MRA
MACRO RISK ADVISORS

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MRA Volatility Risk Premium Index (MRAIVRP): White Paper

- MRA has published an index measuring volatility risk premium (VRP) on the S&P 500, accessible on Bloomberg via {MRAIVRP Index <GO>}, based on the spread between 1M ATM implied volatility and *subsequent* 20-day realized volatility.
- We created a systematic trading strategy to harvest volatility risk premium over time using exponentially-weighted realized volatility as a more coincident signal.
- For investors looking to sell volatility as a form of earning positive carry over time, we find that shorting volatility via selling delta-hedged SPY straddles when VRP is above 2 'vol points' reduces drawdowns and improves risk-adjusted returns.
- We detail the methodology of the index, explaining our assumptions and demonstrating the utility of measuring VRP for short volatility strategies.

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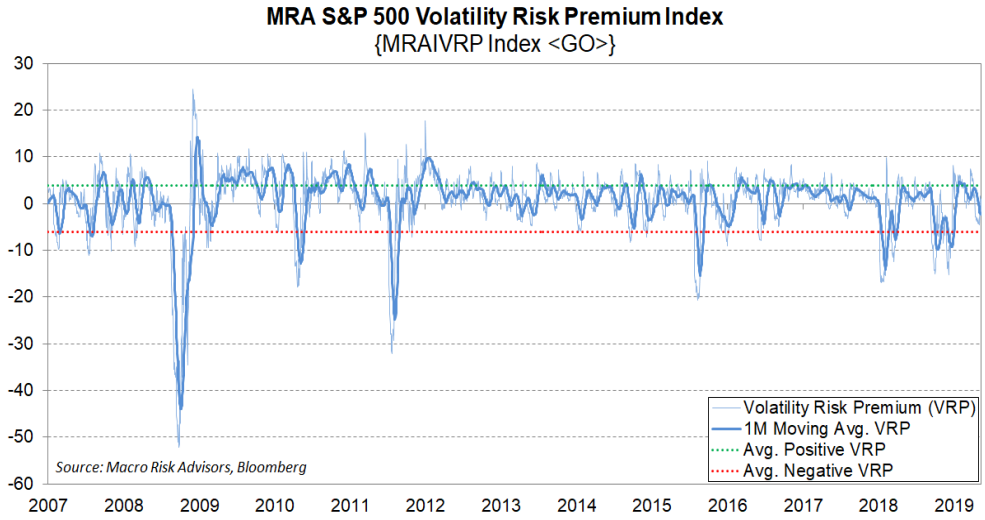
Since options (puts in particular) act as market insurance, the cost of protection more often than not exceeds the financial value of realized losses. In practice, this is why implied volatility generally trades at a premium to realized volatility (both trailing and subsequent). The spread between implied volatility and realized volatility observed over the subsequent corresponding time period is known as volatility risk premium (VRP).

VRP provides an estimate of how much compensation volatility sellers require to sell optionality to the market. We set out to prove through this white paper and future studies that environments with higher VRP can provide lucrative opportunities to sell volatility to harvest the embedded risk premium, whereas environments with lower VRP can provide attractive entry points to tactically hedge.

<u>Index Methodology</u>: We calculate volatility risk premium (**Figure 1**) as the difference between 1M implied (at-the-money) volatility on the S&P 500 and subsequent 20-day realized volatility. Measuring volatility risk premium on a daily basis, we note that since January 2007, volatility risk premium was positive >67% of days with an average premium of +3.8 points versus an average of -6.0 points during negative VRP observations (~33% of days). On page 3, we backtest a volatility selling strategy conditional on VRP being above certain positive thresholds.

Data is updated daily based on Bloomberg implied and realized volatilities from the previous trading day's market close.

Figure 1: MRA Volatility Risk Premium Index {MRAIVRP Index <GO>}



Since volatility risk premium tends to be more backward-looking as it effectively represents the P&L in 'vol points' earned by consistently owning a pure short volatility exposure over a specified time period (1M, 3M, etc.), we look to create a more coincident signal which measures how well option volatility has carried more recently.

For a particular underlying and corresponding tenor, we assume for a time series of daily log returns:
Volatility Carry = σ_n (*Implied*) − σ_n (*Exponentially-Weighted Realized*), where σ_n (*EWMA*) = $\lambda\sigma_n + (1-\lambda)\sigma_{n-1}$

We believe this to be a better methodology for measuring/visualizing the volatility carry as the model allows for a more 'reactive' realized volatility by applying more (less) weight to recent (older) moves in the underlying over each day. For instance, from Dec 14th through and including Dec 24th, 2018, the market fell 9.6% and implied volatility spiked over 12 points. Once the market recovered, however, implied volatility swiftly normalized whereas trailing 20-day realized volatility took over a month to converge back to current implied volatility levels at the time (**Figure 2**).

