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Selling Volatility

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Volatility Is A New Asset Class

Volatility is an alternative asset class linked to the CBOE Volatility Index (VIX). The VIX is a measure of expected volatility of the stock market constructed from the implied volatilities of a wide range of S&P 500 index options.

Potential Benefits of Selling Volatility

- A short volatility strategy has the potential to be similar to being long the S&P 500
- It has built in leverage that contributes to potentially market beating returns
- There are significant risks that need to be actively managed

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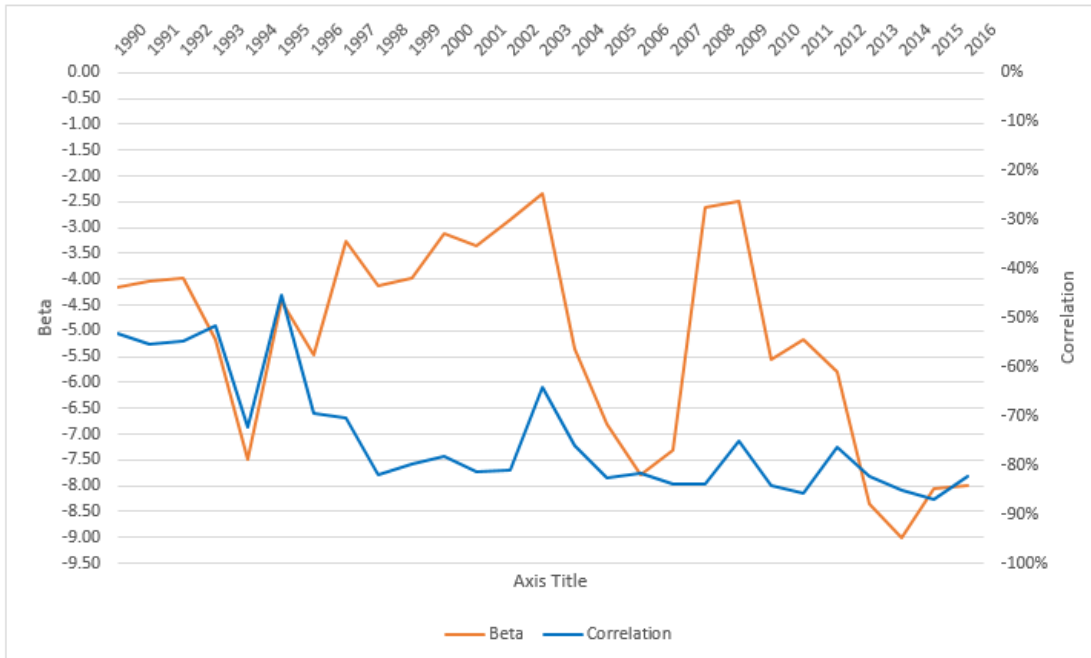
What is the VIX?

The CBOE Volatility Index (VIX) is a measure of expected volatility of the stock market constructed from the implied volatilities of a wide range of S&P 500 index (SPX) options. It is quoted in percentage points and represents roughly the expected movement of the S&P 500 index over the upcoming 30-day period which is then annualized. For example, a VIX of 16 means the one standard deviation move of the SPX over the next 30-days is 16% on an annualized basis whether up or down. The VIX is a measure that can be conveniently plugged right into the Sharpe Ratio¹ formula to give investors an assessment of the risk-adjusted return of the S&P 500 index.

Since the VIX inception in January 1990 through December 2016, the historical correlation of the daily changes between the SPX and the VIX is -70.76%. The beta² is -4.10. The inverse correlation relationship has gotten steadily stronger over the years and since 2010 it has been south of -80% with regularity.

