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VIX futures can give investors an attractive venue for managing tail risk, but they require more in-depth analysis than other financial futures. Short-dated futures provide more protection in a tail event, but have a higher carrying cost. Longer-dated futures have a lower carrying cost, but do not perform as well in a tail event. The key to understanding VIX futures lies in the fact that the VIX is highly mean-reverting. This creates a volatile futures curve; but this volatility spells opportunity, in our view.

Badon Hill White Paper Series

Hedging with VIX Futures

Making sense of the futures curve

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The Importance of Understanding VIX Futures

The potential benefits of the CBOE Volatility Index,[i] or VIX, as a hedge for equity-biased portfolios is now fairly well established academically. In particular, the VIX has a negative correlation with the S&P 500 index and that negative correlation becomes stronger in periods of financial and market stress. This makes the VIX an especially attractive hedge for investors who are looking to manage the "tail risk" in their portfolio since the protection offered by the VIX increases in periods of severe market stress.[ii]

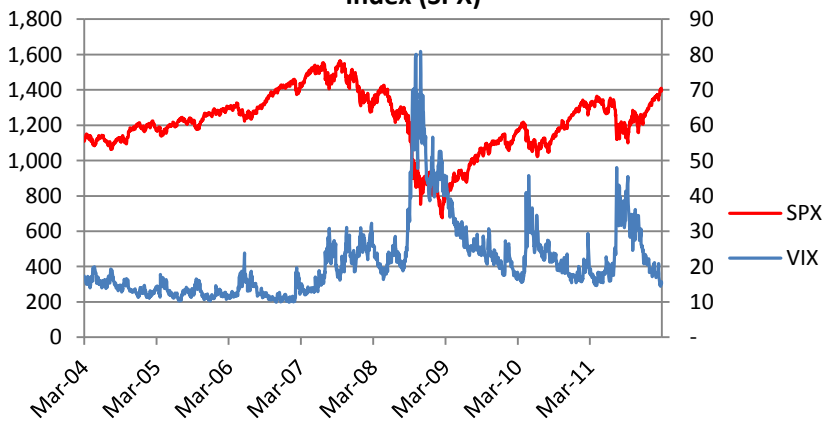
The VIX may look like an attractive hedge for a portfolio, but it is not directly investible

VIX futures are investible, but they behave slightly differently than the VIX

Understanding how VIX futures behave is essential to any volatility-based hedging product or strategy

Unfortunately, the VIX itself is only a mathematical calculation, not an investible index. It is effectively an observation, not an asset. As such, it cannot be "purchased" in a traditional sense. An analogy would be the weather: we can observe and measure it on a real-time basis, but we cannot purchase it. However, we could potentially enter into a purely financial transaction that seeks to benefit from a change in the weather (in fact, people do every day). Similarly, investors who wish to use the VIX to hedge their portfolios are forced to seek derivatives of the VIX index.

Figure 1: S&P Volatility Index (VIX) vs S&P 500 Equity Index (SPX)



Fortunately, there are several ways to profit from a rise in the VIX: VIX futures, variance futures, VIX options, S&P options, volatility-related ETF/ETNs, and over-the-counter versions of just about everything related to volatility. When you consider that similar instruments now exist on many of the world's other major financial indexes, the investible universe appears fairly large and growing. In this paper, we will focus on VIX futures since we believe that an understanding of the dynamics of VIX futures is essential to making sense of the other VIX and volatility products.

