

Research Summary:

The High Sigma Strategy

The Case for Volatility as a Valuable Source of Portfolio Alpha

In today's market environment, any strategic investment decision around alpha generation (profit seeking) and risk diversification (loss minimization) is a challenge because all conventional asset classes are overvalued to extremes prompted by global monetary intervention, leaving little opportunity for growth-seeking portfolios. Several macro factors have increasingly exacerbated the diversification seeking efforts of any portfolio solution as low correlations are more elusive, especially among traditional asset classes. Growth portfolios seeking returns from alternative asset classes encounter illiquidity in most cases. Against this backdrop, volatility has incrementally established itself as a mainstay within the Liquid Alternatives space as a highly liquid and frequently cheap investment choice with varied applications from alpha generation to risk hedging.

The investor's perception of volatility has evolved from a limited view of being a source of risk and fluctuations in asset prices and valuations, to being a quasi asset class that is investable and providing a long-term opportunity for monetization of a positive risk premium. For reasons explained below, a long volatility position in any asset class investment offers a strong negative correlation to the investment. Long volatility allocations, therefore, act as useful and reliable diversifiers in a portfolio allocation because of a natural causality with their corresponding assets.

There are several instruments on offer that capture volatility risk premium across equity, fixed income, commodity, currency and other asset classes, the most popular among them being call and put options. The equity sector has popular indices that are traded in cash and futures markets with options available on each. The U.S. equity indices S&P 500 and NASDAQ-100 command sufficient activity to warrant interest in volatility indices on each. The CBOE S&P 500 Volatility Index (VIX) and the CME-Nasdaq-100 Volatility Index (VOLQ) measure expectations of volatility on their respective indices over a 30-day period. Just as with its underlying S&P 500 index, the VIX also offers futures, options, ETFs and options on ETFs to facilitate alternative ways of directly trading equity market volatility.

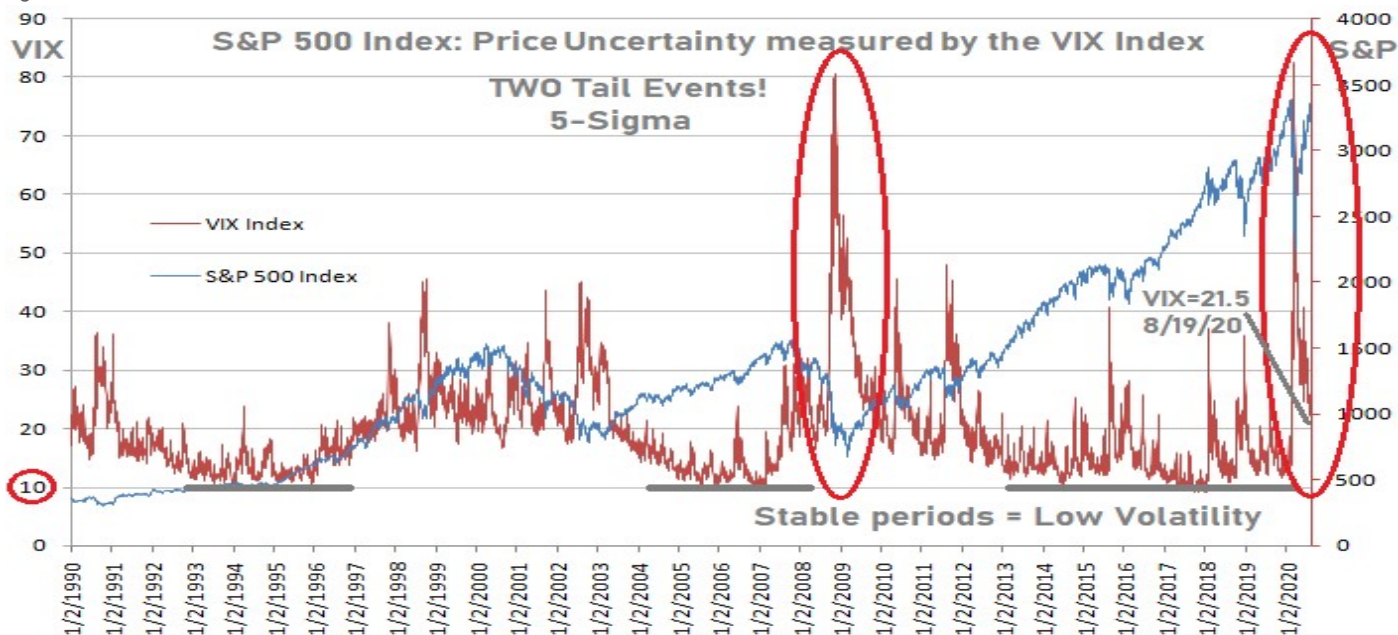
Numerous strategies exist to monetize this risk premium in different contexts of market opportunity, resulting in a range of risk-return profiles. Applications range from defensive risk hedging of portfolio assets to excess return generation in conservative ways like smart beta and more opportunistic alpha seeking ones. Any asset that creates risk exposure is effectively short volatility. The insurance¹ that portfolio hedging brings to portfolio assets creates a very large organic demand for long volatility from numerous application sources. As a result, most markets for volatility, more often than not, tend to price volatility above "fair value" (from a retrospective comparison to the actual or realized index volatility,) resulting in a negative volatility risk premium. It is important to note, this premium is justified as a risk surcharge for estimating unknown future volatility. In the absence of natural short-volatility applications, the original demand for volatility brings in a speculative market participants and selling volatility has developed into, by far, the most prolific activity in volatility markets. The nature of volatility is conducive to such profit-seeking to counterbalance the negative premium and we explain why in the next section.

