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Volatility Products and their Uses: An Introduction to the VIX Index and Volatility Instruments

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Volatility Products and their Uses

An Introduction to the VIX Index and Volatility Instruments

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Abstract

Volatility instruments are complex investment products that can be used to hedge or speculate based on changes in market sentiment and fluctuations in the S&P 500. These products offer a unique approach to protecting one's portfolio and making strategic bets on future market volatility. However, lack of understanding of these products can be potentially dangerous as they can change dramatically in value within extremely short time-frames. Investors must be wary of using these products improperly; failure to adequately assess the risk of using volatility products can deliver devastating losses to one's portfolio.

The purpose of this document is to answer questions pertaining to the utility of volatility instruments as a hedging tool and their value as an investment. In doing so, we examine the historical performance of VIX futures and volatility ETPs (exchange-trade products) and compare their gains and losses as a part of a portfolio primarily invested in the S&P500. The quantitative evidence strongly suggests that volatility products can completely protect against disastrous losses of 20% or more in the S&P. Further studies on the performance of volatility products not covered by this study can lend additional light on potential strategies for protecting one's portfolio against loss, as well as new methods of speculation.

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Introduction

The CBOE Market Volatility index, or VIX for short, was established in 1993 by the Chicago Board Options Exchange. This index was meant to provide a measurement of expected stock market volatility through calculations from Standard & Poor's (S&P) 500 Index options. The CBOE (Chicago Board Options Exchange) introduced VIX futures in 2004 and VIX options in 2006. ETNs (Exchange Trade Notes) such as VXX and TVIX have also been recently established, and these instruments track VIX futures (VIX and Volatility). Volatility products have been labeled as “fear indicators” since their value is tied with investor sentiment; if there is high perceived volatility, VIX and its derivatives can quickly increase in price. VIX can provide investors with a unique tool to hedge their portfolios and greatly enhance their annual returns. However, volatility products are poorly understood by most individuals due to their complexity and average investors are susceptible to dangerous losses if they do not properly use these instruments. In February of 2018, a major spike in volatility triggered an implosion of XIV, an ETN that tracked VIX futures. On February 1st, XIV was valued at over \$130 a share. The very next week, XIV plummeted to \$4.22 a share (Collins, 2018). After XIV experienced an 80% decline in one day, the note was to be called for redemption, turning it into a “defunct security” (Collins, 2018). Investors who were shocked by this explosive decline were not aware of important details in the ETN's prospectus, nor did they truly understand how implied volatility works. This recent example is a vital illustration of how volatility products are poorly understood by the public and the dangers they pose to those who do not fully comprehend what they are invested in. While proper usage of VIX products can greatly augment one's investment performance, they might also be disastrous to those who fail to exercise due caution. Therefore,

this paper should serve as a simple guide that will clearly explain what volatility is and VIX's purpose in an investor's portfolio.

Literature Review

Unfortunately, the literature available on volatility products is somewhat limited. VIX futures and options are complex products that are typically traded by professionals. Since much of the public invests personally to some degree, either in their personal brokerage accounts or their IRAs, there is a great deal of literature on stock picking and day trading but information on this niche asset is comparably sparse. However, Florian Auinger in "The Causal Relationship between the S&P 500 and the VIX Index" provides a wealth of information on VIX's relationship to the S&P, its value as a predictive indicator, as well as many other important volatility characteristics such as its annual performance as part of a diversified portfolio. Russel Rhoades in "Trading VIX Derivatives: Trading and Hedging Strategies Using VIX Futures" and Raymundo Briones in "Volatility/VIX Trading: Your Step-by-Step Guide to Stock Trading and Options Trading with Volatility" both provide thorough analysis of VIX instruments as investments and deliver an abundance of information on the mechanics and intricacies of volatility. Rhoades in particular spends time describing and defining how the VIX index works and how VIX futures operate and can be traded. These works enable us to better understand exactly how volatility can be practically used and its applications in a regular investor's portfolio. The institutions that manage volatility products serve as a valuable source of information as well. The Chicago Board Options Exchange and Credit Suisse both provide data and information on VIX and related volatility products. The prospectus for ETNs and ETFs such as TVIX and VXXB are publicly available and these documents outline the risk elements and

specific mechanics of the products. Internet sources such as blogs and periodicals contribute to our knowledge and understanding of volatility with recent, up-to-date commentary and information on VIX and its derivatives. Vance Harwood at “Six Figure Investing” produces professional content exclusively related to volatility and pertinent updates on current or upcoming events in the volatility space. Additionally, Harwood provides essential details on derivatives of the VIX index such as exchange trade funds (ETFs), exchange trade notes (ETNs) and exchange trade products (ETPs) that are poorly understood by investors and often overlooked. Internet sources are superb in that they are able to digest and translate much of the professional jargon and lingo found in documents issued by major institutions. Blogs can put complex topics into laymen’s terms which can greatly assist in our understanding of volatility.