Relationship between SPX and VIX (1990 - 2016)	
Correlation	-70.76%
Beta	-4.10

Exhibit 1 | Historical Relationship Evolution between SPX and VIX



Data: From 1990 to 2016

Data Source: Black Peak Capital, Yahoo Finance

VIX Futures – The Trading Vehicle for the VIX

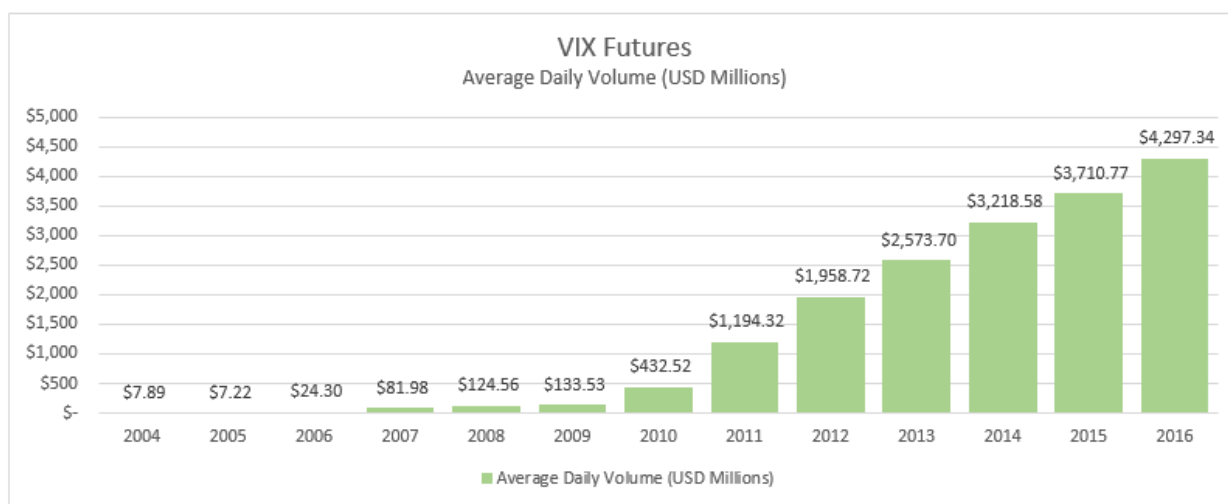
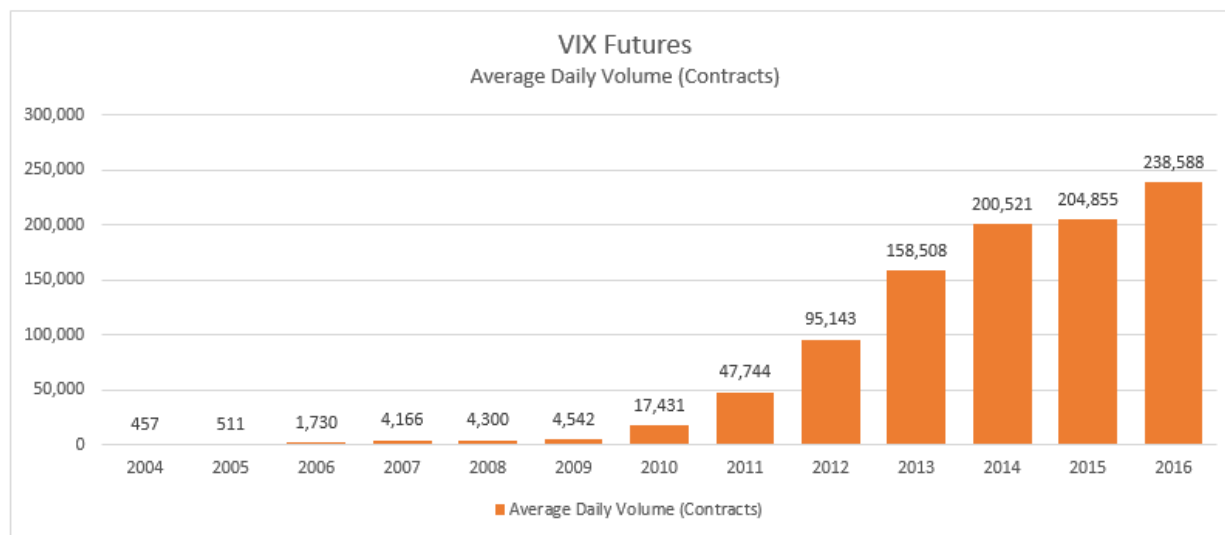
Due to the high inverse correlation and significant leverage embedded in the VIX formula, a small long volatility position in a portfolio would be a very efficient hedge against a market drawdown. Unfortunately,

¹ Sharpe Ratio is the annualized return (total return – risk-free return) divided by the annualized standard deviation (or volatility) of returns. It is a measure of risk-adjusted return in the Capital Asset Pricing Model (CAPM).

² Beta is a measure of the volatility, or systematic risk, of a security in comparison to a market benchmark. Beta is used in the Capital Asset Pricing Model (CAPM) to calculate the expected return of an asset.

the VIX is simply a formula and not a trading vehicle. There was significant interest in a trading vehicle linked to the VIX so in 2004 the CBOE launched the VIX futures market which finally allowed portfolio managers to get direct exposure to the VIX. Since then VIX futures have grown very popular over the years and in 2016 the average daily volume eclipsed \$4 billion.