VIX Futures Can Lag to the Upside

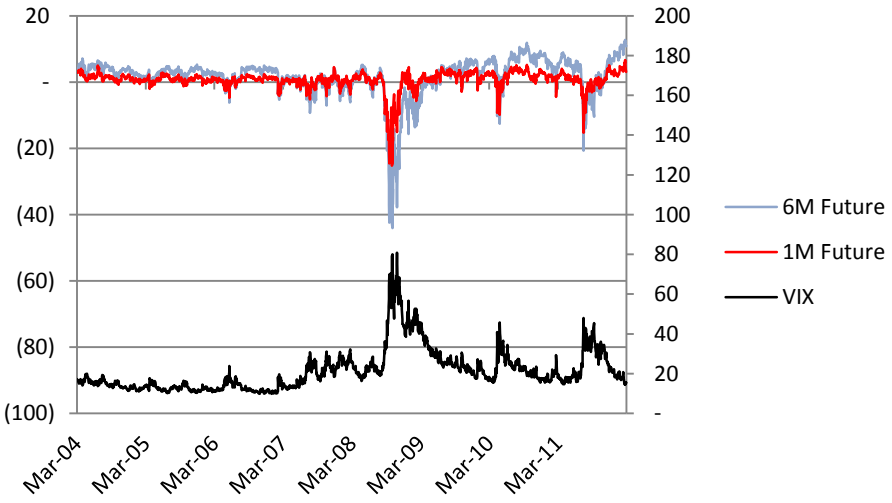
If we had to point to one quirk that makes volatility investing different from most other markets, we would have to go with the fact that it is highly mean-regressive over reasonable time periods. That is to say that, when the VIX spikes up, it tends to settle back down. If you are statistically inclined and interested, we calculate the Hurst Exponent of the VIX to be 0.37 (a value < 0.50 indicates that it is probably mean-reverting).[iii] If you are not statistically inclined, you can probably reach the same conclusion just by glancing at the chart of the VIX below. This is perhaps one of the most important things to keep in mind when analyzing VIX futures.

The VIX is highly mean-reverting. This causes the futures to trade at significant discounts when the VIX spikes.

Investors need to have a reasonably robust model to calculate the hedge benefit and determine optimal position size.

The significance of mean-reversion comes into play when we see a large spike in the VIX. Since the VIX is not directly investible, the futures are at liberty to trade at a significant discount or premium to their fair value, much like a closed-end fund. When the VIX has a sharp rise, there is a strong temptation for investors to bet that the VIX will subsequently decline. This influx of sellers tends to push the VIX futures level down below its fair value, as you can see on the chart below.

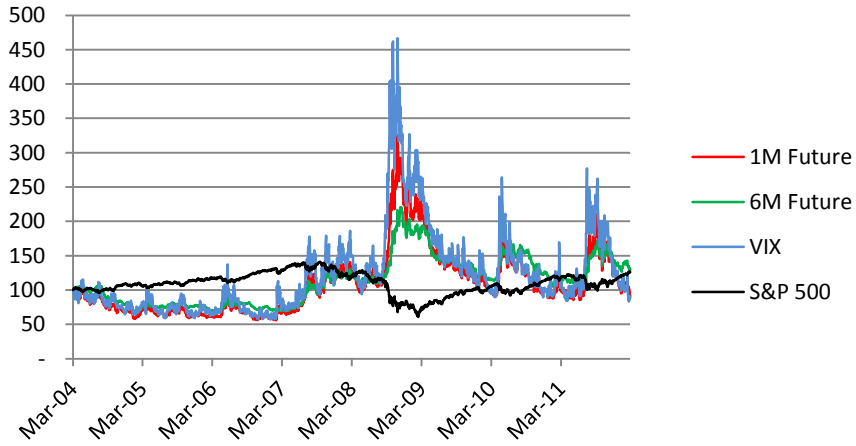
Figure 2: Spread to Fair Value of Generic VIX Futures vs VIX



The net result is that the hedging benefit of VIX futures is less than the theoretical hedging benefit of the VIX itself. However, that is different from saying that the hedging benefit is small. As you can see from the chart below, both the one month and six month VIX futures trailed the rise in the VIX index during the 2008 financial crisis. But we also note that the futures still experienced a 100-200% rise during the crisis, which can

go a long way to providing a hedge for an equity-biased portfolio. In our next paper, we will discuss how this upside lag can be potentially mitigated with some synergistic strategies, such as buying out of the money VIX call options. However, the main take-away for the moment is that VIX futures tend to lag the VIX to the upside due to investor anticipation of mean-reversion and investors need to factor this into their calculations when estimating the hedge benefit and sizing positions.