Any time series of volatility shows common, characteristic patterns (figure 1); there is a baseline range of lows treaded over time and on occasions, we observe sudden spikes to varying heights after which the series quickly reverts back to the baseline range. The spikes are caused by the uncertainty injected by new market information precipitated by market events that are typically adverse to market price. Such events prompt a sudden revaluation of the underlying asset price and a concomitant volatility spike that records the extent of the price revision and its abruptness. Volatility spikes offer the active manager the prospect of successive opportunities for additive profit generation. The key to

effective monetization hinges on the skill to successfully prognosticate the likelihood and extent of uncertainty and its causality with the price of the underlying asset.

The High Sigma strategy represents an implementation of the concept above and banks on equity market disruptions and revaluations caused by economic data releases and geopolitical events. The strategy implements trades using futures and options on the VIX, VOLQ and ETF's linked to these indices.

Figure 1. S&P 500 and the VIX Index



The Nature of Volatility

Volatility is a standardized measure of uncertainty in the future performance of any unstable and randomly changing system. As it applies to asset prices, volatility measures the standard deviation of incremental (normalized) returns over a given time period. Larger price movements lead to bigger measurements of volatility. When such measurements are applied ex post, we obtain the “realized volatility” in the performance of the asset over a period in history or its historical volatility.

Markets in futures and options exist to price expectations of volatility over future time periods; this measure of volatility is referred to as “implied volatility.” Pricing calculators exist to transform assumptions of future prices (standard-normal - bell shaped - probability distribution of future likely paths of asset price,) into the implied volatility measure. In the case of options pricing, the Black-Scholes calculator is popularly used to compute their prices.

Options prices capture expectations on average and most future outcomes never conform to this average. The difference between realized and implied volatility is generally known as “volatility risk premium.”

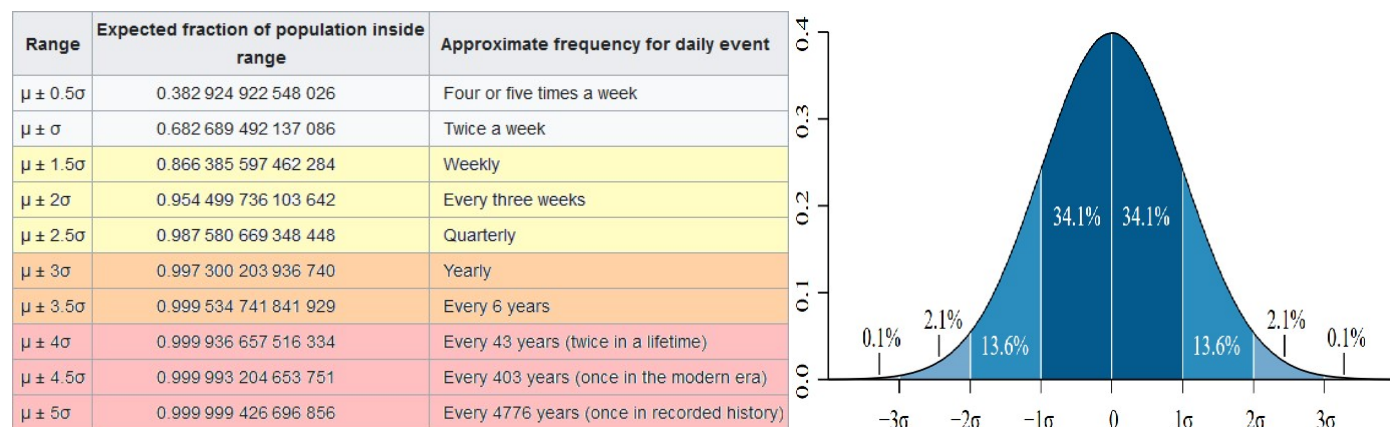
Comparing the option implied risk premium on a given equity index to the volatility of the index invariably reveals, the volatility risk premium is influenced by “squared returns.” In other words, the risk premium on index volatility references the magnitude of index moves as it responds in equal measure to both positive and negative returns. This strong relationship gives rise to fundamentally negative correlations between market prices and their volatility measure. The pricing and trading of this measure facilitates its use as an effective hedge as well as a potential source of alpha generation.