To implement the exponentially-weighted methodology for the realized volatility portion of the analysis, we apply a decay/smoothing parameter (known as lambda) to the time series of returns which acts as a rate at which older returns 'fall off' the volatility series, thus giving higher relevance to more recent moves in the underlying asset. In general, the lower the lambda (bound between 0 and 1), the more reactive the volatility given a faster rate of decay and vice versa. The standard range of lambdas used for exponentially-weighting is 0.90-0.95; in our index, we selected 0.90 as our lambda assumption (**Figure 3**).

Figure 2: Comparison of S&P 500 1M ATM implied volatility and corresponding trailing 20-day realized volatility over the last six months

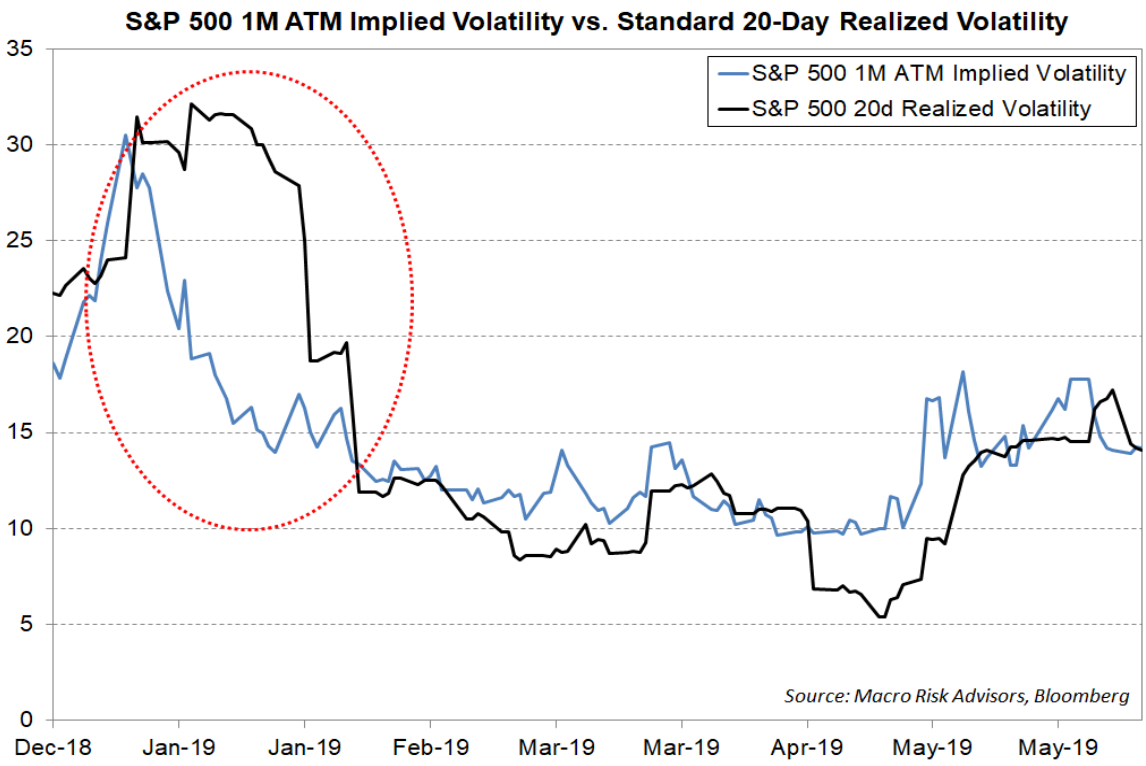
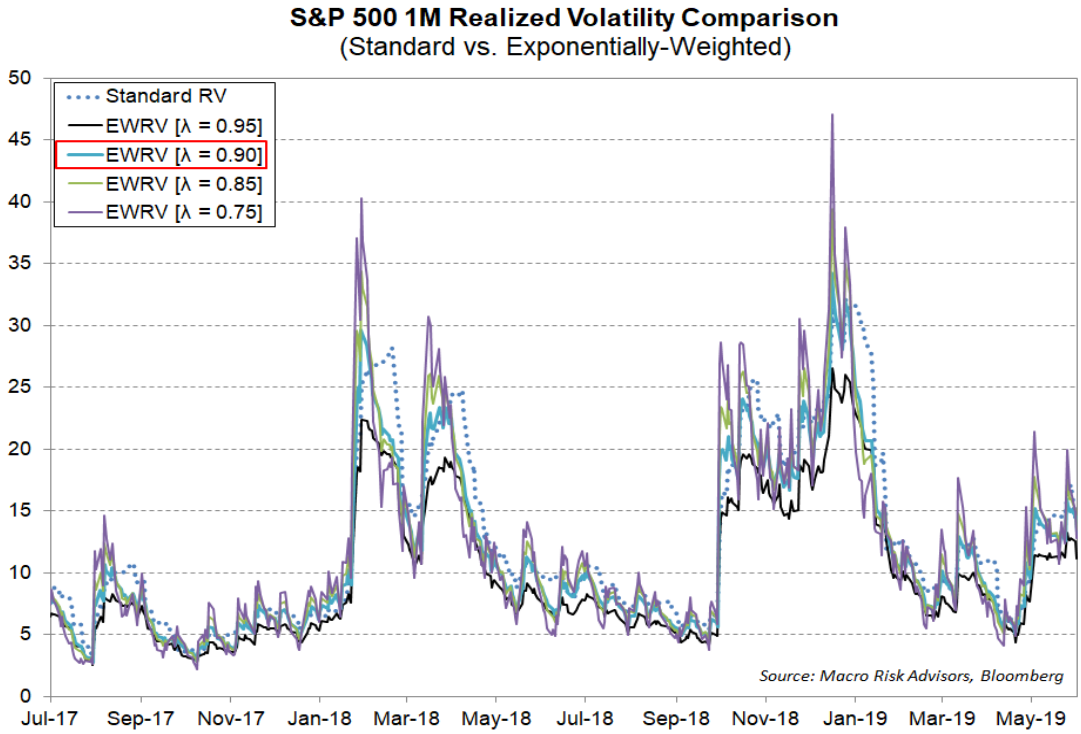