Exhibit 2 | Growth of the VIX Futures Market



Data: From March 2004 to December 2016

Data Source: Black Peak Capital, CBOE

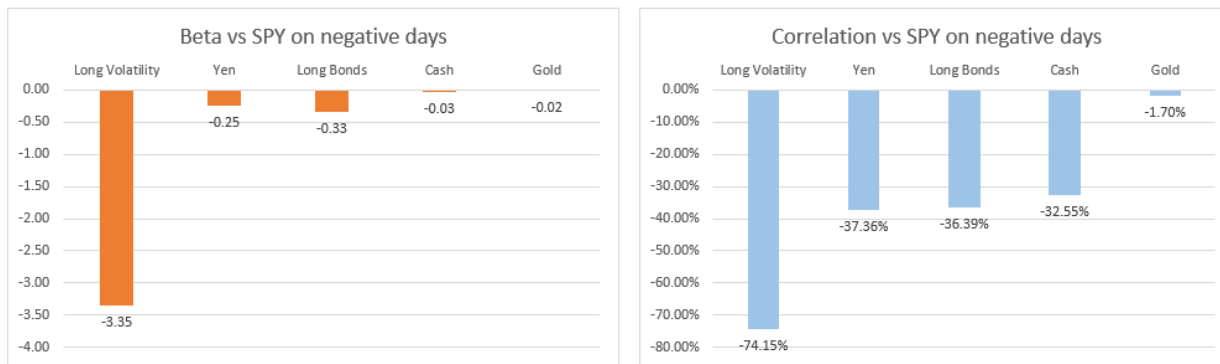
Portfolio managers use VIX futures in an attempt to hedge stock portfolios against systemic market risk. While an option may provide an effective hedge for a specific company, protecting all the stocks in a portfolio individually may prove to be an expensive endeavor. Other major asset classes used for diversification purposes exhibit neither the strong negative correlation nor the leverage that VIX futures do. The traditional asset classes used to diversify exposure to stocks are the Japanese Yen, 20+ Year US Treasuries (Long Bonds), Gold and Cash. A look at the historical performance of the ETFs of these safe havens versus the S&P 500 ETF

(SPY) on negative days reveals that the Long Volatility ETF (VXX) which is comprised of VIX futures may be a better and more efficient hedge.

Exhibit 3 | Hedging with Long Volatility vs Traditional Asset Classes

vs SPY on negative days

ETF	Description	Beta	Correlation	Days	Start Date	End Date
VXX	Long Volatility	-3.35	-74.15%	886	1/30/2009	12/30/2016
FXI	Yen	-0.25	-37.36%	1121	2/16/2007	12/30/2016
TLT	Long Bonds	-0.33	-36.39%	1622	8/1/2002	12/30/2016
SHY	Cash	-0.03	-32.55%	1622	8/1/2002	12/30/2016
GLD	Gold	-0.02	-1.70%	1366	11/19/2014	12/30/2016



Data Source: Black Peak Capital, Yahoo Finance

Due to the low interest rate regime since the Financial Crisis, many corporations have stocks with higher dividend yields than the yields of their respective corporate bonds. As such stocks have turned into bond replacements for many portfolio managers who are looking for extra yield. PMs have become increasingly reluctant to sell their stock positions to avoid losing the dividend stream they provide. As such PMs have become more adept at using hedging techniques to protect a portfolio against principal loss. The enhanced use of portfolio level hedging has propelled the VIX futures market forward and it is now one of the fastest growing financial markets.

Pricing of VIX Futures

Since the VIX futures measure the expected value of the VIX at a certain date in the future, how is the price of a VIX futures contract calculated? Like other index derivatives, the VIX futures contract is settled in cash and as such there is no simple cost-of-carry, arbitrage-free relationship between the futures price and the underlying asset (the VIX). There is no cost-of-carry because there is no tradable asset underlying the VIX futures since the cash VIX index cannot be bought or sold. The VIX index and VIX futures are connected by a statistical relationship that depends on the speed with which the VIX moves toward its average level, the volatility of the index and the time remaining to expiration (G.D., 2012). From a practical standpoint, the VIX futures expire against a defined portfolio of S&P 500 options, specifically the portfolio that is used to calculate the value of the VIX index at expiry (King, 2016). Fair value is derived by pricing the forward 30-day variance which underlies the settlement price of VIX futures. The fair value of VIX futures is the square root of this expected variance less an adjustment factor which reflects the concavity of the square root function used to extract volatility from variance. In percentage points, the fair value of VIX futures is:

Fair Value VIX Futures = 100 $\sqrt{(365/30)(P_t - \text{var}_t[F_T])}$

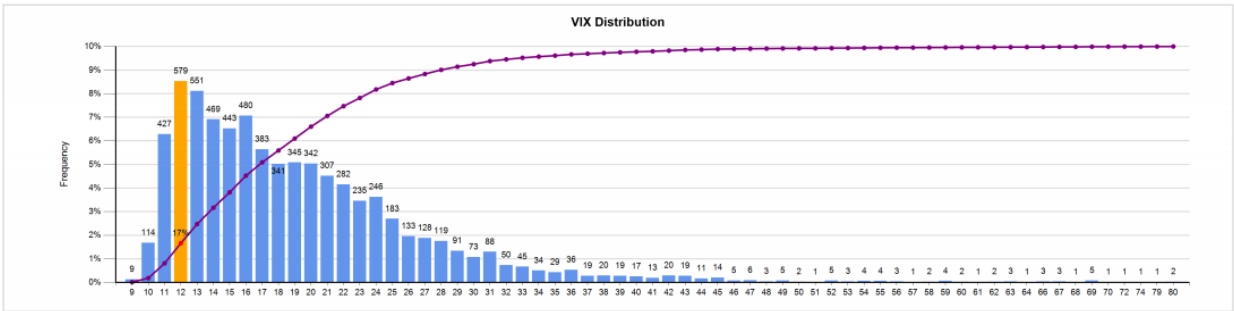
In this expression, P_t is the forward price of de-annualized variance in the 30 days after the futures expiration, and $-\text{var}_t[F_T]$ is the concavity adjustment. (CBOE, n.d.)

Hedging With VIX Futures

For general hedging purposes, however, more important is the historical behavior of the VIX futures relative to the VIX rather than their intricate pricing mechanisms which are more the purview of the market makers at the CBOE Futures Exchange. CBOE research concludes that the closer to expiration a VIX futures contract is, the closer its price to the cash VIX contract is (CBOE, 2016). On any given trading day, there are usually 8 contracts traded in the VIX futures market. The ones that are closer to expiration trade closer to the cash VIX while the ones that are farthest out from expiration tend to trade closer to the long-term average of the VIX. The long-term VIX average has historically been somewhere around 20. On 12/8/2016, the long-term VIX average stood at 19.69.

Since the primary use of the instruments that compose the VIX calculation – SPX options – is to hedge S&P 500 index contracts or broad stock portfolios, they are primarily viewed as a cost of doing business. And since portfolio hedges are a cost that affects the return of a portfolio negatively, during flat or up trending markets portfolio managers seek to minimize that cost, sometimes aggressively. This is evident in the historical distribution of the VIX which is heavily skewed to the downside.

Exhibit 5 | Historical Distribution of the VIX



Data Source: Black Peak Capital, Yahoo Finance

While the long-term average of the VIX is 19.69, the median³ is 17.83 and the mode⁴ of the VIX is 12. Historically, the VIX has closed 57% of the days below its long-term average; since 2010, the year when the VIX futures market expanded dramatically, that percentage is 76%.

Since the VIX has traded below its long-term average the majority of the time, the VIX futures curve tends to have a positive slope. The front contract tries to approach the cash VIX value which is usually far below

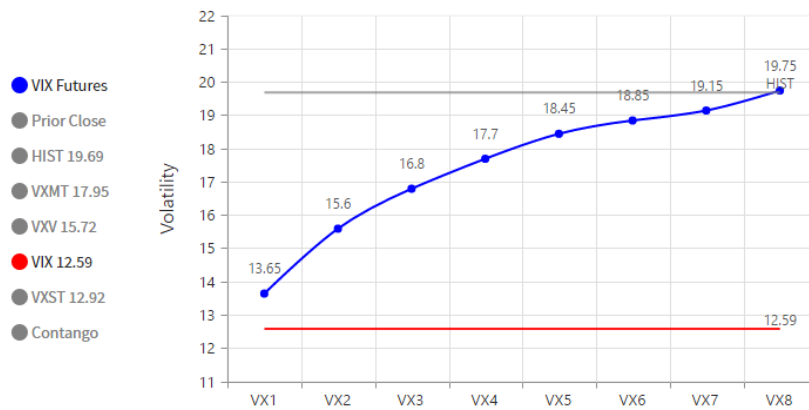
VIX Distribution Statistics (1990 - 2016)	
Average	19.69
Median	17.83
Mode	12
Skewness	2.11

³ Median – midpoint of distribution of observed values

⁴ Mode –value that appears most often in a set of data

the long-term VIX average while the farthest from expiration contract tries to approach the long-term VIX average.

