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Directional Exposure to Volatility Via Listed Futures

S&P 500 VIX Short-Term Futures Index

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- Volatility has emerged as an important asset class in the last decade. It is actively traded through over-the counter swaps, and more recently through exchange listed VIX® futures and options.
- While VIX has achieved widespread recognition, it remains very challenging to replicate spot VIX. The S&P 500 VIX Short-Term Futures Index is the first index to offer replicable, directional exposure to volatility using exchange-listed futures contracts.
- The index is comprised of two near term VIX futures contracts, which are rebalanced daily in equal increments in order to maintain a constant one month maturity.
- While the correlation between spot VIX and the S&P 500 VIX Short-Term Futures Index is not perfect, it is a healthy 87%. More importantly, the correlation of the index to the S&P 500 is -76%, similar to the correlation of spot VIX to the S&P 500 of -74%.
- The index has a positive return 95% of the time that the S&P 500 has a loss of more than 1%. During days of sharp market declines, index returns are usually greater in value than corresponding S&P 500 losses.
- Dedicated long positions in the index are expected to decline during normal volatility regimes. Not only is volatility mean reverting to a theoretical expected long term return of zero, but the index is also expected to suffer from roll loss due to term structure decay. Conversely, short positions in the index provide exposure to a forward starting volatility arbitrage strategy.

Introduction

Volatility, or the second moment of the price distribution of an asset, has emerged as an important asset class in the last decade. It is actively traded through over-the counter (OTC) variance and volatility swaps, and through exchange listed VIX futures and options. While VIX® has achieved widespread recognition, it remains very challenging to replicate spot VIX. The S&P 500 VIX Short-Term Futures Index is the first index to offer directional exposure to volatility through publicly traded futures markets. This paper provides a background on the construction, replicability and characteristics of this index.

