Quant Lab

Smart Volatility Investing

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Overview

The purpose of this report is to introduce the notion of 'Smart Volatility'. The concept is gaining ground as more investors look for strategies to hedge against tail events which have better risk/reward profiles than long options exposure.

Holding options can be an expensive exercise over the long run. Investors have tried to time the purchase of volatility to minimise these costs, but long term analysis shows that even good timing has failed to markedly improve the performance record of such opportunistic buying.

Some of the basic characteristics of the options markets such as momentum in volatility, rising skew in times of crisis, etc. can be utilised to build systematic models to assist investors with the question of timing entry and exit points.

Other relative value Smart Volatility strategies provide investors with long volatility and convexity exposure at relatively modest costs. These strategies should be considered as part of a diversified tail-hedge strategy.

Section 1:

Volatility used as a hedging instrument

Implied and realised volatility

Over the years, investors and speculators have been trading options on various underlying instruments with the aim of realising gains when markets move in a certain direction or profile. The trading of volatility provides a direct way to capitalise on uncertainty in financial markets, with volatility increasing in line with market stress.

Before delving too far into the practical trading of volatility, it is important to distinguish between realised volatility and implied volatility.

Realised volatility: This is the standard deviation of price returns; it is a backward looking measure considering the path behaviour of the stock price over the history of the volatility window.

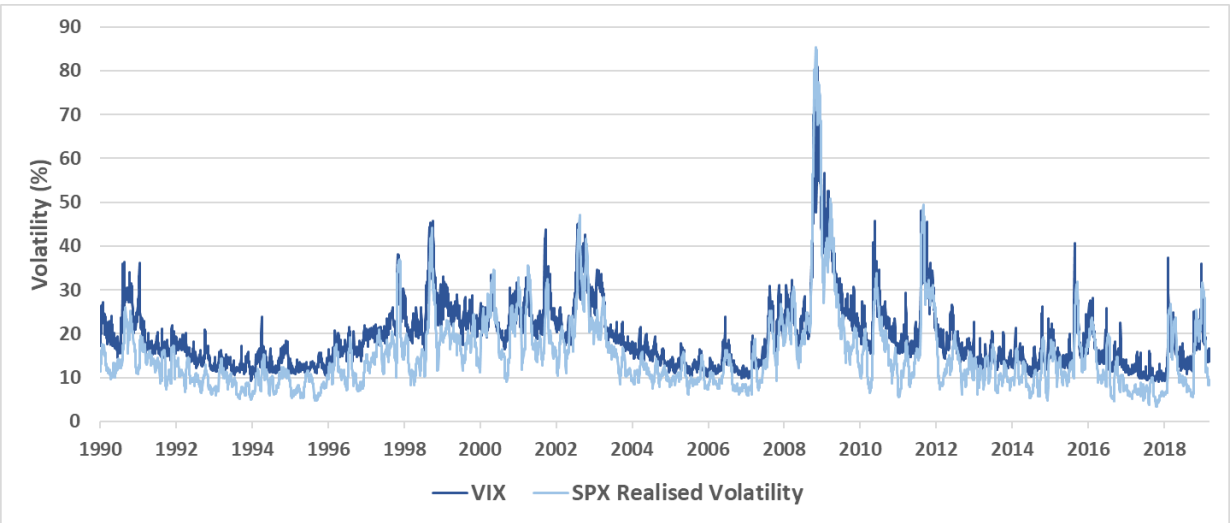
Implied volatility: This is the market forecast of future realised volatility; it is a forward looking measure which is inferred from the Black-Scholes equation based on the prices of traded options.

Historically, implied volatility tends to act as a biased predictor of realised volatility, and tends to trade at a premium to the subsequent realised volatility, as shown in the figure below for the SPX.

More recently, VIX futures, options and exchange traded notes (ETNs) have been utilised to trade expectations of stock market volatility in the near future.

The current VIX index value quotes the expected realised volatility of the S&P 500 index over the following 30 days, and is calculated by using the mid-point of real-time S&P 500 index option bid/ask quotes.