Traditional risk frameworks that rely on standard deviation make a convenient but limiting assumption that investment returns conform to a standard normal (bell-shaped) distribution. Such a distribution provides handy reference points but imposes limiting constraints from an investment standpoint:

- about two-thirds of the time (68.3%), returns should fall within (+/-) one standard deviation or 1-sigma (σ) and such a range can be expected on average, twice within a week; similarly, 95% of the time, returns should fall within two standard deviations or 2-sigma (σ) with a frequency of once every 3 weeks

- A limiting feature of a standard normal distribution graph is skinny "tails." Skinny tails imply a very low occurrence (about 0.3% of the time) of returns that are more than three standard deviations away from the average. This far from reality for returns in markets and investments
- Another constraining quality of this bell shaped assumption is perfect symmetry. Symmetry implies that the frequency and magnitude of upside gains is a mirror image of downside losses. Consequently, traditional models treat all uncertainty as risk, regardless of direction. This is a problem if returns over a period are not symmetrical or if investors worry about losses "to the left" of the average in seeking to hedge just this risk

Figure 2: Sigma (σ) – Probability, Frequency and the Standard Normal Distribution



Markets tend to price in all known and expected risks. Each new, unexpected event will reprice related markets. The severity (magnitude & speed) of the repricing caused by any adverse event depends on the significance of the event, its influence on future market valuation and the increased market risk premium to reflect increased uncertainty. Once the process of price discovery outweighs the impact of inflowing, new adverse information, prices start to stabilize.

Economic cycles are characteristically identified by relatively long periods of positive growth interspersed with short periods of retrenchment in growth. Equity markets generally tend to rise gradually over the long periods of growth and fall sharply over the brief periods of economic contraction. Economic data releases, geopolitical events and periods of financial instability have also prompted shorter periods of sudden and rapid market drawdowns.

Two observations can be made from the description of equity market price behavior: There exists an asymmetry between rising and falling markets. Falling markets comprise of larger moves in shorter periods of time. Secondly, 3+ sigma events occur more frequently than the 0.15% probability suggested by the standard normal distribution.

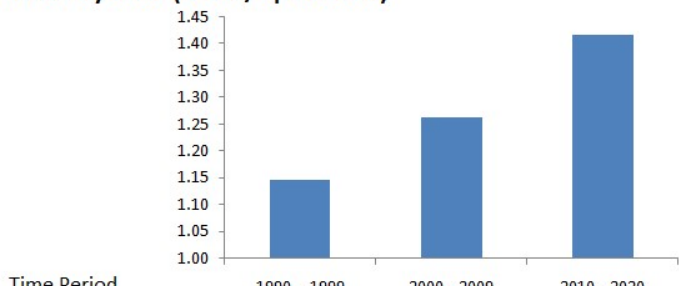
Consequently, any time-series of equity market volatility (eg. VIX) displays the following recognizable characteristics:

- Relatively extended periods of low range-bound volatility as a baseline during normal market regimes (figure 1)
- The baseline is interspersed with sudden spikes that capture the larger market price fluctuations during market corrections as investors navigate the uncertainty brought about by adverse, unexpected information with strong causality to market prices. The magnitude of the spike is proportional to the severity (magnitude & speed) of market repricing
- Any volatility spike always returns to its long-term mean (characteristic "mean-reversion" effect) as efficient markets seek clarity and certainty in newly evolving data to overcome the original, unexpected and adverse market correcting information, allowing market prices to stabilize
- The asymmetry in price returns in down markets when compared to rising ones is captured by corollary asymmetry in volatility prices; falling markets are more volatile than rising ones
- A closer look at equity index volatility asymmetry over time shows a trend of growing asymmetry or skew with each passing decade. This ratio of volatility shows that over time, equity markets are declining more rapidly versus their rate of climb; (figure 3)