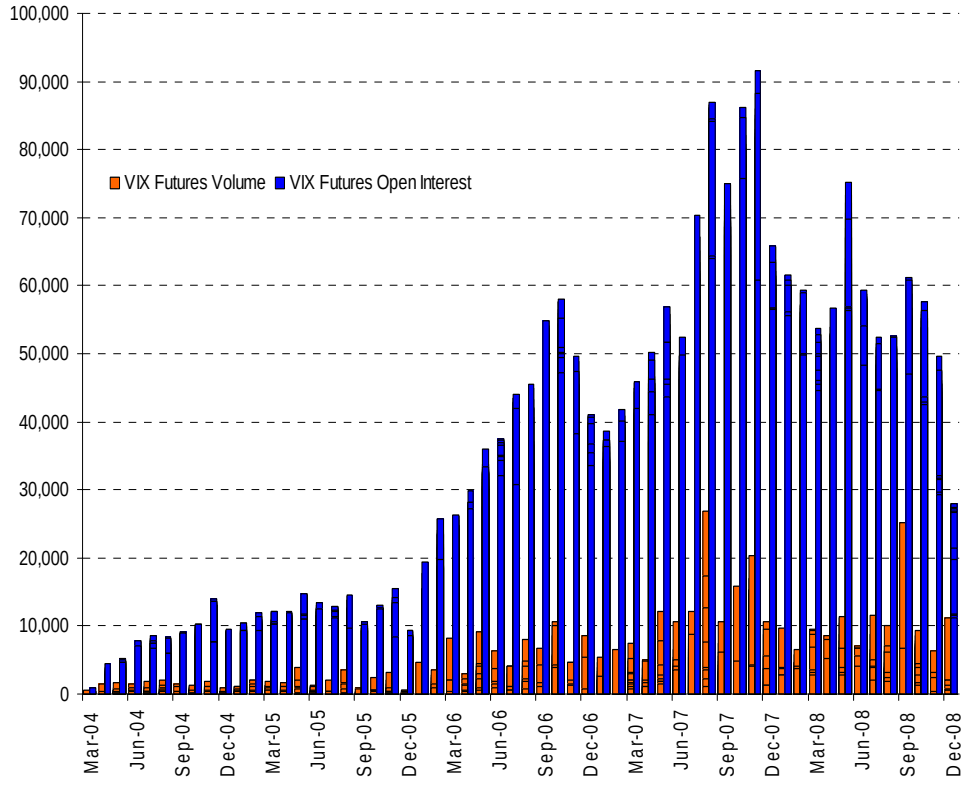
A Brief History of VIX

Since Black-Scholes and similar option pricing models came into widespread use after 1973, market participants have had access to tools that provide a framework for pricing options once expected volatility has been forecast. By repeatedly adding educated guesses as to implied volatility into the formula, implied volatility can be calculated, given a known option price.

In 1993, The Chicago Board Options Exchange introduced VIX, which combined implied volatility calculated via the Black-Scholes model for a range of at-the-money S&P 100 options strikes. The resulting index provided a minute-by-minute calculation of implied 30-day volatility, and rapidly became the premier indicator of US stock market volatility. Analysis of volatility showed that it hits its highest level during periods of market turbulence; hence VIX gained the moniker “the investor fear gauge.”

Changes in theory and in market practice led to a suite of methodology changes in September 2003 that further improved the usefulness of VIX. Since the S&P 500 is the more widely-followed indicator, it replaced the S&P 100 as the index underlying the options used for VIX calculation. Equally importantly, the calculation method was changed, replacing Black-Scholes with a more practical method used in the variance swap market, independent of any particular pricing model. This simplified the methodology as well as making it more useful. The calculation also uses a broader range of strike prices, rather than just at-the-money strikes, although it gives a lower weighting to strikes further from the money. The changes increased the practical appeal of VIX and allowed VIX to be replicated, in theory, using underlying options. Futures and options on VIX were launched in March of 2004 and February of 2006 respectively. In practice, however, VIX remains difficult to trade or replicate because the underlying basket of options is large and constantly rebalanced. However, volumes and open interest for both VIX futures and VIX options have increased dramatically since their launch, as shown in Exhibit 1.

Exhibit 1: Volume & Open Interest for VIX Futures



Source: CBOE

The S&P 500 VIX Futures Index Series

Futures based indices have proven to be valuable tools to access exposure to alternative assets with limited liquidity in the spot market. The advent of the VIX futures market provided an opportunity to extend this concept to the volatility market. The S&P 500 VIX Futures Index Series includes two indices, the S&P 500 VIX Short-Term Futures Index and the S&P 500 VIX Mid-Term Futures Index. This document focuses on the former.

The S&P 500 VIX Short-Term Futures Index is comprised of the first nearby and second nearby VIX futures contracts, which are rebalanced daily in equal increments to maintain a constant one month maturity. The index has an excess return version which is comprised solely of futures price returns, and a total return version which includes the reinvestment of risk free returns. The index is calculated in a similar way to the S&P GSCI, the leading futures based index[1].

A key feature of the index is replicability. While spot VIX is difficult to replicate, the index can be easily replicated via exchange listed VIX futures contracts using the index's simple, publicly available methodology. The constant one month maturity also