Exhibit 6 | VIX Futures Curve



Data: As of 12/8/2016

Data Source: Black Peak Capital, DTN

The most popular VIX futures contracts are the front 2 contracts, the ones that are closest to expiration. On average the front 2 contracts have about 80% of the total tradable volume and about 70% of the total open interest. The closer to expiration a VIX future contract is, the higher its beta to the VIX and thus the better hedge it is. One way to hedge the SPX is by using a combination of VX1 (front-month) and VX2 (second-month) futures which has an average time to expiration of 30 days. This approach is captured by the S&P 500 VIX Short-Term Futures Index (SPVIXSTR). Many of the popular volatility exchange traded products seek to implement this index such as iPath S&P 500 VIX Short-Term Futures ETN (VXX) or the ProShares Ultra VIX Short-Term Futures ETF (UVXY). In fact, the top 4 volatility ETPs by AUM are based on the SPVIXSTR. The top 2 inverse volatility ETPs are based on the inverse version of that index – the S&P 500 VIX Short Term Futures Inverse Daily Index (SPVXSPIT).

Exhibit 7 | Volatility ETPs by AUM and VIX Futures Exposure

Ticker	Description	Most Popular Volatility ETPs		Leverage	AUM	VIX Futures Exposure (millions)	
		Exchange Traded Product				Total	Net
VXX	Long Volatility	iPath S&P 500 VIX Short-Term Futures ETN		1	\$ 1,290.00	\$ 1,290.00	\$ 1,290.00
UVXY	2x Long Volatility	ProShares Ultra VIX Short-Term Futures ETF		2	\$ 536.75	\$ 1,073.50	\$ 1,073.50
TVIX	2x Long Volatility	VelocityShares Daily 2x VIX Short-Term ETN		2	\$ 222.42	\$ 444.84	\$ 444.84
VIXY	Long Volatility	ProShares VIX Short-Term Futures ETF		1	\$ 176.59	\$ 176.59	\$ 176.59
VIXM	Long Volatility - Mid Term	ProShares VIX Mid-Term Futures ETF		1	\$ 47.67	\$ 47.67	\$ 47.67
VXZ	Long Volatility - Mid Term	iPath S&P 500 VIX Mid-Term Futures Class A ETN		1	\$ 43.02	\$ 43.02	\$ 43.02
VIIIX	Long Volatility	VelocityShares Daily Long VIX Short-Term ETN		1	\$ 10.53	\$ 10.53	\$ 10.53
ZIV	Short Volatility - Mid Term	VelocityShares Daily Inverse VIX Medium-Term ETN		-1	\$ 73.62	\$ 73.62	\$ (73.62)
SVXY	Short Volatility	ProShares Short VIX Short-Term Futures ETF		-1	\$ 265.32	\$ 265.32	\$ (265.32)
XIV	Short Volatility	VelocityShares Daily Inverse VIX Short-Term ETN		-1	\$ 616.90	\$ 616.90	\$ (616.90)
As of 12/8/2016						\$ 4,041.99	\$ 2,130.31

Data: As of 12/8/2016

Data Source: Black Peak Capital, etf.com

Exhibit 8 | VIX Futures Contract By Volume and Open Interest

VIX Future Contract	Future Term	Expiration Date	Settle	Volume	Open Interest	Volume Notional	Open Interest Size
VXZ16	1	12/21/2016	13.325	111,357	166,815	\$ 1,483,832,025	\$ 2,222,809,875
VXF17	2	1/18/2017	15.475	75,631	149,165	\$ 1,170,389,725	\$ 2,308,328,375
VXG17	3	2/15/2017	16.625	21,429	40,901	\$ 356,257,125	\$ 679,979,125
VXH17	4	3/22/2017	17.550	8,078	29,711	\$ 141,768,900	\$ 521,428,050
VXJ17	5	4/19/2017	18.300	5,761	22,802	\$ 105,426,300	\$ 417,276,600
VXK17	6	5/17/2017	18.725	2,657	15,900	\$ 49,752,325	\$ 297,727,500
VXM17	7	6/21/2017	19.025	1,705	8,566	\$ 32,437,625	\$ 162,968,150
VXN17	8	7/19/2017	19.575	426	3,276	\$ 8,338,950	\$ 64,127,700
VXQ17	9	8/16/2017	19.675	32	805	\$ 629,600	\$ 15,838,375
As of 12/7/2016			Total	227,076	437,941	\$ 3,348,832,575	\$ 6,690,483,750

