
After Hours	1,725.52	1.2%
1,722.51 x 1,729.65	1 x 1	

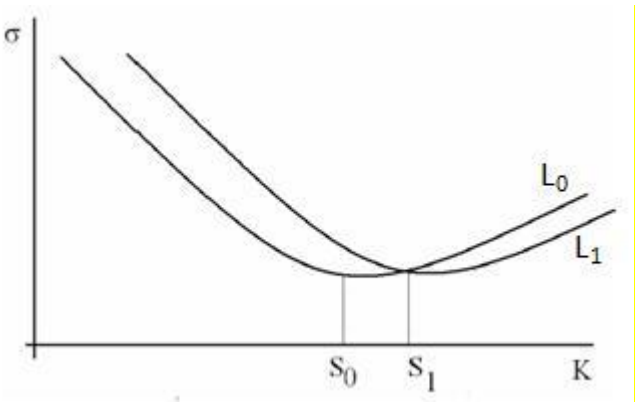
IV	Bid	Ask	Strike	Bid	Ask	IV
12.54	24.90	26.50	SPX Oct19 1720	22.10	23.70	12.41
12.24	21.90	23.40	SPX Oct19 1725	24.10	26.00	12.21
12.06	19.30	20.70	SPX Oct19 1730	26.40	28.20	11.98

The next step is to price the first downside strike that is outside of the straddle range. So, with SPX spot at 1725, the straddle is $47.70; (1725 - 47.70 = 1677.30). Thus, we will look to the 1675 strikes. Using this strike price, we will now quote a weighted 1675-strike combo, in a 3:1 ratio favoring puts (selling 3 1675 puts against one short 1675 call). 1675 put = 10.00, 1675 call = 58.15 (10.00*3) + (58.15*1) = $88.15 credit.

IV	Bid	Ask	Strike	Bid	Ask	IV
14.71	56.90	59.40	SPX Oct19 1675	9.60	10.40	14.30

Now that we have the premium value of the spread, we will solve for the risk of a strike touch, assuming a flat-volatility surface, and a gain due to sticky-delta (perhaps slightly beyond the scope of this paper, but I will summarize below).

> [Keep in mind, assuming a flat volatility surface is strictly theoretical, but will serve as a basis for obtaining a premium value of skew. The raw premium of the spread is of little value without putting it in some sort of historical context. Therefore, it is necessary to calculate a rolling 30-day straddle volatility based upon listed SPX CBOE straddle vols to arrive at an average volatility figure, which will be used as the volatility input to price the 3:1 spread (hence, flat-vol). In order to simply things for demonstration purposes, we will simply use the volatility of the 1725 straddle.]
>
> [Sticky-delta simply means that volatility skew remains unchanged with money-ness. For example, say the implied vol of an ATM option is 30% with the spot of the index at 100 (assuming zero rates). Now, if the index drops to 90, the volatility of the 90-strike (ATM) option would now be 30%. For further reading, Emanuel Derman's work on volatility surfaces is the main source for this theory. His papers are widely published on the internet.]



To solve for the strike-touch risk, simply double the ATM-straddle price from above ($47.70*2 = $95.40). This is value of a pinned straddle at an SPX spot price of 1675 under a flat-vol assumption. Basically, if the 1675 price level is touched we would be short four ATM options (which is why we use the ATM straddle multiplied by 2). Granted, at this level our position would have a very large long-delta value, but we are solving for strike-touch risk, not our aggregate deltas. So, the credit we receive is $88.15, and the ATM straddle*2 is $95.40, so our risk is $7.25 per contract (3x1) (95.40 - 88.15 = 7.25). As previously stated, the relative value of this trade will materialize when placed in a historical context, only then will we be able to ascertain whether skew is over/under valued.

Next, let's look at the *greek* profile of the position in order to assess our source of edge, and P/L attribution. Here is a risk slide of the position:

We can see here that we are nearly neutral on delta, this is often the case when selecting one strike outside of the ATM straddle range.

> [In this example we are using the 1675 strike, however it is acceptable to vary the strike selection if needed, i.e. 1680. In practice, I would suggest interpolating your values to arrive a true penny-strike figure, especially when the spot price of the index is between listed strikes.]

It is clear that this is a risk-on, bull-type strategy. It will perform well over a couple of sigmas due to the volatility-edge; (3x1 IV ≈ 14.50% vs. ATM straddle ≈ 12.23%). We are simply trading vol-edge for gamma risk. We expect to earn on skew and symmetry, while our risk is to gamma/vega.

> [Note: although we are building the spread with 3 OTM puts and 1 deep ITM call, I would suggest to structure the trade as an overwrite if one intends on actually trading this strategy. By overwrite, I mean selling four 1675 puts and shorting the underlying, as opposed to selling a deep ITM call. So, for SPX we would sell the four puts, and then sell one E-mini futures contract. Also, I have had success using this strategy on some of the leveraged ETFs (such as TZA). Those products exhibit a positive skew (OTM call vols are greater than OTM puts, similar to VIX skew). Keep in mind, you would sell 3 calls and 1 put (or sell 4 calls and buy shares).]