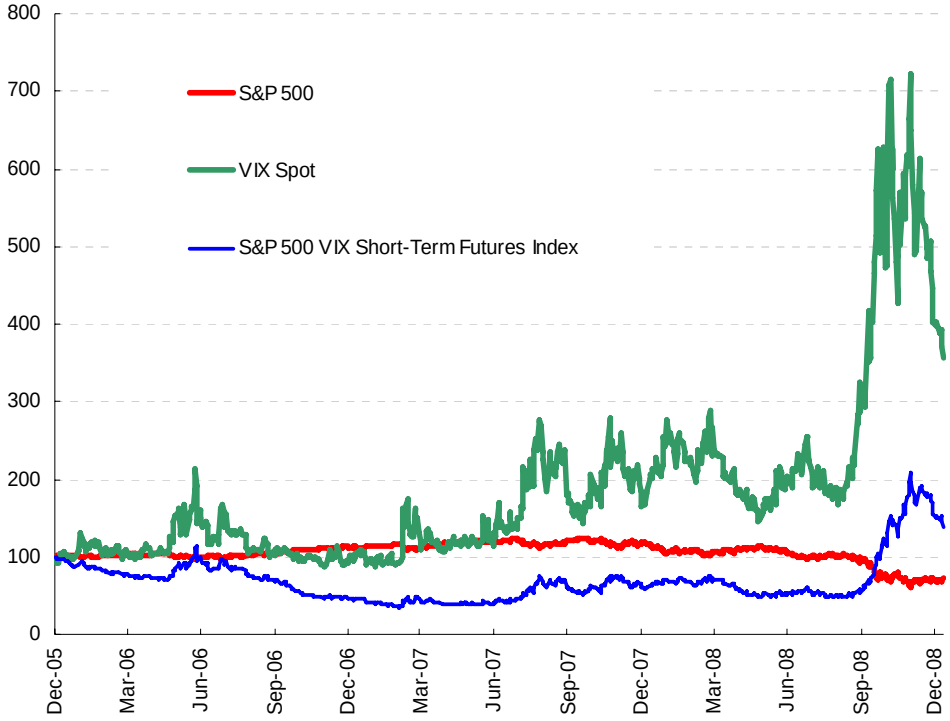
[1] See "S&P 500 VIX Futures Index Series - Methodology" at www.indices.standardandpoors.com for details on index computation.

presents opportunities to indirectly replicate the index via OTC volatility swaps, which are well established in the institutional market.

Index Returns and Term Structure Decay

The performance of the S&P 500 VIX Short-Term Futures Index is shown in Exhibit 2. The chart illustrates a positive relationship with spot VIX, as well as a negative relationship with the S&P 500.

Exhibit 2: Index Returns



Source: Bloomberg

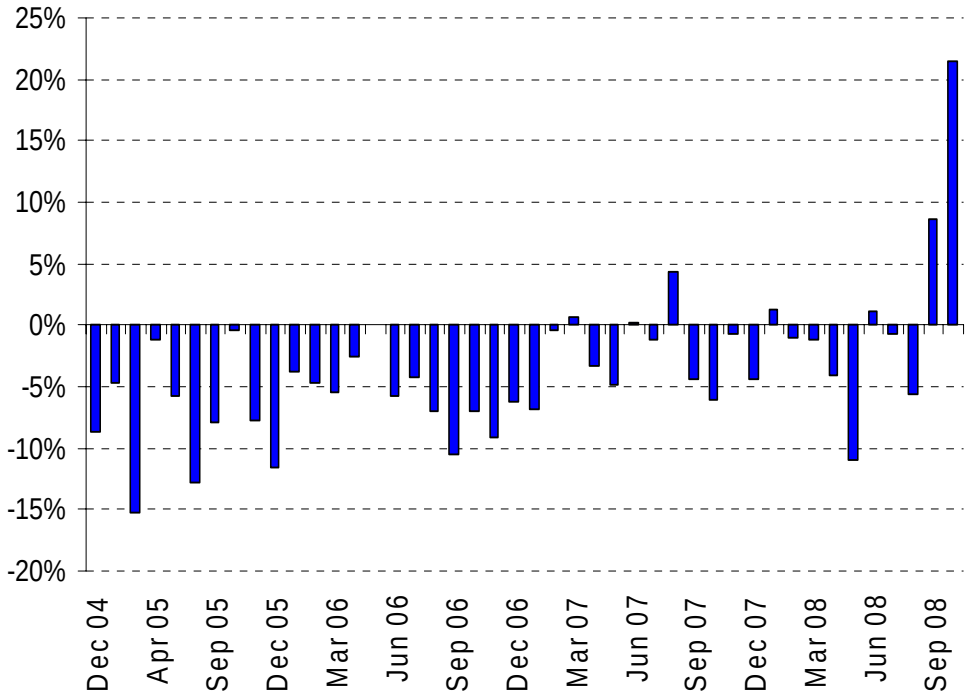
Exhibit 3 shows that for various holding periods, the returns of the index are generally negative. Closer observation reveals a strange characteristic, in that the S&P 500 VIX Short-Term Futures Index definitively moves downward for the majority of its history except for the period of extreme stress and volatility in the latter part of 2008. Intuitively, as volatility is not a return-generating asset, its value should vary around its mean. However, term structure decay results in the index declining for most periods. In other words, the price received for the sale of the current near term contract is generally less than that paid for the next term, as expected VIX is generally greater than current VIX. This feature is not unique to VIX futures; commodity markets often experience this in contango. Exhibit 4 shows the percent loss every month if one were to simply roll contracts at month-end.