Research Question

The key questions that this paper will strive to answer are the following: what is VIX, what are its derivatives, how is VIX related to the S&P, and how can VIX be used effectively as part of one’s portfolio? The answers to these questions will permit any investor to develop relatively simple strategies using volatility products.

Methodology

This paper will utilize a combination of quantitative and qualitative analysis to provide an in-depth understanding of VIX and how it works. We will use a regression test to examine VIX and its derivatives’ correlation to the S&P and Dow Jones. Additionally, we will examine VIX’s merits as a part of one’s portfolio by comparing different scenarios and different uses of volatility products such as VIX options, futures, and ETNs. The primary purpose of this paper is to uncover the value of volatility products as an investment strategy and hedging tool.

What is Volatility?

Volatility can be defined simply as the degree of variation in trading price over time and it can be measured by using the standard deviation or variance of returns for a stock or index (Chen, 2018). Implied volatility is the use of options prices to determine expected volatility. Volatility is closely related to a security's risk or uncertainty. The higher a security's volatility, the more uncertain its future value will be; higher volatility means that a stock has a large range and the price can change dramatically in either direction (Chen 2018). The concept of volatility is one of the most essential aspects of finance since volatility is closely related to risk. Money managers must consider the risk of an investment, and therefore its volatility, or its tendency to swing significantly in value over time. For example, an asset manager of a retirement fund will be more interested in investments that have low volatility. Individuals who are close to retirement cannot afford the risk of a large decline in the value of their portfolio. On the other hand, speculative investors may seek out securities with high volatility as it gives them the potential to experience greater financial gain within a much shorter period of time. The implied volatility of an option contract is an important consideration for one interested in investing in options. High implied volatility will generally mean a higher option premium, and it is an indicator of uncertainty as to the future movement of a stock. Option writers will demand higher premiums on a volatile stock as large price swings mean higher risk for the option writer. These option writers will of course want to be compensated for the risk, and therefore charge higher prices on written calls and puts. A savvy investor must consider the impact of IV (implied volatility) as high option premiums can greatly impact his break-even point and potential for profit. For example, if an investor were to purchase a call option on a stock, he or she may fail to experience any profit at all if the stock does not move high enough in a favorable direction.

What is the VIX and how does it work?

The VIX is an index that uses SPX (S&P 500 Index) option prices to create an estimate of volatility for the next 30 days (Harwood, 2018). As aforementioned, a highly volatile market will produce higher option premiums. The VIX combines the prices of hundreds of different SPX options to come up with “an aggregate value of volatility” (Harwood, 2018). The VIX has been termed as an ‘investor fear gauge’ and it is often used as an indicator of market anxiety. An extremely high VIX level indicates a great deal of fear and uncertainty in the market; market pessimism results in a rush to buy puts and pushes options premiums higher (Auinger, 2015). Harwood affirms this observation, stating that:

Option premiums move inversely to the market. In a rising market, stock prices tend to be less volatile and options premiums low- hence a lower VIX. Declining markets are volatile and options premiums increase. Much of this increase occurs when worried investors pay a large premium on puts to protect their positions (Harwood, 2018).

Sudden, explosive news stories can trigger rapid increases in the price of VIX and its derivatives. Conflict over trade and political disputes between the United States and other countries have provoked powerful surges in VIX on multiple occasions this year. When pessimistic news is released, investors quickly buy puts to safeguard their positions in anticipation of future market volatility and negative performance. As we can see, the “fear index” is true to its name. Another consideration is that although the VIX represents the 30-day implied volatility, it is also expressed as an annual figure. If the VIX is quoted at 30, this can be interpreted as SPX options pricing in an annual move of 30% in the S&P 500 index over the next 30 days. (Rhoades, 2011).

VIX's inverse relationship with the S&P can provide significant diversification benefits. A case study by Edward Szado investigated the potential impact of VIX products during the latter half of 2008 and concluded that "investable VIX products could have been used to provide some much needed diversification during the crisis of 2008. In addition, the results of this study suggest that, dollar for dollar, VIX calls could have provided a more efficient means of diversification than provided by SPX puts" (Szado, 2009). Szado also notes that many investors who "had previously thought themselves well diversified" generated significant losses (Szado 2009). The key takeaway is that the use of VIX options or futures can be of great benefit during a period of calamity. VIX can move far more aggressively but not proportionally to the S&P 500. Raymundo Briones found that on average, a 10% decrease in the stock market index may cause a VIX increase of 30-50% (Briones, 2014). The implication here is that a relatively small holding of VIX products can potentially provide extremely effective protection for the entire portfolio.