- The time series of the VIX also reveals a fatter left-tail than suggested by the bell curve. Moreover, the tail has grown fatter over time; (figure 4)

Figure 3:

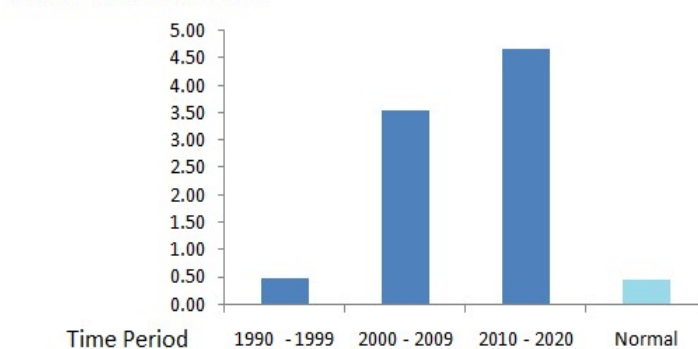
Volatility Ratio (Down/Up Markets)



Time Period	1990 - 1999	2000 - 2009	2010 - 2020
Volatility Ratio (Down/Up Markets)	1.15	1.26	1.42
Average Daily Volatility Range in Down Markets	1.35	1.81	2.25
Average Daily Volatility Range in up Markets	1.17	1.43	1.59

Figure 4:

Fatter Tails over Time



Time Period	1990 - 1999	2000 - 2009	2010 - 2020	Normal Distribution
Likelihood at 3 Std.Dev. (Fatness of Tail)	0.47	3.54	4.67	0.44

The last two observations make it increasingly conducive to successfully implement the High Sigma Volatility strategy. The ability to price and transact volatility has allowed for various methods of monetization of volatility risk premium in light of the observations above. We rationalize them next.

Profiting from Volatility with Focus on the VIX

Volatility is, by far, the primary means of securing protection from downside risk for any asset class, as investors count on the fundamentally negative correlation between asset price performance and its volatility. With downside events being relatively infrequent, there is a continuous, organic demand for insurance protection to long risk exposures to any portfolio during normal market regimes. This demand has the effect of driving implied volatility up, creating a negative volatility risk premium. Volatility sellers act as a counterbalance to bring pricing back towards fair value. This activity has gained popularity over time, particularly with the VIX index where net open futures positions have been increasingly negative on average.

The demand for protection is counterintuitive as the options markets systematically overprice insurance premia in a crisis while the combination of complacency and competitive selling drive them towards relative cheapness during periods of stability. This paradoxical swing in the volatility risk premium, despite the fact that most options expire worthless, gives a statistical edge to option sellers² and facilitates a systematic approach to the activity.

On the flip side, there is an edge to be gained by capturing volatility spikes if, during periods of stability, an investor can deploy skill to predict future, adverse market events and any associated mispricing. Several factors combine to make economic events, opportune times to trade the markets:

- Sources of Volatility: Fundamentally, volatility creates price dispersion and greater dispersion presents an opportunity for profit-making with the application of insight. Without volatility, there is no dispersion around predicted expectations of outcome and consequently no requirement for premium compensation. Economic data releases and geopolitical events often inject periods of heightened volatility resulting from new and unexpected uncertainties. Changes in volatility (or changes in the rate of price movement of the underlying asset price) are necessary to allow for the application of profit-seeking efforts.
- Predetermined Volatility: Economic events are pre-scheduled. Economic research groups publish their estimates of each from which a consensus average estimate and the dispersion around it can be gauged. The dispersion in forecasts provides input on the uncertainty around expected outcome. When compared to past announcements of the same data release, this uncertainty and corresponding SPX and VIX option premia, we get an idea on whether our own estimate is fairly priced or otherwise. If our expectation is an outlier to consensus expectation and pricing, we evaluate the potential payoff and its value
- Recurrence: Economic events happen on a recurring basis. This is crucial because it means that we can measure how the market reacted to each situation, and predict a market move in the case of similar events.