Fig 1. VIX vs. S&P 500 Realised Volatility



Source: Bloomberg

Section 1:

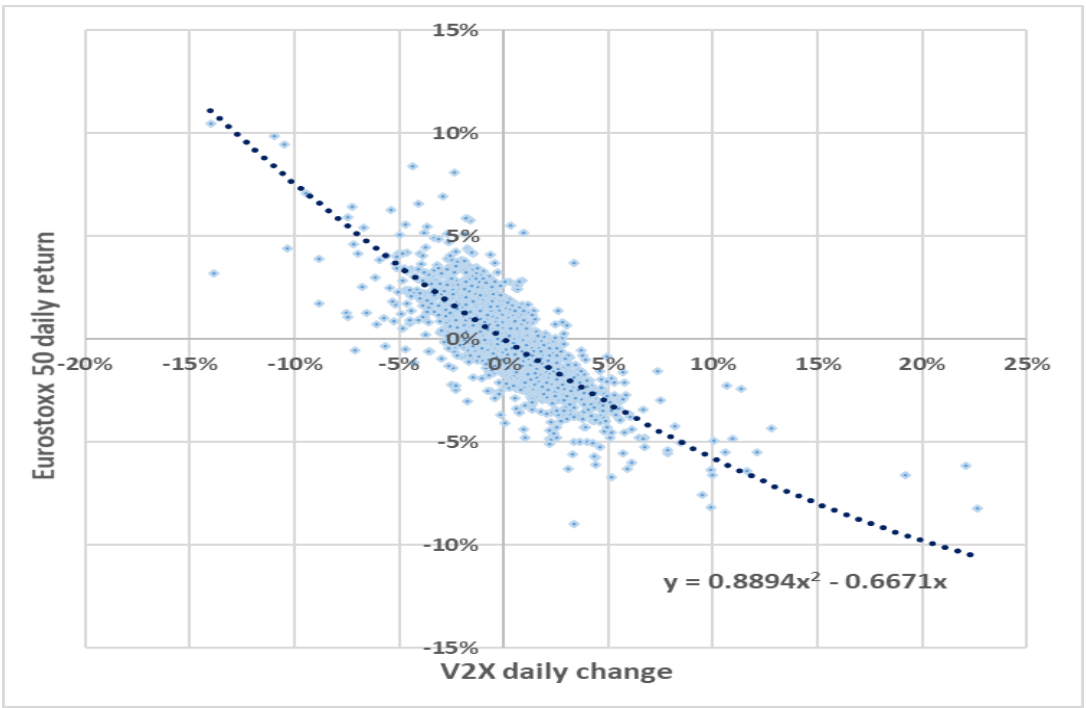
Volatility used as a hedging instrument

Negative correlation to equity returns

The feature that makes VIX or volatility in general attractive to investors is its negative correlation to equity returns. As equity markets decline, equities tend to become more volatile. Hence, the VIX tends to rise as the market anticipates increased future volatility.

The behaviour of implied volatility tends to be strongly negatively correlated to market movement. As shown in the figure below, market uncertainty tends to increase in times of market stress for the VSTOXX index (equivalent of VIX for European stocks) vs. the Eurostoxx50 index.

Fig 2. Eurostoxx daily return vs. V2X daily change



Source: Bloomberg

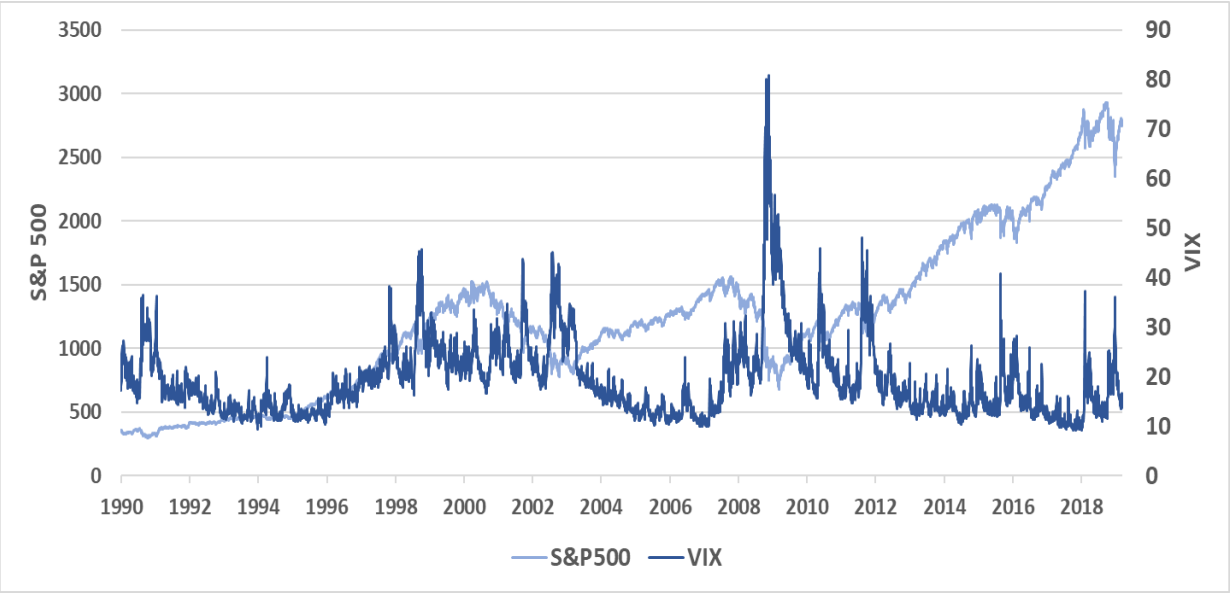
Section 1:

Volatility used as a hedging instrument

Large spikes for significant equity losses

Volatility expectations tend to spike after large sell-offs but gradually move down in a rally. This is consistent with investor behaviour – they are more anxious to purchase protection when equities are falling than they are to sell volatility when the market is rising. This makes the VIX potentially attractive as a tail risk hedge, due to its negative correlation and its convexity to large negative equity returns.

Fig 3. S&P 500 vs. VIX



Source: Bloomberg

Section 1:

Volatility used as a hedging instrument

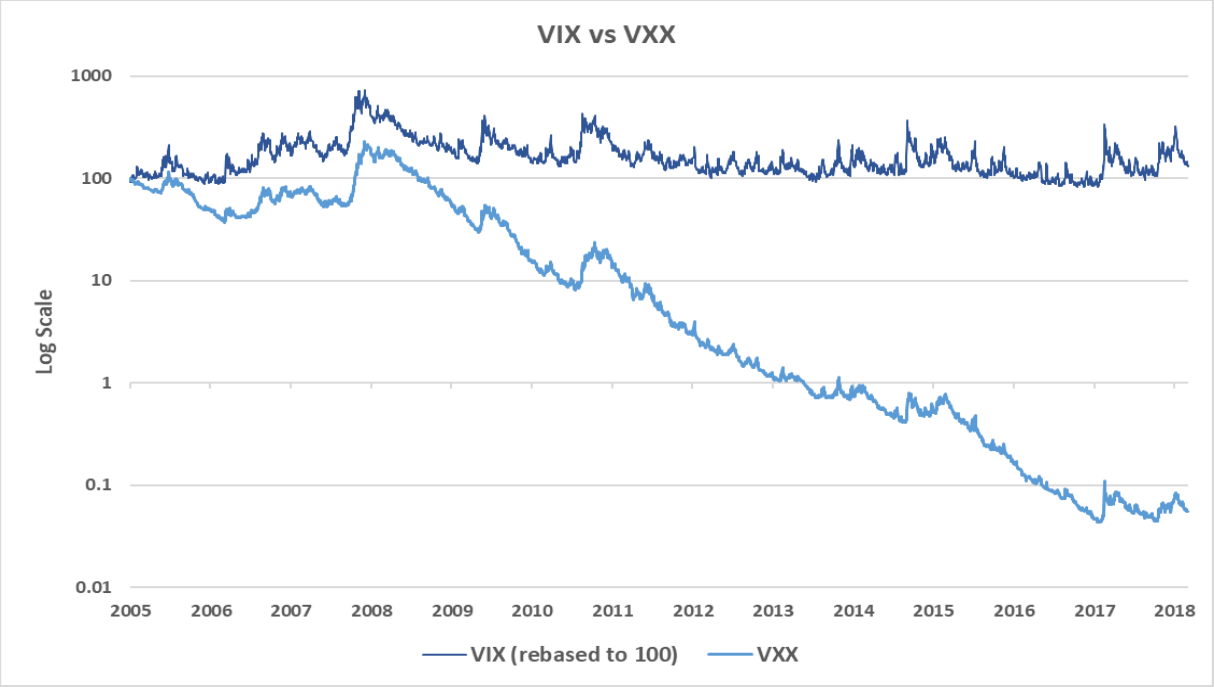
Time decay

The most expensive times to own insurance against a U.S. equity crisis were, not unexpectedly, the periods surrounding the global financial crisis (2008), the flash crash (2010), the Greek debt crisis (2011) and the 'Vixmageddon' in February 2018.

This pattern illustrates why the VIX is often referred to as the 'fear index.' However, it is more useful to think of the VIX as the current cost of the insurance premiums. The actual, investible volatility assets most closely related to the VIX are VIX index futures and VXX. The VXX is an ETN designed to track VIX futures. Investing in VXX is essentially equivalent to exposure to a daily rolling long position in the first and second month VIX futures contracts.