Indeed, Nassim Taleb, the author of "The Black Swan" warns of events that are both highly improbable and impossible to predict according to any man-made models. Taleb emphasizes the importance of the 1987 market crash, which remains the largest one-day percentage decline in the DJIA. The drop was not the response of any news, and Taleb asserts that had he pointed out its possibility the day prior he would be labeled a lunatic (Taleb, 2007). Taleb defines a "Black Swan" event as an event of great magnitude whose probability cannot be computed. To illustrate our inability to predict the future based on information from the past, we are presented with the metaphor of the Turkey:

Consider a turkey that is fed every day. Every single feeding will firm up the bird's belief that it is the general rule of life to be fed every day by friendly members of the human

race ‘looking out for its best interests,’ as a politician would say. On the afternoon of the Wednesday before Thanksgiving, something unexpected will happen to the turkey. It will incur a revision of belief (Taleb, 2007).

The metaphor of the turkey can be translated to market conditions. It is easy to believe that since the market has been trending upwards for the past several years that it will continue to do so without great change. This information from the past does not offer the ability to see into the future, however. Given this observation, the savvy investor may look to VIX instruments as a tool to guard themselves against the “Black Swan” conundrum. It is a mark of irony that Nassim Taleb’s “Black Swan” was published only shortly before the Great Financial Crisis of 2008-2009, an event that came as a great shock to not only the general population but to professional investors and institutions as well.

Russel Rhoades provides an in-depth analysis on VIX’s ability to hedge against Black Swan type catastrophes and also typical bearish movements. On November 20, 2008, the S&P closed at 752.44, representing a loss of approximately 40% from the closing price of 1,260.31 on August 1, 2008. Over the same period of time, the VIX index and VIX futures market gained over 250% (Rhoades, 2011). Rhoades compares the hedging effectiveness of S&P 500 put options with VIX call options as well. In order to hedge a \$500,000 S&P 500 index portfolio, Rhoades calculated that 4 S&P put contracts at a cost of \$5,400 would be required. In the event of a 2.5% decline in the S&P, the portfolio would experience a net loss of approximately .60%. However, VIX calls at a cost of \$900 would achieve equal protection of the entire portfolio during a 2.5% decline (Rhoades, 2011). More advanced option strategies can provide even better protection of one’s portfolio. One example of such a strategy is the sale of a put in order to fund

the purchase of a call. Rhoades provides the example of purchasing a November \$20.00 call at \$.60 and selling the November \$19.00 put for \$.85, resulting in a credit of \$.25 (Rhoades, 2011). If the VIX remains unchanged, this strategy will yield a profit whereas a decline in VIX will be compensated by gains in the S&P and an increase in VIX results in profit on the VIX calls which is offset by losses in the S&P. This option spread provides an effective safeguard against a short term decline in the S&P and also offers the potential for profit if the situation remains unchanged. VIX futures can additionally serve as excellent hedging tools. A portfolio 100% invested in the S&P 500 would experience an annual return of 3.53%, -38.49%, 23.45%, and 13.27% for the years of 2007, 2008, 2009 and 2010 resulting in an average return of .44% for all four years. A portfolio with 90% exposure to the S&P and 10% exposure to VIX futures would experience an annual return of 11.7%, -26.85%, 16.98%, and 11.16%, coming to an average return of 3.24% for the same four-year time-frame (Rhoades, 2011). These examples are based on relatively passive strategies, and further outperformance is possible using even more dynamic methods and active management.

Studies conducted by the Securities Litigation and Consulting Group shed more light on the value of volatility products as hedging tools. The organization found that a portfolio with positive exposure to medium-term VIX futures ETNs and negative exposure to short-term VIX futures ETNs could be a good diversifier for stock and bond portfolios (Deng, Mccann, and Wang, 2012). However, the study discovered that the inclusion of short-term VIX futures ETPs (exchange-trade products) lead to a hedge position with negative average return and stated that such products do not serve as an ideal hedge. Despite this, Deng, et al (2012) found that a buy-and-hold strategy in leveraged ETFs combined with selling leveraged ETFs when the VIX level exceeds 20 generate higher returns than stock portfolios without leveraged ETFs. Although in

this scenario VIX is not physically part of the portfolio in question, its use as an indicator can have a positive effect on the portfolio. Additionally, Deng et al warn against the use of a constant hedge ratio, which has the effect of increasing the volatility of one's portfolio without increasing its return. The Securities Litigation and Consulting Group concluded that VIX futures ETPs fail to provide any significant amount of reduction in the variance of the portfolio, and short-term VIX futures ETPs substantially reduced the returns to hedged stock and bond portfolios (Deng, et al, 2012).

VIX products do not only have value as hedging instruments, but they offer a wealth of opportunities for speculative investors and traders as well. In early 2018, Houndstooth Capital Management, LLC scored a 6,000% return on its volatility related gamble (Peterseil and Waite, 2018). The hedge fund achieved this by buying put options on SVXY, which tumbled 83% during a record one-day spike in volatility in February of 2018. The firm continues to speculate on volatility by using out of the money options with near-term expiration dates to achieve extraordinary returns on investment. Lincoln Edwards, the founder of Houndstooth, stated that the firm's goal is to look for "areas where buying or selling volatility is mispriced by the market (Peterseil and Waite, 2018).