Economic data releases provide regular opportunities for potential sigma-driven profit, examples being Employment Report (Non-Farm Payrolls), Consumer Price Index (CPI), ISM Non-manufacturing, ISM Manufacturing, GDP, Federal Open Market Committee meetings to name a few.

The Hercules Investments High Sigma Strategy – Description

The High Sigma strategy is an intermediate (medium) term strategy that opportunistically takes long volatility positions to bet on underpriced volatility in future events. It is implemented using either futures or options (as available) on primarily the VIX index, the VOLQ index, or on one of the several ETP’s that reference the indices. The strategy can be applied to any market or market sector that offers cheap volatility.

High sigma events, collectively defined as a 3-sigma or greater move, are expected to occur every one to seven years at a minimum. A long volatility strategy purely built around such infrequent events, however large and lucrative, is inefficient. The effective short risk position demands a risk premium for the duration of the trade horizon that bleeds capital over the lead-time to the event. The strategy is made practicable by targeting more modest “moderate sigma” events that occur more frequently but provide lower payoffs.

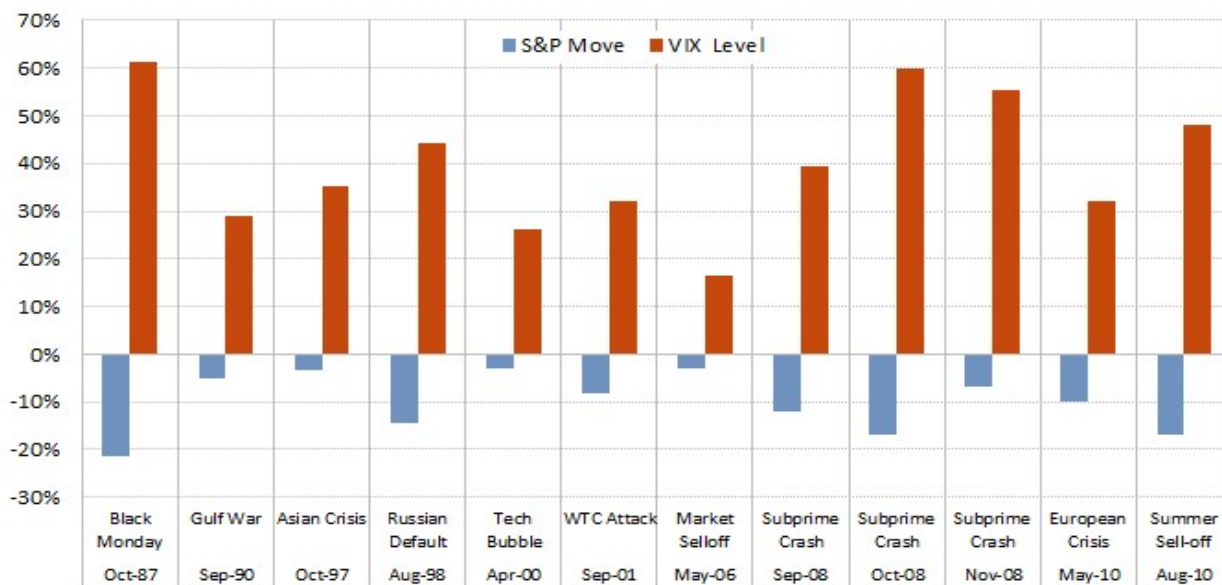
Once a position is initiated, the strategy is guided by very short-term signals from the Index Trend Reversal Strategy (ITRS) model-set as a guide to determine loss limit bounds and successfully navigate the trade to expiry.

In this context, a time-series of the VIX index (figure 1) shows the following:

- A tail event (extremely high sigma) occurs very rarely in history and offers maximum profit
- High sigma events (3σ to 3.5σ) occur anywhere between 1 and 7 years in frequency (figure 5.) Markets tend to fall anywhere between 20% and 35% from peak to trough in a recessionary environment or in reaction to serious external market shocks. In this bear market, the VIX index tends to spike to levels north of the 30% annualized volatility