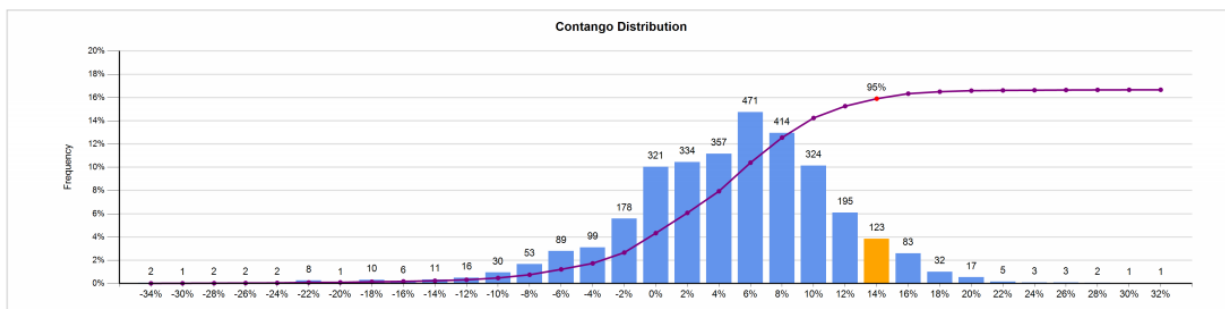
Data: As of 12/7/2016

Data Source: Black Peak Capital, CBOE

The SPVIXSTR based ETPs (VXX, UVXY, TVIX, VIXY, VIIX) on 12/7/2016 had AUM of \$2.995 billion and represented 66% of the open interest in the VX1 and VX2 futures (total notional value of \$4.531 billion). This illustrates that majority of the hedging in the VIX futures markets happens through an exchange traded fund with VXX being the most popular one.

The Cost of Contango

As we discussed in Exhibit 3, the Long Volatility ETN VXX is a very efficient hedge for the SPX with its strong negative -70% correlation and with its high degree of leverage embedded in its -3.35 beta. However, hedging with VXX comes at a cost. Just like hurricane insurance for your house is not free, portfolio hedging, especially as good as the VXX, is also not free. Since the VIX trades below its long-term average most of the time, this means that majority of the VIX futures contracts decline in value as they get closer to expiration. This decline gets accelerated as the futures contracts enter the final 2 months.

Exhibit 9 | VX1 and VX2 Contango Historical Distribution

Data: From March 2004 to 12/8/2016

Data Source: Black Peak Capital, CBOE

The rate of decline of the VIX future contract in its last 2 months can be estimated by the premium with which the VX2 contract trades over the VX1 contract. Most of the time that premium is positive and when the premium is positive, the standard industry term for this relationship is “Contango”. The average historical VIX Contango is 5.6% and the mode is 6%. It is positive 81% of the time. Thus holding a VXX position during

Contango Distribution Statistics
 (3/26/2004 - 12/30/2016)

Average	5.7%
Mode	6%

a flat or up trending market will automatically result in losses if held over a long period of time and if the stock market is flat or up trending.

Exhibit 10 | Long term performance of VXX



Data Source: stockcharts.com

The average loss of VXX from January 2009 through December 2016 during weeks when the SPX is flat or positive is -5.65%. The average loss of VXX during a month when the SPX is flat or positive is -12.44%. But since the VXX has the best leverage and correlation combination, many portfolio managers are willing to carry its cost with a small allocation of their portfolio, use it as a hedge and sleep well at night.

The Short Volatility Opportunity

The cost of using VXX as a hedge is also an opportunity to collect a premium. Due to the built-in leverage of the VIX futures, significant returns are possible. There are 2 exchange traded products that offer exposure to the S&P 500 VIX Short Term Futures Inverse Daily Index (SPVXSPIT) – VelocityShares Daily Inverse VIX Short-Term ETN (XIV) and ProShares Short VIX Short-Term Futures ETF (SVXY).

XIV is the oldest product and is generally more liquid and more widely used, but SVXY also has a following because it offers options and the opportunity to participate in favorable tax treatment through the publicly traded partnership (PTP) that passes through special IRS

Relationship between XIV and SPX (Nov 2010 – Dec 2016)	
Correlation	83%
Beta	3.60

Section 1256 contract taxation by statute. During weeks when the SPX has been flat or positive, the XIV averages a positive return of 5.28% (vs 1.41% for the SPX). During months when the SPX has been flat or positive the XIV averages a positive return of 11.19% (vs 2.74% for the SPX). The long-term correlation is 83% and the beta is 3.60. So XIV can be used as a leveraged version of the S&P 500 index and can be used to boost returns when the market is flat or trending up. It is important to note that XIV or SVXY or other volatility exchange traded products may have significantly greater daily movements than that of the broad US equity markets. The higher volatility of this investment strategy may be unsuitable for investors depending on their specific investment objectives and financial situation.