Proper use of VIX products as a speculative instrument requires an understanding of the concept of contango. TVIX, UVXY, SVXY, and other volatility exchange trade products do not take physical possession of the underlying assets that they track. These ETFs and ETNs own VIX futures contracts in order to mirror the change in volatility. Chris MacIntosh, the Managing Partner and Founder of the Asymmetric Opportunities Fund, provides a concise explanation of how contango works in regards to volatility instruments:

The contracts' values fluctuate (and thus the ETFs value fluctuates) along with market price changes in the underlying asset. If you own an oil futures contract and oil prices rise the contract becomes more valuable so the ETF's share price will also rise. So far, no problem. But futures contracts have expiration dates and as those dates approach the contract owner (the ETF) needs to sell them and buy new contracts with expiration dates that are further out, otherwise, the owner will take delivery (via a warehouse receipt) which nobody wants due to storage and insurance costs, slippage, spoilage and lack of liquidity. Tracking error is primarily derived from rolling (selling and rebuying) these contracts because the new contracts purchased are usually more expensive than the old ones being sold. When this is the case (which it is more than 80% of the time for some assets) the asset's price is said to be in contango." (MacIntosh, 2013).

The prevalence of contango in volatility products such as TVIX and UVXY necessitate that speculators and investors limit the length of time that they hold long positions of these assets in their portfolio. Shorting these instruments provides tremendous opportunity, however. In 2013, natural gas experienced a 9.1% gain while UNG, an ETF that tracks natural gas, was down -10.4%. This represents a 19.5% loss due to contango. Although long positions in UNG suffered, short-sellers were able to experience an astounding gain.

VXX experiences some of the most severe contango-related decay in the market. Between 2011-2013, the volatility index suffered a -15.7% loss while VXX was down -79.3%; this is a decay of 63.6% (MacIntosh, 2013). The exceptional decay experienced by volatility products does not mean they only move in one direction, however. VXX is prone to sudden and prodigious spikes in value that offer plenty of upside-related opportunities as demonstrated by

Houndstooth Capital's success during the February 2018's volatility fiasco. Despite VIX's ability to spike, the volatility ETNs such as TVIX are currently near all-time lows again as of March 2019. Contango offers speculators a relatively safe opportunity to profit from short-selling, as long as they have the capital to endure short-term market reversals and spikes in volatility. Harris Kupperman, the CEO of Mongolia Growth Group, describes VXX as a product that is "designed to fail". Kupperman states the following:

Every time this contract rolls from the current month to the deferred month, you are paying up 6.2%. That means that if you own 100 May VIX futures, you will only own 94 June VIX futures then 89 July VIX futures. Pretty soon, you own nothing. That's before you pay the .89% yearly expense ratio. Did I mention tracking error and slippage? (Kupperman, 2010).

According to Kupperman, the only time that VXX does not decay is when there is a sudden spike in the VIX index. During this period of time, the product can experience backwardation in which more futures contracts are earned than the prior month. It must be noted that this scenario occurs rarely and only in times of crisis. For the most part, VXX and similar volatility products exhibit severe contango which requires investors to hold long positions for only a short period of time. Over short time frames, volatility products can serve as a valuable hedge as well as a speculative trade. Indeed, even FINRA, the Financial Industry Regulatory Authority, warns against using a buy and hold strategy on volatility products precisely due to the characteristics of contango. FINRA classifies volatility investing not for those "faint of heart" (Volatility Investing, 2018). Retail investors, a term used to describe unprofessional or amateur players in the market, find themselves lured by volatility regardless. In early 2018, only one fifth of the outstanding shares

of volatility products were owned by funds and institutions, suggesting that there was a great deal of retail interest in these investments. In fact, during the six months prior to the volatility implosion in February 2018, hedge funds pulled back and retail ownership increased. (Ahmed, 2018). The termination of XIV and the sudden explosion of TVIX and VXX was devastating for everyone holding positions in these securities, but the blow was heaviest to amateur investors. As we can see, a thorough understanding of these products is an absolute prerequisite to hedging or speculating on them.

VIX Derivatives

There is a number of volatility products that are based on the VIX index and are heavily traded by both professional and amateur investors today. TVIX, VXXB, UVXY and SVXY are instruments that trade like stocks and each have special characteristics. Despite each product being different in its own way, we will pay special attention to TVIX and VXXB.