Figure 3: Standard 1M realized volatility versus exponentially-weighted realized volatility computed using various lambda assumptions



We show in **Figures 4-6** that conditionally selling index volatility (via delta-hedged SPY straddles) when the volatility carry signal is at or above a certain threshold (e.g. 2-4 points) helps to avoid large drawdowns and improves our risk-adjusted returns. During periods of ongoing market turbulence, when recent realized volatility exceeds the forward volatility implied by the market (i.e. volatility risk premium below 0), short volatility strategies often suffer large drawdowns. However, if volatility sellers are too selective with the amount of VRP they demand (e.g. over 4+ points), they potentially miss opportunities to capture carry.

Figure 4: Backtest of selling SPY straddles (delta-hedged) with conditions for selling based on minimum volatility carry signal levels since Jan 2007

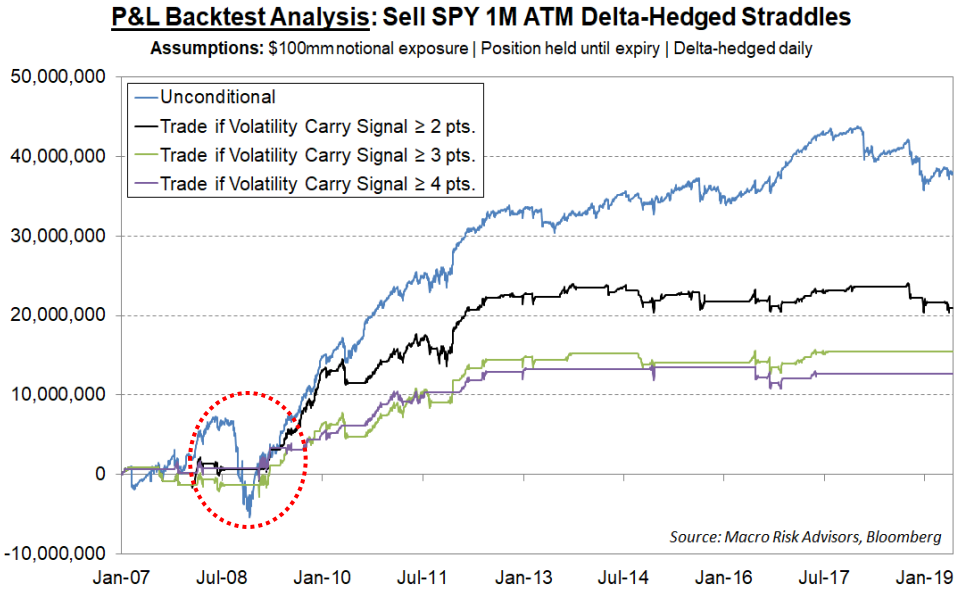


Figure 5: Aggregate performance metrics of selling SPY straddles based on volatility carry signal threshold, assuming $10mm starting capital on $100mm notional exposure