Exhibit 3: Percentage number of positive returns from S&P 500 VIX Short-Term Futures Index holdings

	Rolling 5-day periods	Rolling 30-day periods	Calendar weeks	Calendar months
Average before July 07:	33%	23%	38%	25%
Average since July 07:	55%	62%	53%	58%
Average over full period:	44%	44%	46%	43%

Source: Standard and Poor's

Exhibit 4: Term structure decay and losses incurred in VIX futures roll



Source: Bloomberg, Standard and Poor's

Insurance in Market Downturns

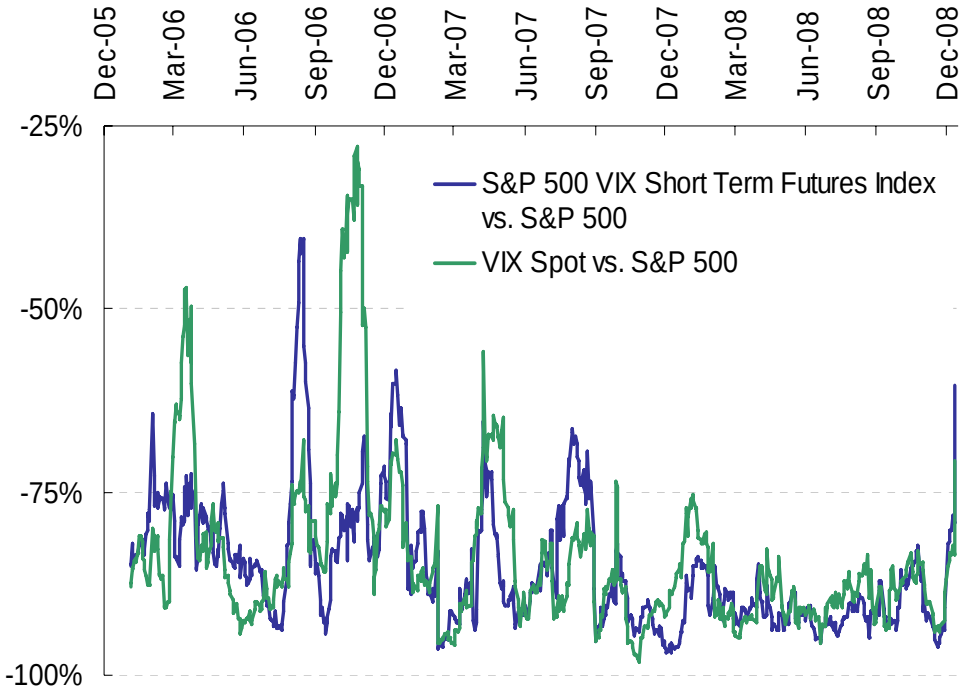
Looking at the holding period returns in the previous section, it can be difficult to see why this index is useful. One obvious use is simply shorting the index. A short position would basically serve as a volatility arbitrage strategy which generally delivers positive returns, but breaks down during periods of stress such as in Q4 2008. However, a key point to note is that the VIX and the S&P 500 tend to move in opposite directions, i.e. they are strongly negatively correlated. This property carries over to the S&P 500 VIX Short-Term Futures Index, as shown in Exhibit 5. While the correlation between spot VIX and the futures index is not perfect, it is a healthy 87%. More importantly, the correlation of the index to S&P 500 is -76% which similar to the correlation of spot VIX with S&P 500 of -74%. Exhibit 6 shows that this inverse relationship holds over time.