TVIX is an exchange trade fund that tracks two times the daily performance of the S&P 500 VIX futures index (Moskowitz, 2015). The VIX index itself cannot be traded, so TVIX manages a hypothetical portfolio of the two nearest to expiration VIX futures contracts (Harwood, 2018). Since TVIX tracks two times the daily performance of the VIX futures index, it is referred to as a 2X leveraged exchange-trade note. It is vital to note that TVIX is subject to significant decay over time. According to Harwood, TVIX suffers an average contango loss of 7.5% per month. This loss combined with TVIX's leveraged structure result in typical losses of 15% per month. TVIX is simply not an investment to be held for long periods of time. The effects of contango necessitate a reverse split every so often. A reverse split is a reduction in outstanding shares paired with an increase in the share price of a security. To date, TVIX has

experienced a total of 6 reverse splits with the next reverse split scheduled for some-time in mid-2019. The tremendous decay presents an attractive opportunity for short sellers, but these speculators must be wary of TVIX's potential to triple or quadruple during times of extreme market pessimism (Harwood, 2018). ETF.com's fund flows tool allows us to observe TVIX's net inflows which are approximately \$2.8 billion since its inception. The ETF is currently worth roughly \$333 million, meaning over \$2 billion of investor money has been destroyed by this instrument (ETF Fund Flows, 2019). This is another testament to the risks of investing in TVIX. However, just because investor money was lost in this investment does not mean that it was a bad purchase. Professionals that use TVIX to hedge themselves against declines in the S&P will often treat the expense similar to the cost of an insurance premium. Since TVIX provides effective protection against a market decline, it can essentially serve as a form of insurance for one's portfolio. Naturally, insurance comes with a cost. Owners of disability policies or casualty insurance pay premiums so that in the event of a disaster, they will be protected by the insurance payout. Volatility products can be viewed with the same lens.

VXXB is another popular volatility instrument that trades similar to TVIX. For example, VXXB also holds a hypothetical portfolio of VIX futures contracts (Bishop, 2018). However, this product is an exchange-trade note (ETN) so there are some important differences that must be considered. VXXB is structured like a bond in that it has a built-in maturity date on which it will expire. A special element of VXXB is that options may be written and sold based on the product. Investors who wish to leverage themselves or use VXXB as a hedge may buy and write calls and puts on the product. Unlike an exchange trade fund, an exchange trade note is backed by the issuer of the security; in case of a crisis, the ETN is exposed to default risk depending on the financial health of the issuer (Briones, 2014). VXXB is a replacement of VXX, an ETN that

reached its maturity date on January 30th, 2019. VXXB has a maturity date 30 years from now which is much longer than VXX's 10-year lifespan (Bishop, 2019).

All volatility derivatives have several characteristics that set them apart from other conventional investments that most people are accustomed to. Purchasing VXXB or TVIX does not give you ownership of a corporation. There are no sales, no quarterly reports, no profit/loss, no PE ratio, and no potential for any dividends (Harwood, 2019). The nature of these products renders any kind of fundamental analysis obsolete. Consider also that traditional stocks offer tangible investment opportunities; the purchase of a share in a corporation offers an investor exposure to the operations and profitability of the business. Conversely, volatility products such as TVIX and VXXB present intangible investment opportunities. The purchaser of TVIX does not expose themselves to the operations of the business, but instead is making an investment decision in regards to market sentiment and future volatility. This is characteristic inherent in volatility products, and it is worth noting that sentiment can quickly change from euphoria to fear, and vice versa.

VIX and its Relationship to the S&P

Prior to quantitatively analyzing VIX's performance as an investment, it will be important to observe its correlation to the S&P as well as its derivatives. By performing a linear regression test on the S&P 500 and VIX, we can gain a better understanding on the relationship of the two instruments and how movements in the S&P can influence fluctuations in the value of VIX.