Performance Jan 2007 - Present

Metric	Unconditional	Trade if Volatility Carry Signal ≥ 2 pts.	Trade if Volatility Carry Signal ≥ 3 pts.	Trade if Volatility Carry Signal ≥ 4 pts.
Annualized Return	13.4%	9.5%	7.8%	6.8%
Maximum Drawdown	**-73.6%**	**-24.8%**	**-35.0%**	**-19.8%**
Max DD / Ann Ret	5.5	2.6	4.5	2.9
Sharpe Ratio	**0.51**	**0.52**	**0.41**	**0.43**
Sortino Ratio	0.64	0.69	0.54	0.58
Annualized Volatility	**31.5%**	**16.9%**	**18.6%**	**13.8%**
Volatility on Down Days	41.7%	31.7%	42.7%	40.5%
Ratio of Down Vol / Vol	1.32	1.88	2.29	2.94

Source: Macro Risk Advisors, Bloomberg

Figure 6: Yearly performance metrics of selling SPY straddles based on volatility carry signal threshold, assuming $10mm starting capital on $100mm notional exposure

Performance Jan 2007 - Present: Yearly Stats

Strategy:	Unconditional	Trade if Volatility Carry Signal ≥ 2 pts.	Trade if Volatility Carry Signal ≥ 3 pts.	Trade if Volatility Carry Signal ≥ 4 pts.	Unconditional	Trade if Volatility Carry Signal ≥ 2 pts.	Trade if Volatility Carry Signal ≥ 3 pts.	Trade if Volatility Carry Signal ≥ 4 pts.
Year	Annualized Return	Annualized Return	Annualized Return	Annualized Return	Max Drawdown	Max Drawdown	Max Drawdown	Max Drawdown
2007	24.0%	-12.5%	-12.5%	2.4%	-26.4%	-20.9%	-20.9%	-11.6%
2008	-16.5%	21.4%	-1.1%	5.9%	-73.6%	-20.7%	-22.5%	-14.9%
2009	138.4%	116.1%	87.0%	39.0%	-40.4%	-14.0%	-17.2%	-13.7%
2010	30.9%	6.6%	9.3%	27.0%	-11.8%	-13.1%	-18.1%	-7.5%
2011	18.7%	16.3%	23.6%	6.3%	-7.2%	-14.6%	-12.2%	-8.7%
2012	12.9%	14.3%	12.4%	13.3%	-3.8%	-4.3%	-4.1%	-4.4%
2013	0.1%	2.9%	2.8%	1.0%	-7.5%	-4.5%	-5.9%	-0.5%
2014	3.2%	-4.6%	-4.7%	1.0%	-6.4%	-10.5%	-11.0%	-7.9%
2015	0.5%	-0.4%	0.0%	0.0%	-6.6%	-7.3%	-4.7%	-1.2%
2016	9.8%	-0.3%	-0.4%	-6.1%	-4.9%	-8.6%	-11.2%	-12.1%
2017	8.9%	6.2%	5.9%	2.8%	-2.9%	-4.8%	-6.2%	-6.7%
2018	-12.8%	-6.3%	0.0%	0.0%	-15.1%	-10.9%	-1.2%	-1.4%
2019	4.6%	-4.8%	0.0%	0.0%	-12.9%	-7.4%	0.0%	0.0%
Year	Sharpe Ratio	Sharpe Ratio	Sharpe Ratio	Sharpe Ratio	Annualized Volatility	Annualized Volatility	Annualized Volatility	Annualized Volatility
2007	0.58	-0.67	-0.67	-0.12	43.8%	23.2%	23.2%	15.2%
2008	0.26	0.71	0.02	0.23	88.6%	26.9%	30.1%	18.5%
2009	2.23	2.18	1.60	1.08	40.7%	36.5%	42.9%	33.7%
2010	1.81	0.52	0.55	1.77	14.6%	12.7%	17.9%	13.1%
2011	1.14	0.84	1.13	0.49	15.1%	18.9%	19.2%	12.8%
2012	1.51	1.61	1.24	1.25	7.6%	7.9%	9.0%	9.6%
2013	0.01	0.49	0.46	0.34	7.2%	5.4%	5.5%	2.0%
2014	0.43	-0.63	-0.58	0.14	6.9%	7.1%	7.8%	6.4%
2015	0.07	-0.02	-	-	9.5%	10.3%	0.0%	0.0%
2016	1.12	-0.07	-0.03	-0.47	7.6%	8.9%	11.7%	12.5%
2017	1.81	1.17	0.95	0.38	3.8%	3.9%	4.6%	3.8%
2018	-1.46	-1.09	-	-	10.2%	7.6%	0.0%	0.0%
2019	0.28	-0.79	-	-	7.3%	8.7%	0.0%	0.0%

Source: Macro Risk Advisors, Bloomberg