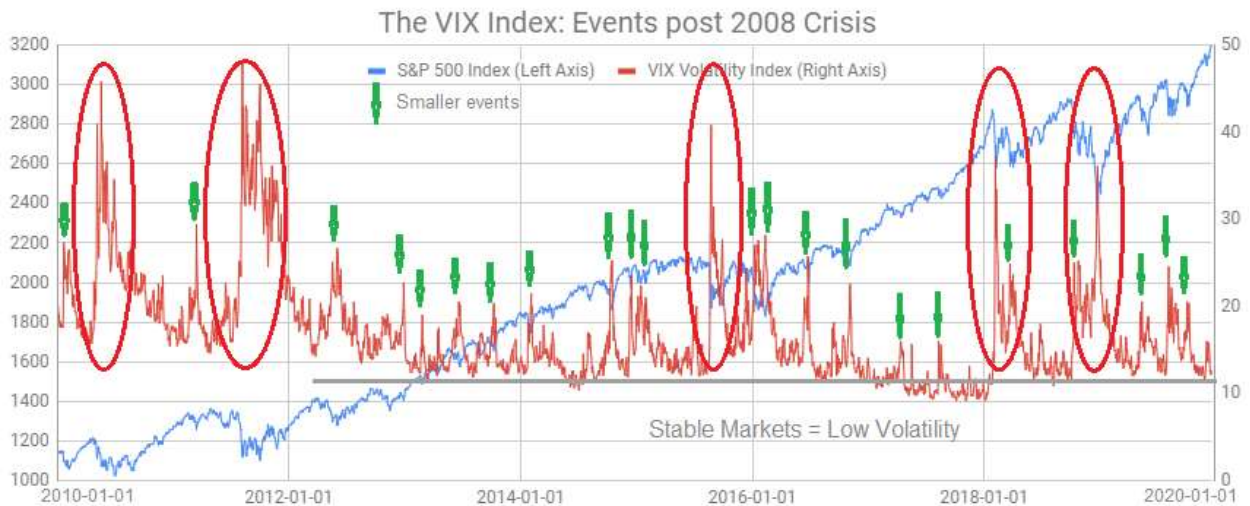
Figure 5: Historical High Sigma Events

High Sigma Events: Relationship between S&P 500 Drawdown and VIX Gain



- The ability to periodically create profits continues even in steadily rising bull markets. Despite uptrends, markets experience “moderate sigma” events (figure 6.) Adverse economic data releases can trigger pullbacks of <10% (1.5σ to 2.5σ - monthly to quarterly) causing VIX spikes in the 20 - 35% range. Furthermore, cumulative data suggesting an inflection point in the economy can cause a 10% to 15% correction (3σ - ranging from 6 months to 3 years) triggering 15 - 25% range VIX spikes

Figure 6: Moderate Sigma Opportunities



A. high sigma option trade is typically implemented conservatively by going long sufficiently deep in-the-money (ITM) options with an expiration date sufficiently past the expected event date. The position is expected to lose time value in the lead-up to the event and going deep ITM ensures considerable reduction in time value decay rate, not to mention reduced leverage in the trade. A trade on any event is implemented incrementally.

Risk Management

Being an intermediate term long option strategy, risk management primarily focuses on bringing cost efficiency through active management of each trade. The application of our ITRS model signals to guide the trades through implementation and loss management is instrumental to achieving this goal. In addition to systematic trade signal generation and trade execution, the strategy adopts a systematic budgeting of portfolio risk capital, wherein the trade may be legged into incrementally.

We utilize several measures in ensuring risk mitigation to each of our trades. We typically implement trades using deep in-the-money strikes to ensure a high option delta with the underlying index and a much reduced option time premium (option value close to intrinsic) for a given trade horizon. The trade horizon includes a sufficient time margin or buffer to safely include the likelihood of the expected event and avoid premature expiration prior to the event. Each trade is set with a maximum downside limit on holdings and the position is reduced or closed when thresholds are crossed.

Conclusion

Volatility captures the extent of market oscillations and allows for it to be consistently priced over time. The measure successfully isolates the magnitude of market gyrations, completely agnostic to market directionality. This key element gives volatility its strong negative correlation to its referenced asset and makes it valuable as an investment tool for protecting returns from the asset.

While most participants utilize volatility for market hedging purposes, a growing number apply it as an alpha generator. Its use for excess return generation depends considerably on the market environment. It allows experts in a given asset class to opportunistically seek profits through successful predictions of future market moving events that are underpriced. As with any volatility based strategy, managers employing such a strategy must be disciplined, especially with respect to the use of leverage, and need to employ the proper systems to monitor risk in real time. We believe the high sigma strategy stands to generate returns by capturing underpriced volatility in implied option premia, to generate a return stream with limited correlation to most other investments and deserves consideration as a portfolio allocation.

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