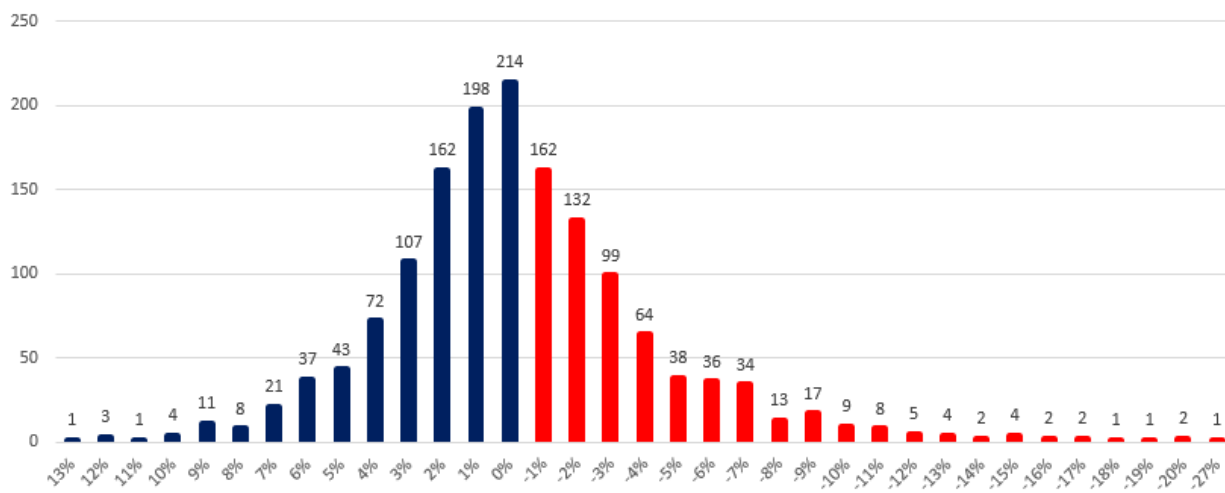
Risks

Just as a short volatility strategy can produce market beating returns during up trending markets, it can produce market trailing returns during down trending markets. The implied leverage means a short volatility trade can lose a lot of money and fast when the market is going down.

Exhibit 10 | XIV Performance Breakdown

XIV Returns (Nov 2010 - Dec 2016)					
Frequency	Positive	Avg Return	Negative	Avg Return	% Positive
Daily	882	2.7%	636	-3.3%	58%
Weekly	186	6.5%	131	-7.2%	59%
Monthly	86	13.5%	56	-13.5%	61%
Yearly	4	91.6%	3	-23.4%	57%

Distribution of XIV Daily Returns



Data: From December 2010 to 12/8/2016

Data Source: Black Peak Capital, Yahoo Finance

Since its inception in late 2010, the XIV has had 2 top to bottom drawdowns of -75% and -68% and regularly encounters drawdowns of the -10 to -20% variety. It took the XIV 249 trading days – almost a year – to recover from its biggest -75% drawdown. As such the short volatility trade needs to be actively monitored and managed and it is very important that large drawdowns be avoided as the XIV can lose years of gains in a matter of days. There are 2 major risks in using the short volatility strategy.

High Volatility Regime Risk

A high volatility regime is when the VIX is rising on a daily or weekly basis, maintains a strong momentum above the 10 or 50 day moving averages or has settled above the long-term average of about 20. When the VIX is rising, the VIX futures generally rise in tandem and then the short volatility trade experiences quick losses. If the VIX is above the long term average, then VIX futures curve moves into backwardation and then the monthly rollover of the futures results in automatic losses. Historically this happens about 20% of the time.

Liquidation Risk (Overnight Volatility Spike)

An example of that was during the British European Exit Referendum in June of 2016 (Brexit) when the S&P 500 dropped -5% overnight due to the unexpected result. But the VIX spike was far bigger because market participants weren't positioned correctly. The VIX jumped 49.3% that day resulting in the biggest daily drop for the XIV ever of -26.8%. Historically, the VIX has had 4 days with spikes over 50% with the maximum spike of 64% ever recorded happening on February 27th, 2007 when there was massive selloff on the Shanghai exchange which spilled over into the US markets. Events such as a sudden nuclear explosion in a metropolitan city could cause an even bigger VIX spike thus putting the short volatility strategy and the XIV at a significant liquidation risk.