Obviously this trade is only suitable for accounts with portfolio margining, and trading it conservatively is advised (cash-secured isn't a bad idea). I primarily use it as an analytical tool to price skew, as opposed to consistently trading it.

Trade Postmortem:

Now that we know who to structure the trade, let's see how it performed over the past week. The first table shows the prices and volatilities for the prevailing ATM straddle:

SPX Oct 19 ATM Straddle								
Date	Spot	ATM Strike	Call Mid	Call IV	Put Mid	Put IV	Straddle Mid	Straddle IV
9/18/2013	$1,725.52	1725	22.65	12.38%	25.05	12.25%	47.70	12.32%
9/19/2013	$1,722.34	1720	23.70	11.81%	21.55	11.86%	45.37	11.84%
9/20/2013	$1,709.91	1710	20.25	11.67%	22.80	11.63%	43.17	11.65%
9/23/2013	$1,701.84	1700	20.55	12.41%	22.95	12.38%	43.62	12.40%
9/24/2013	$1,697.42	1695	22.30	12.44%	20.00	12.39%	42.42	12.42%
9/25/2013	$1,692.77	1695	17.85	11.73%	22.05	11.76%	40.02	11.75%

You will notice that the implied volatility of the straddle remained fairly consistent over the past week, even though the SPX declined from 1725 to 1692. This is an illustration of sticky-delta. As the spot price moved down, the downside puts became closer to ATM, and thus their respective volatilities converged to the previous ATM volatility. This is often the case in trending markets; skew and volatility are negatively correlated to the spot price.

Here are the values for our 1675 weighted straddle (3x1):

Relative Value	
ATM Straddle (x2):	95.40
3x1 Spread Credit:	88.15
Strike-Touch Risk:	$7.25
Vol Diff:	2.26%

SPX Oct19 1675 Weighted Straddle (3 Puts X 1 Call)								
Date	Spot	Strike	Call Mid	Call IV	Put Mid	Put IV	Spread Credit	Spread IV
9/18/2013	$1,725.52	1675	$58.15	14.66%	$10.00	14.48%	$88.15	14.57%
9/19/2013	$1,722.34	1675	$56.05	13.62%	$8.75	13.62%	$82.30	13.62%
9/20/2013	$1,709.91	1675	$43.70	13.31%	$11.45	13.25%	$78.05	13.28%
9/23/2013	$1,701.84	1675	$36.45	13.73%	$13.85	13.60%	$78.00	13.67%
9/24/2013	$1,697.42	1675	$35.40	13.54%	$13.30	13.41%	$75.30	13.48%
9/25/2013	$1,692.77	1675	$30.30	12.75%	$14.60	12.84%	$74.10	12.80%

Here we can see how the values of the options we sold decreased substantially. Also, notice how the volatility of the spread converged to the ATM volatility, even though the SPX spot price fell almost 33 points. We can also see the strike-touch risk value, as well as the volatility difference (skew) between the 1725 straddle and out 1675 spread. Take a look at the *greek* profile of the trade:

Volatility Skew (Spread vs. ATM)			
Date	ATM IV	Spread IV	Vol Diff
9/18/2013	12.32%	14.57%	2.26%
9/19/2013	11.84%	13.62%	1.79%
9/20/2013	11.65%	13.28%	1.63%
9/23/2013	12.40%	13.67%	1.27%
9/24/2013	12.42%	13.48%	1.06%
9/25/2013	11.75%	12.80%	1.05%

Greeks and P/L						
Date	Spread Credit	P/L	Delta	Gamma	Theta	Vega
9/18/2013	**$88.15**	**$0.00**	-4.54	-1.75	149.30	-605.76
9/19/2013	**$82.30**	$585.00	-8.02	-1.86	139.40	-582.68
9/20/2013	**$78.05**	$1,010.00	13.53	-2.18	152.96	-634.07
9/23/2013	**$78.00**	$1,015.00	30.56	-2.41	176.14	-633.73
9/24/2013	**$75.30**	$1,285.00	34.43	-2.53	179.12	-627.00
9/25/2013	**$74.10**	$1,405.00	51.41	-2.80	180.87	-644.77

We can see how the P/L evolved from day-to-day. Most importantly, as the SPX spot price decreased, our long delta position increased. So, while the underlying moved against us, the gain

from skew overcame the long deltas. The volatility chart shows that the options we sold converged to the ATM volatility.

This trade was profitable, as the implied volatility surface of the SPX lent itself to a short-skew trade. If we did this trade during a time when index volatility gapped higher abruptly, we would have lost money.

As mentioned previously, the method we covered here is very useful for pricing and analyzing skew, even if it is not traded. In a subsequent paper, I intend to outline how to use this method find other trade structures.

I hope this is useful and interesting. Please feel free to contact me with any questions or comments. Thank you.