The ever-widening spread between VIX and VXX is the cumulative cost of the regular roll-down, often referred to as the decay. Unfortunately, as clearly illustrates here, a long-term allocation to a static volatility holding is a drag on a portfolio. In the case of VXX, the long-term drag amounts to an average of 13 bps per day.

Fig 4. VIX vs. VXX



Source: Bloomberg

Section 2:

Buying volatility or put options

Betting on increased volatility

Many investors use put options to hedge their portfolios. Some investors prefer to purchase volatility in the shape of options that they regularly delta hedge, or by just buying VIX futures, trying to benefit from a jump in S&P volatility regardless of the direction.

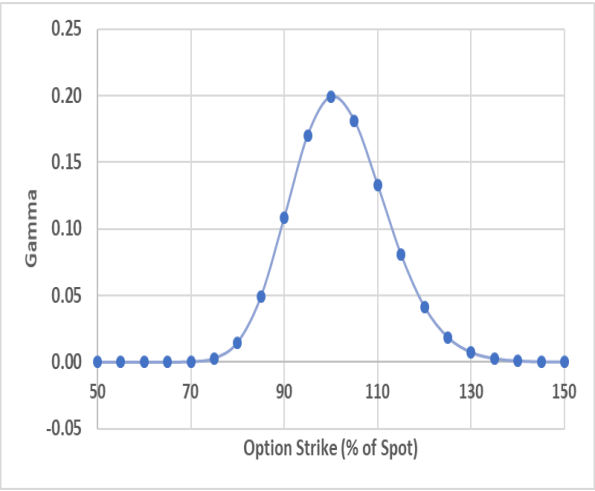
The P&L of volatility trading through delta-hedging options is a function of the gamma (or option curvature) and spread between implied and subsequent realised volatility:

Fig 5. Options volatility as a function of gamma

$$P\&L = \frac{1}{2}\int \Gamma S^2 \left[\sigma_{RV}^2 - \sigma_{IV}^2\right] dt$$

One of the main problems with trading volatility through vanilla options directly is the changing exposure to the volatility of the product as the underlying moves away from the strike. Due to gamma acting as a scaling factor, and ATM options having the highest gamma exposure, the P&L sensitivity to volatility falls as the option moves away from the ATM strike.

Fig 6. Option strike price and Gamma



Source: Tages Capital

Section 2:

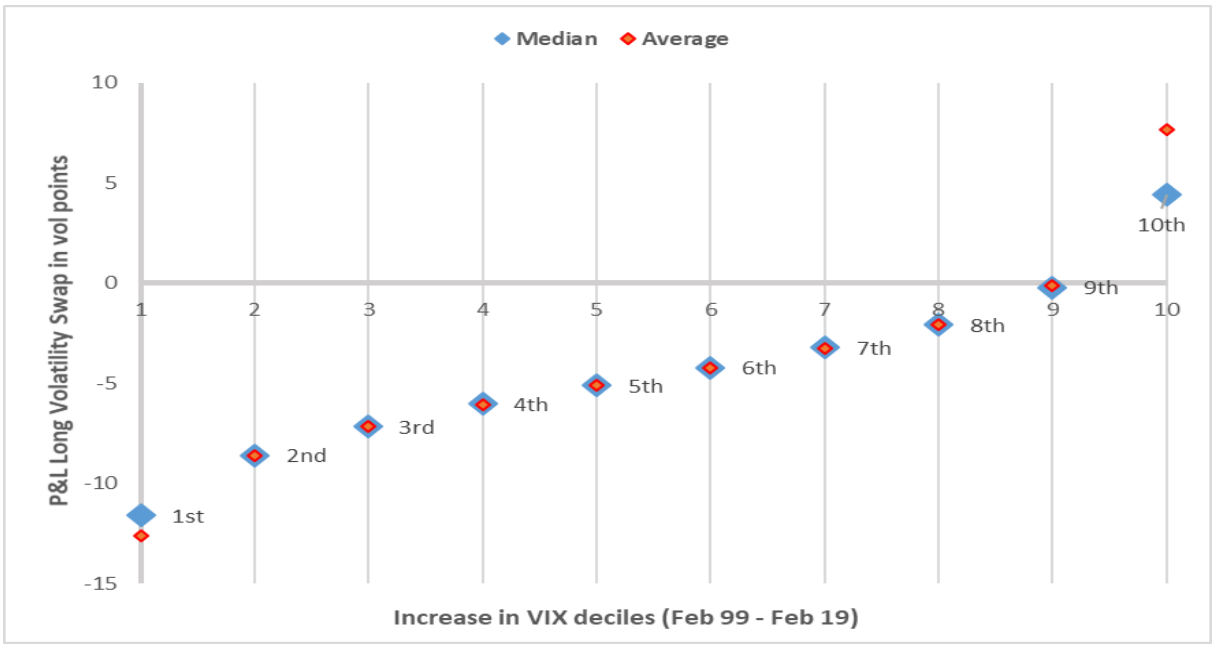
Buying volatility or put options

Timing volatility

Unfortunately, due to the difference between implied and realised volatility, as well as the time decay involved in owning options, the practice of owning options ends losing money about 70% of the time. In fact, the only time one might benefit from owning volatility as a hedge is when volatility increases significantly.

The below chart demonstrates the average annual return of a long volatility strategy for different deciles of S&P volatility increases from 1999 to 2019:

Fig 7. Average annual return of a long volatility strategy



Source: Tages Capital

Even when volatility is on the rise as above, an investor, on average, benefits only during the most volatile decile. So not only does one need to know when volatility is on the rise, but one must buy volatility only when the expected rise is to be significant. This exercise seems quite unrealistic.

Additionally, the time decay forces one to time the entry and exit of such transaction quite accurately as, on average, about 20 days after the first spike in volatility, gains start diminishing quickly.

Section 3:

Smart Volatility

Concept

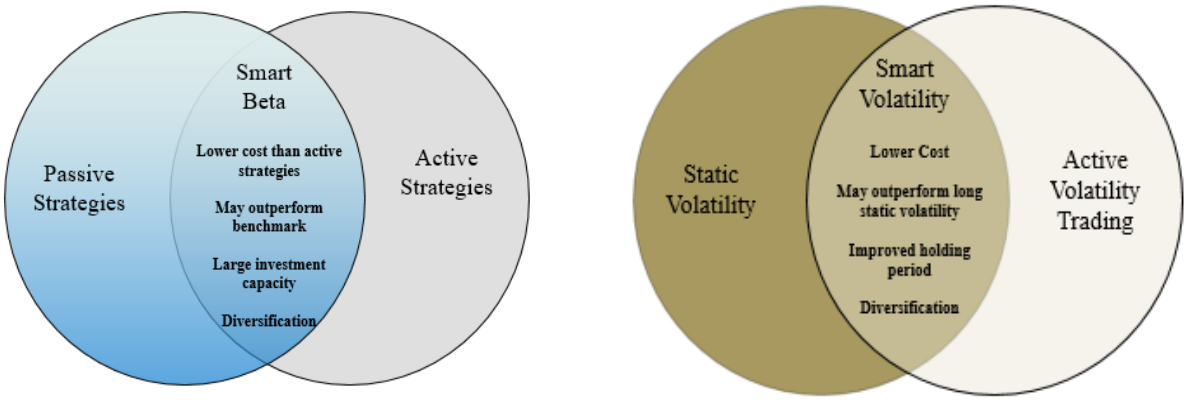
Smart Volatility strategies are essentially rule-based trading strategies whose objectives are to capture a specific part of the performance sought by active volatility managers. These strategies can either be designed to be hedging strategies or alpha strategies, and they seek to improve performance as it relates to the aforementioned timing difficulties, as well as to help optimise the strategy weightings.

Smart Volatility, effectively, is to active and passive vol strategies what Smart Beta is to active and passive long only strategies. Like Smart Beta, Smart Volatility strategies tend to be a very liquid and relatively inexpensive way to take advantage of perceived systematic biases or inefficiencies in the market.

As referenced above, Smart Volatility strategies can be roughly divided into two categories:

- Market-timing type strategies assisting with the issue of timing by providing systematic exposure to volatility using certain basic rules based on the most common characteristics of the options markets.
- Relative value strategies benefiting from market inefficiencies to provide cheap optionality. Such strategies typically consist of purchasing more of relatively cheap options against overvalued options. Investors have the opportunity of designing such strategies according to their preferred outcome in different market conditions.