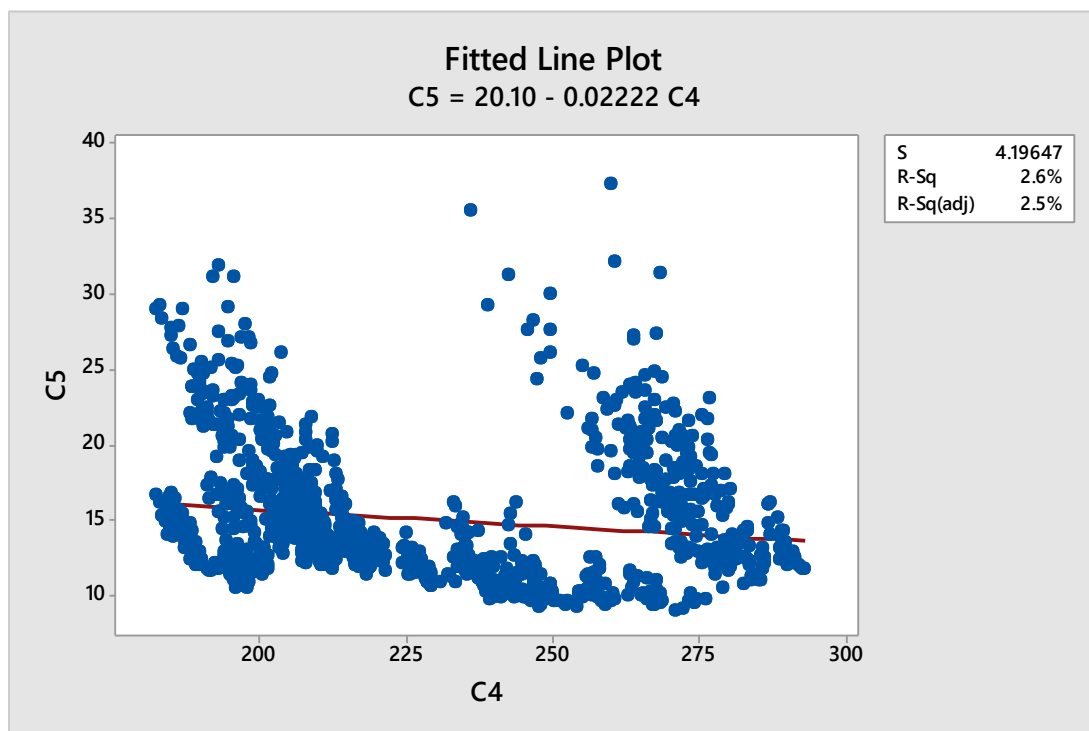


Figure 1

The figure displayed above shows the daily open price of the SPDR S&P 500 ETF plotted against the daily open price of VIX between February 2014 and January 2019. The r-sq value we received was 2.6%, which means that 2.6% of the variation in VIX can be accounted for by the variation in the S&P. However, this regression model also provided a p-value of 0.0, indicating that changes in the S&P are related to changes in VIX. Although there is low r-sq value, this is indicative that there may be more variables that pertain to the VIX index. By including the Dow Jones index along with the S&P, our regression test delivers the same p-value but a higher R-squared of 11.92%.

However, the relationship between volatility and the S&P is much more prominent when we replace VIX with the 2X leveraged ETF TVIX. Figure 2 is a graphical display of the correlation between TVIX and the S&P.

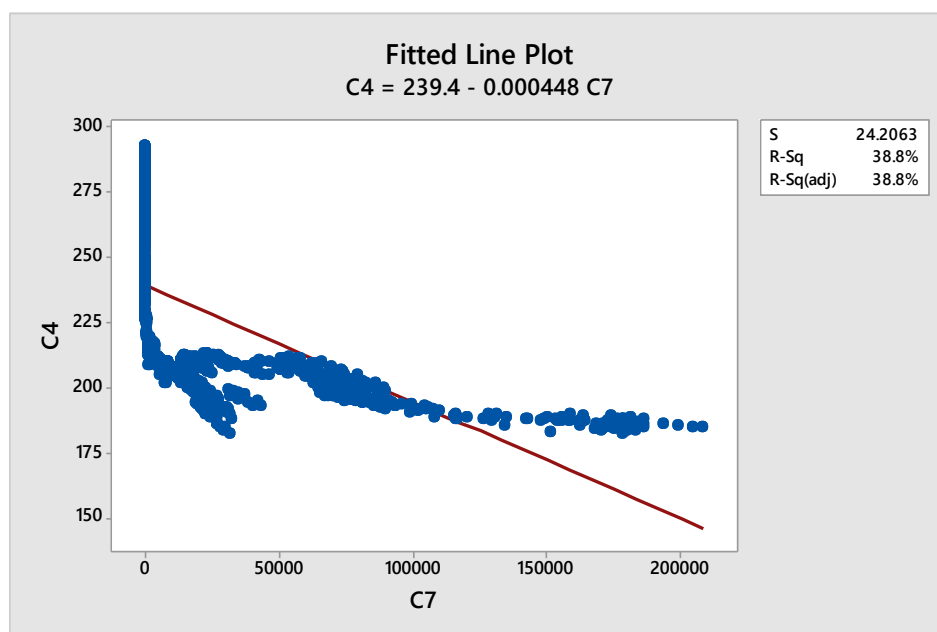


Figure 2

As we can see, there is a significant downward correlation with a R-squared value of 38.8%.

This means that 38.8% of the variation in TVIX can be explained by the variation in the S&P.