Exhibit 5: Correlation of S&P 500 VIX Short-Term Futures Index with VIX and S&P 500 (Dec 2005 – Dec 2008)

	S&P 500	VIX Index	S&P 500 VIX Short-Term Futures Index
S&P 500	100.00%	-73.58%	-76.26%
VIX Index		100.00%	86.78%
S&P 500 VIX Short-Term Futures Index			100.00%

Source: Bloomberg, Standard and Poor's.

Exhibit 6: Rolling 20-day correlation of the S&P 500 VIX Short-Term Futures Index with VIX and the S&P 500



Source: CBOE, Standard and Poor's

Exhibit 7 shows that daily declines in the S&P 500 are highly likely to be accompanied by rises in both the VIX spot and VIX futures index.

Exhibit 7: Probability of VIX rises given particular S&P 500 declines

S&P 500	Probability Of a Rise in Volatility	
Daily Return	VIX	S&P 500 VIX Short Term Futures Index
< 0	81.36%	71.47%
<-0.5%	93.88%	90.31%
< -1%	96.72%	95.08%
<-1.5%	97.44%	96.15%

Source: Bloomberg, Standard and Poor's. (Using data from Dec 2005 – Dec 2008)

Particularly during periods of market stress, the rise in the S&P 500 VIX Short-Term Futures Index tends to outweigh the decline in S&P 500, as shown in Exhibit 8.

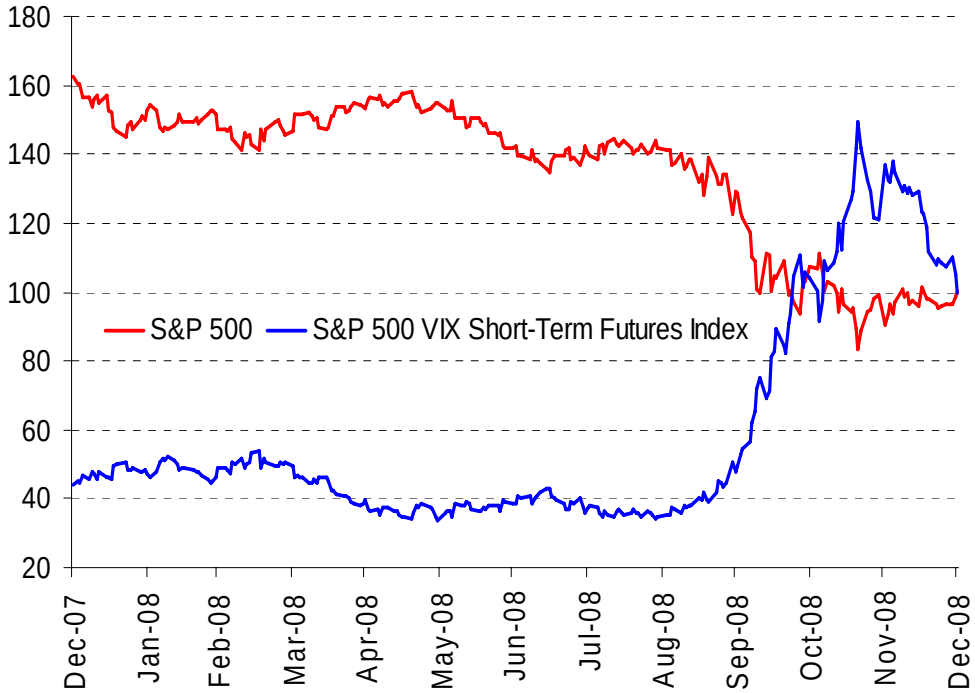
Exhibit 8: 20 biggest daily S&P 500 falls from 2005 to 2008