Fig 8. Comparing smart volatility to smart beta strategies



Source: Tages Capital

Section 3:

Smart Volatility

Options markets characteristics

Most options markets share the below features which can be employed in building market-timing models to assist with the problem of timing options transactions:

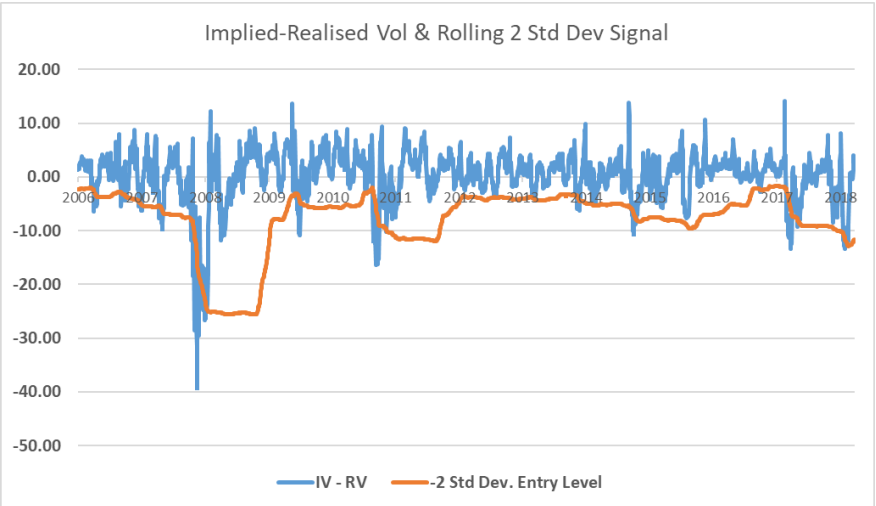
- The price of vol is all relative. Contrary to most people's initial intuition, a 'high' price does not necessarily mean 'overpriced' and a 'low' price does not necessarily indicate 'under-priced'. Instead, we must compare the implied volatility (as indicated by the market price) versus its own history, or the realised volatility of the investment universe in question.
- Options exhibit a degree of momentum, or self-correlation. Simply put, when volatility is increasing, it has a slight tendency to continue increasing and vice versa.
- Volatility is mean reverting in nature. It tends to trend over short time horizons and reverts over longer periods.
- Skew, term structure and convexity can also have predictive characteristics. It is important to analyse which area of the volatility surface looks most attractive. As an example, a steeper put skew denotes a larger demand in downside protection.

How to build a Smart Volatility signal

We can use the above factors to build a simple systematic model. For each factor, we observe the z-score to measure relative cheapness, we check the predictive power of a potential signal, and we then test the signal to measure its effectiveness.

In the below example, we observe the spread between 1-month S&P 500 implied and realised volatility, and measure this versus the rolling 1 year two standard deviation level. From this, we can see that it seems to make sense to buy implied vol when it is below realised vol.

Fig 9. Implied Realised Vol & Rolling 2 Std Dev Signal



Source: Tages Capital

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Smart Volatility

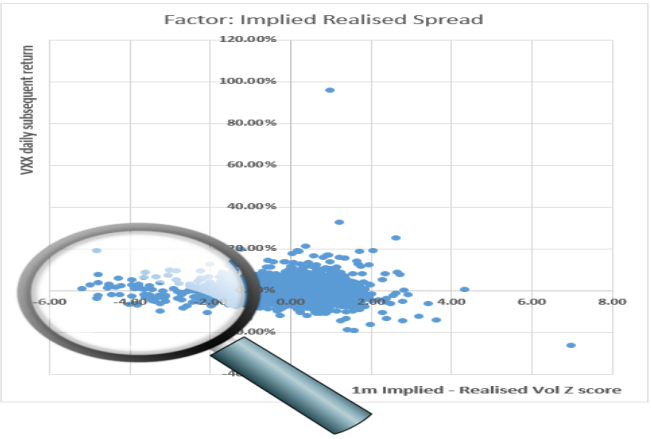
How to build a Smart Volatility strategy

We then need to determine whether two standard deviations is the appropriate trigger level. The below scatter plot demonstrates the relationship between the z-score of the S&P implied-realised vol spread and the subsequent performance of VXX.

As shown by the highlighted area below, when implied volatility is relatively cheap (negative z-score), the returns tend to be more positive.