Figure 3: Indexed Returns



Short vs Long Term: Short Term benefits more in a decline

Short Term futures perform better in a tail event but have a higher carrying cost

Favored by investors that prioritize downside protection and investors who wish to play a near term bearish thesis

We can also note from the chart above that different series of futures can behave differently. Like most financial futures, at any given time there is an active, laddered series of futures that expire on different months. When one future expires, it is replaced by a new future at the end of the chain. Collectively, these futures are often referred to as the "futures curve" of the VIX. For many financial futures, there are only subtle differences between the price of one future and the price of one of its counterparts. However, when it comes to investing in VIX futures, investors need to carefully analyze the entire curve since the differences in price can be relatively more dramatic.

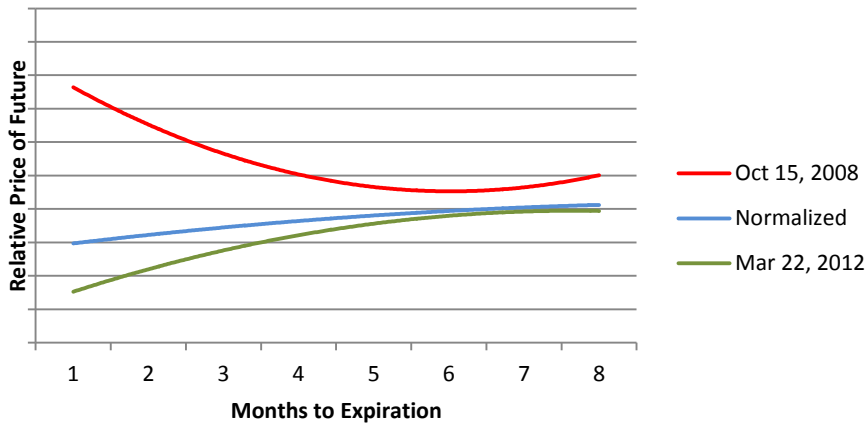
Once again, mean-reversion comes into play. As it turns out, although there is an expectation that the VIX will decline back to normal levels after it has risen sharply, investors do not necessarily expect it to do so immediately. After a spike, the VIX can stay elevated over the short term. Following this logic, investors wishing to bet on a post-spike decline in the VIX should probably be more comfortable selling a medium-term horizon (for example, six months) versus a short-term horizon (one month). The

excess selling of longer term futures relative to short term futures causes the latter to outperform the former.

One way to illustrate this concept is to look at the futures curves during times of stress and during "normalized" periods. Figure 4 shows the Badon Hill Normalized VIX Curve, which represents what we currently calculate to be the average VIX futures curve under normal conditions.[iv] During normalized periods, investors are happy to pay more for future expirations versus near term expirations, which is not uncommon for a financial future. In futures parlance, this condition is known as "contango," or having a forward sloping futures curve. However, during times of stress, the situation reverses itself, as we can see from the curve on October 31, 2008.

The net result is that the performance of short-dated futures is better than long-dated futures in a VIX spike, making them potentially a more appropriate choice for an investor that is looking for more protection or feels that a market disruption is relatively close at hand. For example, from August through October of 2008, the Badon Hill One Month VIX Future Index[v] was up 122% versus only 57% for its 6 month counterpart (for comparison, the VIX itself was up 167% and the S&P was down 23%).

Figure 4: Scope of VIX Futures Curves



Long term futures have a lower carrying cost, but do not provide as much protection in a tail event

Favored by investors engaged in long-term strategic hedging where carrying cost is a factor

Short vs Long Term: Long Term has a lower hedging cost

However, the holding cost of maintaining a one month VIX futures position is higher than longer dated futures. Why is this so? It has to do with the shape of the VIX futures curve. As the expiration of the future approaches, the price of the future will "decay" under normal conditions. However, as we can surmise from Figure 4, the rate of decay tends to

increase the closer we get to expiration. This effect is particularly pronounced in VIX futures since the slope of the forward curve tends to be steeper than in other financial futures.