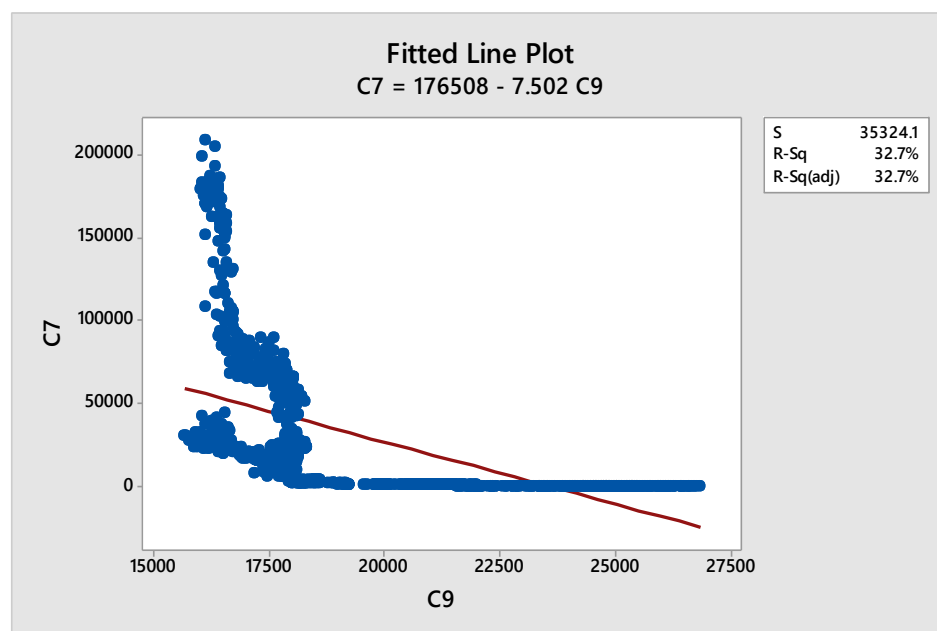


Figure 3

A plot of the Dow Jones Index against TVIX provides us with a near identical observation – this time with a correlation statistic of 32.7% and a similar negative linear relationship. Performing a regression test with both the DJI and S&P500 against TVIX provide us with a R-sq of 58% but a VIF statistic 86.46, indicating excessive multicollinearity. Therefore, either the S&P or the DJI serve as accurate stand-alone predictor variables to compare with TVIX.

Due to reverse-splits in TVIX (a reverse split being an increase in share price and simultaneous reduction in shares), the regression plots displayed above can appear distorted. By plotting data just from the beginning of 2018 to the beginning of 2019, we are given the figure below.

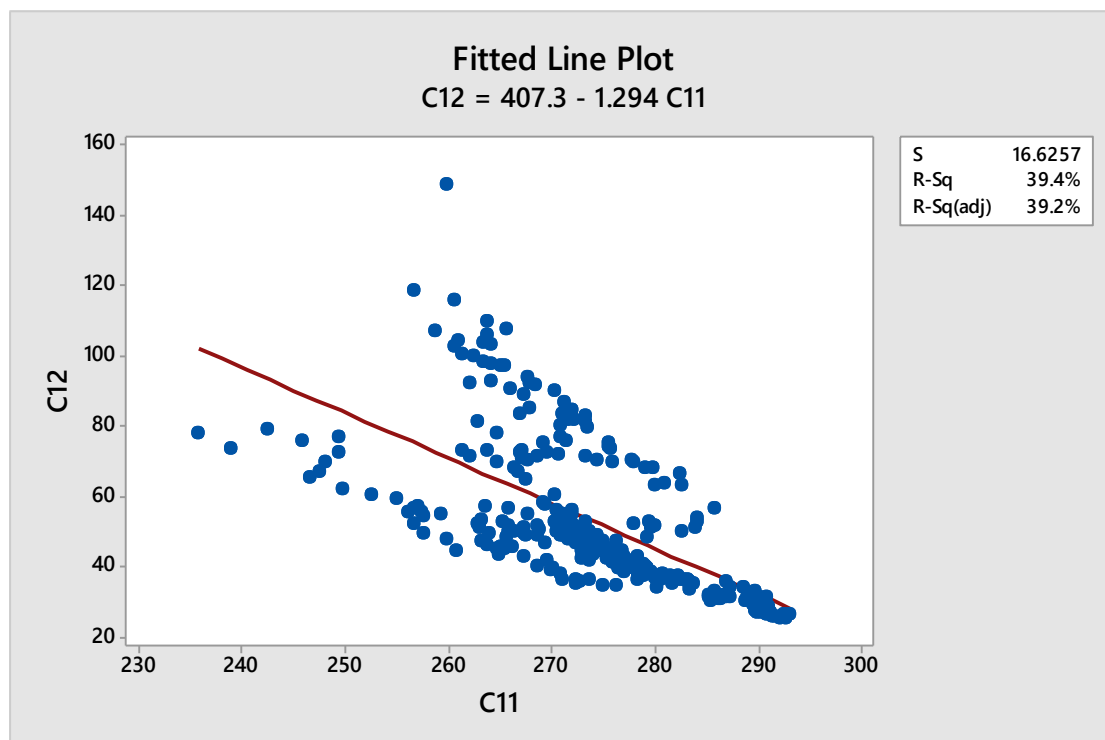


Figure4

The regression statistics are little changed, but the graphical display is much clearer and the correlation between TVIX and the S&P appears more prominent. As we can see, TVIX exhibits a very strong negative relationship with the S&P 500. Our regression model comparing the S&P 500 and TVIX provides us with the following equation as well: $Y = 407.3 - 1.2936(X)$. This equation can help predict future values in TVIX based on expected values of the S&P.