Date	S&P 500	VIX	S&P 500 VIX Short-Term Futures Index
15/10/2008	-9.03%	25.61%	14.03%
1/12/2008	-8.93%	23.93%	12.76%
29/9/2008	-8.79%	34.48%	14.00%
9/10/2008	-7.62%	11.11%	9.97%
20/11/2008	-6.71%	8.89%	5.28%
19/11/2008	-6.12%	9.79%	9.79%
22/10/2008	-6.10%	31.14%	10.34%
7/10/2008	-5.74%	3.13%	9.60%
5/11/2008	-5.27%	14.31%	6.52%
12/11/2008	-5.19%	8.17%	7.72%
6/11/2008	-5.03%	16.72%	11.76%
15/9/2008	-4.71%	23.54%	6.00%
17/9/2008	-4.71%	19.54%	5.72%
14/11/2008	-4.17%	10.83%	7.57%
2/10/2008	-4.03%	13.69%	6.67%
6/10/2008	-3.85%	15.31%	3.60%
22/9/2008	-3.82%	5.55%	6.99%
27/2/2007	-3.47%	64.22%	24.53%
24/10/2008	-3.45%	16.71%	11.34%
9/9/2008	-3.41%	12.50%	7.00%

Source: Bloomberg, Standard and Poor's

This relationship is clearer if one looks at 2008, one of the worst years for U.S. equity markets in history. Exhibit 9 shows that as the market declined, the S&P 500 VIX Short-Term Futures Index rose.

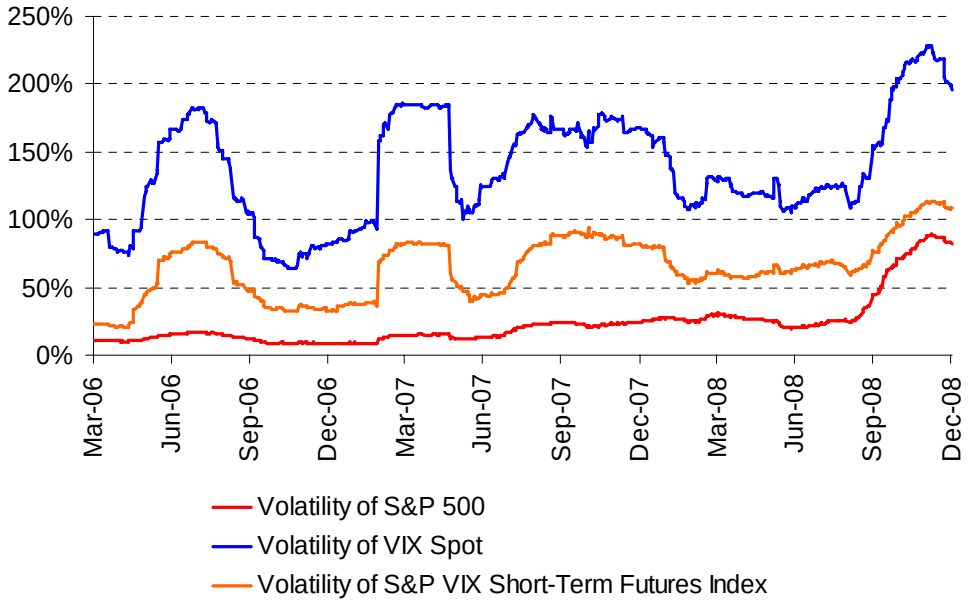
Exhibit 9: S&P 500 and S&P 500 VIX Short-Term Futures Index in 2008



Source: Standard and Poor's (Data rebased to 100 at period end for clarity)

It is important to note that during periods of market stress, the move in spot VIX is more than the move in the index, as can be seen from Exhibit 8. This is because the volatility of spot VIX is greater than the volatility of the futures based index, as shown in Exhibit 10.

Exhibit 10: Trailing 60-day volatility of VIX and S&P 500 VIX Futures Index



Source: Standard and Poor's, Bloomberg

Disclaimers