This makes longer-dated VIX futures potentially more appropriate for investors who prioritize lower carrying costs or who feel that there is a fairly low probability of an imminent tail event. Of course, investors may have a habitual preference for low carrying cost or high hedge benefit, but the actual choice of instrument needs to be made with live market data and within a more thoughtful risk/reward context. We encourage all investors to at least think openly about using any point on the curve in a tail risk management program.

A high normalized holding cost can be appropriate given the risk-reducing nature of VIX futures in a portfolio. Although it is tempting to compare this cost against other financial futures, we feel it is more appropriate to judge the holding costs versus other hedging strategies such as protective put buying or buying credit default swaps. In that light, the costs may seem more palatable.

Understanding VIX futures creates insights into other investment areas

A volatile forward curve can lead to opportunities to lower carrying cost and/or increase hedge efficiency

Curve analysis can provide insights for credit and equity investors in general

One last observation from Figure 4: the slope of the VIX futures curve is highly volatile. This suggests that there is a strong incentive for investors to pay close attention to the shape of the VIX curve and be prepared to adjust positions accordingly. It also suggests that there may be ways to lower overall holding costs by betting that the curve will steepen or flatten (buying short dated and selling long dated, and vice-versa).

Because of the peculiarities of the VIX futures, we strongly advise all investors looking to embark upon VIX-based tail risk management to develop a reasonably robust model to cope with upside lag and curve fluctuation issues. This model is not only essential for VIX futures investing, it also is a prudent pre-requisite for VIX options investing, investing in variance contracts and even strategies that are correlated with volatility, such as purchasing credit default swaps.

Additionally, an understanding of the shape and behavior of the VIX futures curve can lead to some insight into how investors are thinking about the future volatility of the market, which may lead to more effective market timing or equity and debt investing. For example, as you can probably see in Figure 4, the slope of the VIX futures curve is currently close to an all-time high. This may indicate that investors are fairly sanguine on the near-term prospects for volatility, but may be concerned about an increase in volatility over the medium to longer term.

[i] The CBOE Volatility Index is a product of the CBOE. More information can be accessed at http://www.cboe.com/micro/VIX/vixintro.aspx

[ii] Keith H. Black, "Improving Hedge Fund Risk Exposures by Hedging Equity Market Volatility, or How the VIX Ate My Kurtosis" The Journal of Trading, Spring 2006. (Also, see our October 3, 2006, memo entitled "Article Summary: Improving Hedge Fund Risk Exposures by Hedging Equity Market Volatility").

[iii] To estimate the Hurst Exponent we used a method commonly known as "Peng Fit" or "Minimum Variance of Residuals."

[iv] The Badon Hill Normalized VIX Curve represents an average of the Badon Hill Term VIX Futures Indexes on "normal" VIX days. We define a "normal" VIX day as a day where the VIX spot is less than 20 (starting on March 26, 2004).

[v] The Badon Hill Term VIX Futures Indexes are a proprietary series of continuous price VIX futures indexes target at exactly 1, 2, 3, 4, 5, 6, 7, 8, and 9-month expirations. The indexes are calculated using the "daily roll" method, which we find preferable to "monthly roll" or other such calculations since it (1) maintains a constant and exact time to expiration and (2) is more reflective of how a liquidity-aware manager might behave in actual trading.

About Badon Hill

Started in 2004, Badon Hill is a consultancy and advisor to both investment managers and investors in the hedge fund industry. The principals and consultants of Badon Hill have hedge-fund related research and investment experience in excess of 20 years each. Drawling upon this experience and our proprietary analytical systems, Badon Hill provides research, management and consulting products to leading investment firms and high net worth individuals. As a normal part of its business, Badon Hill is compensated for producing reports such as this for third parties. Badon Hill has not been offered, nor has it solicited, any compensation for this report, but reserves the right to accept compensation in the future. More information is available at www.badonhill.com.

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