Both of these risks can be mitigated by monitoring a variety of volatility signals or via the use of option stock replacement strategies. Volatility momentum, speed, term structure, risk premium, mean reversion and chandelier stops are some of the signaling strategies that can be used to detect a high volatility regime. Option stock replacement strategies can be used to limit risk against overnight volatility spikes. To mitigate these risks, a successful short volatility strategy needs to be actively managed and requires a complex implementation. There can be no assurance that this strategy will be successful and more over it may be unsuitable for investors depending on their specific investment objectives and financial situation.

Notes

All historical data is from when data was available until 12/8/2016

The VelocityShares Daily Inverse VIX Short-Term ETN (XIV) started trading in Nov 2010.

The iPath S&P 500 VIX Short-Term Futures ETN (VXX) started trading in Jan 2009.

The CBOE Volatility Index was started in January 1st, 1990.

VIX Futures started trading in March 26th, 2004.

VIX Options started trading in 2006.

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Volatility Exchange Traded Products (ETPs) may have significantly greater daily movements than that of the broad US equity markets. Investors cannot directly invest in an index and unmanaged index returns do not reflect any fees, expenses or sales charges. The use of trading algorithms and judgments about the attractiveness, value and potential appreciation of particular volatility ETPs and options may prove to be incorrect and may not produce the desired results.

Exchange Traded Fund (ETF): A security that tracks an index, a commodity or a basket of assets like an index fund, but trades like a stock on an exchange. ETFs experience price changes throughout the day as they are bought and sold.

Exchange Traded Note (ETN): A type of unsecured, un-subordinated debt security typically issued by a bank. This type of debt security differs from other types of bonds and notes because ETN returns are based upon the performance of a market index minus applicable fees, no period coupon payments are distributed and no principal protections exists.

Options: An option is a financial derivative that represents a contract sold by one party (the option writer) to another party (the option holder). The contract offers the buyer the right, but not the obligation, to buy (call) or sell (put) a security or other financial asset at an agreed-upon price (the strike price) during a certain period of time or on a specific date (exercise date).

Implied Volatility: Implied volatility is the estimated volatility of a security's price. In general, implied volatility increases when the market is bearish, when investors believe that the asset's price will decline over time, and decreases when the market is bullish, when investors believe that the price will rise over time. This is due to the common belief that bearish markets are riskier than bullish markets. Implied volatility is a way of estimating the future fluctuations of a security's worth based on certain predictive factors. Implied volatility is one of the deciding factors in the pricing of options.

Futures: Futures are financial contracts obligating the buyer to purchase an asset or the seller to sell an asset, such as a physical commodity or a financial instrument, at a predetermined future date and price. Futures contracts detail the quality and quantity of the underlying asset; they are standardized to facilitate trading on a futures exchange. Some futures contracts may call for physical delivery of the asset, while others are settled in cash. VIX futures in particular are settled in cash.

Short Selling or “Shorting”: Short selling is the sale of a security that is not owned by the seller, or that the seller has borrowed. Short selling is motivated by the belief that a security's price will decline, enabling it to be bought back at a lower price to make a profit. Since the risk of loss on a short sale is theoretically infinite, short selling should only be used by experienced traders who are familiar with its risks.

Leverage: Leverage is the investment strategy of using borrowed money: specifically, the use of various financial instruments or borrowed capital to increase the potential return of an investment. Leverage can also refer to the amount of debt used to finance assets. When one refers to something (a company, a property or an investment) as “highly leveraged,” it means that item has more debt than equity.

VIX: The CBOE VIX (S&P 500 Volatility Index) is a measure of market expectations of near-term volatility conveyed by S&P 500 stock index option prices. The VIX is forward looking and seeks to predict the variability of future market movements. This is in contrast to realized (or actual) volatility which measures the variability of historical (or known) prices.

Short VIX or Short Volatility: A “short VIX” investment is one that is designed to correlate negatively or move opposite of the Chicago Board Option Exchange Volatility Index (VIX). These investments may take many forms but are typically Exchange Traded Funds (ETF) or Exchange Traded Notes (ETN). They may also be designed to have various ratios to the daily movement of the VIX (for example 2 times or .5 times) in which case they are also referred to as leveraged or geared ETFs or ETNs

SVXY: ProShares Short VIX Short-Term Futures ETF seeks daily investment results, before fees and expenses, that correspond to the inverse (-1x) of the daily performance of the S&P 500 VIX Short-Term Futures Index.

XIV: The VelocityShares Daily Inverse VIX Short Term ETN provides -1x leveraged exposure to an index comprising first- and second-month VIX future positions with a weighted average maturity of 1 month.

VXX: The iPath S&P 500 VIX Short-Term Futures ETN tracks an index with exposure to futures contracts on the CBOE Volatility Index with average 1-month maturity.

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