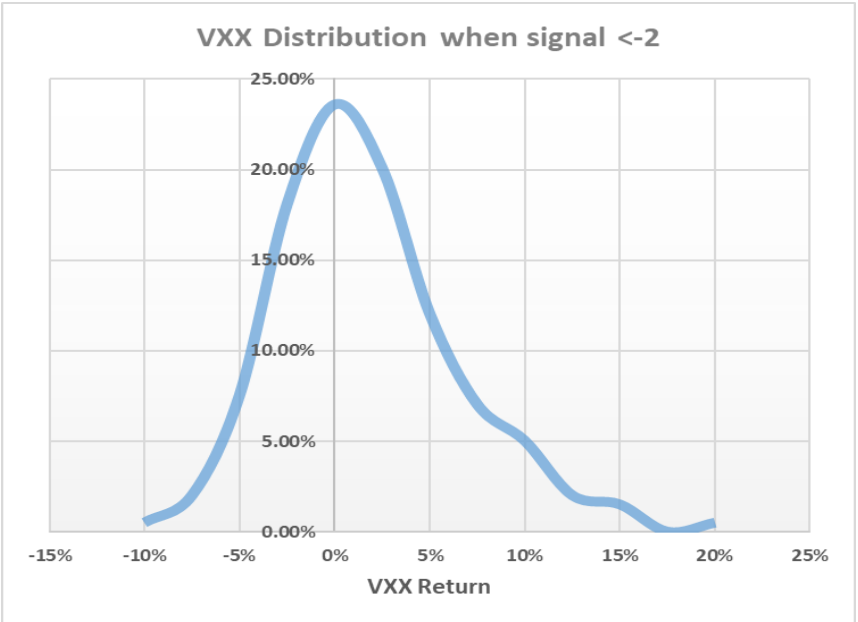
Finally, we test the results. The distribution plot below shows the VXX returns when the z-score is extreme. Thus, this signal would be deemed a good candidate for our systematic test model.

Fig 9. Factor: implied realised spread



Source: Tages Capital

Fig 10. Implied Realised Vol & Rolling 2 Std Dev Signal



Source: Tages Capital

Section 3:

Smart Volatility

Example Smart Volatility strategy

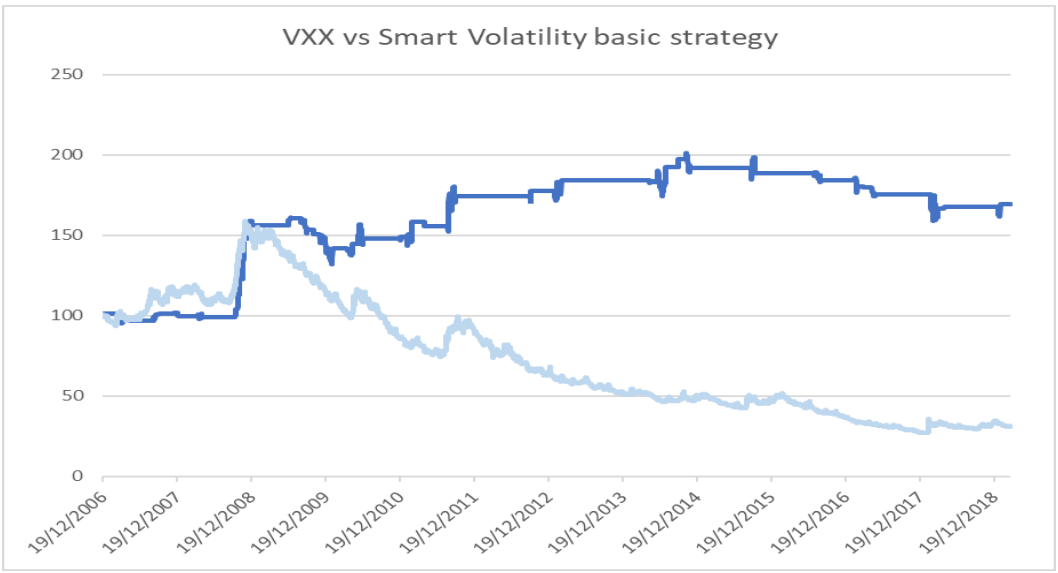
We now want to show a simple example. We apply the Smart Volatility concept to VXX using just two signals to build a systematic model. In our example, we will use the signal explained on the previous page, and combine this with an additional signal looking at skew (vol smile).

- The first signal is based on the cheapness of S&P implied to realised volatility. The indicator provides a buying signal when the z-score hits two standard deviations.
- The second signal is based on the ratio of S&P 500 At The Money volatility versus put volatility. A VXX buy signal is produced when downside volatility rises more than two standard deviation relative to ATM volatility.
- In order to produce a Smart Volatility strategy with a comparable structure and volatility to the reference strategy (long VXX), we have structured our Smart Volatility strategy to be long only and with a gross exposure to VXX of not more than 100%. In addition, we have assigned a 50% weight to each signal when activated.

Below, you can see the results of our Smart Volatility strategy versus a typical VXX allocation (25% long, again to ensure we are comparing strategies with similar risk profiles).

This simple exercise demonstrates how some simple factors can assist in building a model which can outperform the outright purchase of VXX.

Fig 11. VXX vs. Smart Volatility basic strategy



Source: Bloomberg, Tages Capital

Section 3:

Smart Volatility

Relative value strategies

In addition to models structured to optimise the timing of options strategies, there are many other Smart Volatility strategies, which offer cheap optionality and convexity. Here are a few examples:

- VIX vs S&P options

Combination long VIX and long S&P due to the negative correlation. This strategy has produced a positive track record with the exception of Q4 2018 when the beta of VIX futures relative to the index itself collapsed.

- S&P options Vs EuroStoxx options

At times, the flow in options markets tends to depress implied volatility in one market relative to other markets. These anomalies can last for a few months or years and can be a cheap source of optionality.

- Skew or term-structure spreads

Flows and investor behaviour can often create opportunities for relative value strategies across different option tenors (three month vs one year, for example) or across the volatility surface (ATM vs OTM options for example). Such situations can provide the investor with cheap protection or alpha opportunity over prolonged periods.

- Dispersion trades

This strategy involves the purchase of options on a number of single stocks against selling volatility on the basket itself (or, as an example, buying the options on a number of single stocks in the S&P and selling the vol on the S&P index). With the diversification effect, the index usually has a lower realised volatility than a collection of single names, the strategy acts as a long volatility strategy especially in bear markets. This strategy could be implemented in vega neutral, theta neutral and other combinations, which provides the investor with a defensive or carry profile.

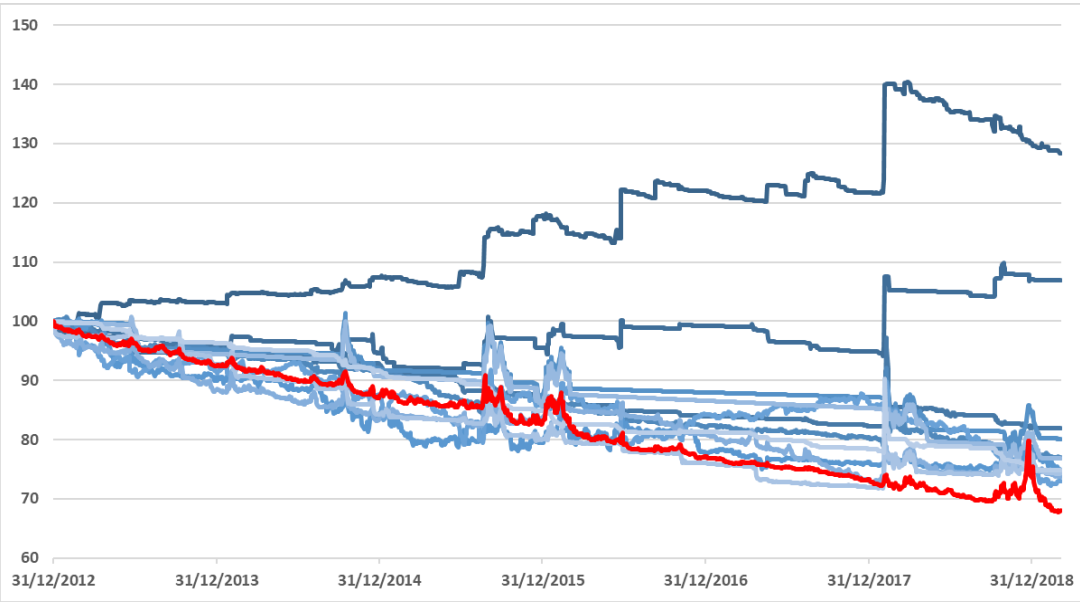
Section 3:

Smart Volatility

Relative value strategies

The below picture includes performance of some of the above strategies against S&P puts. It is clear that most have demonstrated varying degrees of positive returns during the periods of crisis. A combination of those systematic strategies could be a very cost effective tail-hedge solution over medium to long term.

Fig 12. Relative value volatility strategies vs. S&P Puts



Source: Tages Capital

Conclusion

The concept of Smart Volatility is at the heart of our Paladin UCITS Fund. The Fund is structured to provide a multi-asset hedge against tail type events, by combining relatively inexpensive Smart Volatility strategies with trend, mean reversion and very low beta carry strategies. We perform various quantitative and qualitative analysis on each of the sub-strategies to ensure their robustness. And we diversify and update the models we use in the portfolio on an on-going basis. This latter point should not be under-estimated as systematic signals tend to have a limited life span. As a consequence, we believe accessing a portfolio of such strategies is best done through an experienced portfolio manager.

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