Predicted Value in S&P	Predicted Value in TVIX
274	52.89
272	55.48
271	56.77
273	54.19
273.5	53.54

Figure 5

Figure 5 illustrates the predicted values of TVIX according to our regression equation. Should the S&P fluctuate between 271-274 over the next 5 days, the price of TVIX is expected to fluctuate between \$52.89 – 56.77.

Hedging and Speculative Strategies using Volatility Products

The plethora of volatility products currently offered on the market present investors with a variety of choices in how they protect their portfolios and manage their speculative strategies. Some products may offer better opportunities and protection than others; therefore, it is vital to compare and contrast the effectiveness of various volatility ETPs, VIX futures, and VXXB options. Through quantitative analysis, one can determine which product best suits their goals and intentions.

First we will examine the effectiveness of different VIX products during periods of crisis. The “Black Monday” volatility implosion of February 2018 and the major stock market

correction of October 2018 both serve as excellent, recent examples of turbulent market conditions that can be hedged with volatility positions.

Consider a portfolio of \$100,000 invested in the SPDR S&P 500 (SPY) as well as a single long VIX futures contract. Figure 6 pictured below displays the profit and loss of both positions between 02/02/2018 – 02/09/2018. Every .01\$ tick in VIX represents a \$10 profit or loss on the VIX futures contract; a one point (\$1) change in VIX represents a \$1,000 change in the value of the contract being held. During the height of the spike in volatility, VIX futures experienced over a 100% increase in value whereas the S&P experienced a decline of nearly 10%. The VIX futures contract yielded a maximum profit of \$18,500 while the greatest decline in the S&P incurred a \$7,190 loss. Throughout this turbulent time, each day's loss in the S&P was completely offset by gain in the VIX futures contract. As we can see, an investor with a position in VIX at this time would have been fully protected. A particularly savvy investor could profit from this scenario by selling the contract during the height of the crisis. This requires very precise market timing, however.

VIX Futures Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 13.25	\$ -	\$ 280.08	\$ -
\$ 16.10	\$ 2,850	\$ 273.45	\$ (2,367)
\$ 31.75	\$ 18,500	\$ 259.94	\$ (7,190)
\$ 23.90	\$ 10,650	\$ 268.50	\$ (4,134)
\$ 23.10	\$ 9,850	\$ 268.01	\$ (4,309)
\$ 27.95	\$ 14,700	\$ 260.80	\$ (6,883)
Net Gain/Loss			\$ 7,817

Figure 6

VIX Futures Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 15.22	\$ -	\$ 292.11	\$ -
\$ 19.93	\$ 4,710	\$ 287.05	\$ (1,806)
\$ 18.43	\$ 3,210	\$ 275.55	\$ (5,912)
\$ 21.07	\$ 5,850	\$ 277.00	\$ (5,394)
\$ 19.57	\$ 4,350	\$ 268.80	\$ (8,322)
\$ 17.48	\$ 2,260	\$ 272.44	\$ (7,022)
\$ 18.27	\$ 3,050	\$ 277.19	\$ (5,326)
\$ 20.48	\$ 5,260	\$ 273.05	\$ (6,804)
\$ 17.68	\$ 2,460	\$ 265.78	\$ (9,400)
\$ 21.43	\$ 6,210	\$ 280.28	\$ (4,223)
\$ 21.73	\$ 6,510	\$ 263.37	\$ (10,260)
\$ 24.30	\$ 9,080	\$ 259.40	\$ (11,677)
\$ 25.32	\$ 10,100	\$ 239.04	\$ (18,946)
\$ 21.93	\$ 6,710	\$ 249.56	\$ (15,190)
Net Gain/Loss			\$ (8,480)

Figure 7

With the same portfolio, we examine VIX futures hedging ability during the market correction of October-December 2018. Figure 7 displays weekly data for the following timeframe: 09/24/2018 – 12/31/2018. The data show that the VIX futures contract is not as effective in hedging during a sustained market slump as it is during a “flash-crash” type scenario. That is not to say that the VIX futures fails to adequately protect one’s portfolio. The position in VIX reduces the total loss of the portfolio by nearly one half – an 8.5% loss versus a 15.2% loss.

The next instrument we will observe is TVIX. TVIX’s 2X leverage offers extensive short-term protection, though the effects of contango may reduce its ability to protect a portfolio over longer time-frames.

TVIX Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 63.00	\$ -	\$ 280.08	\$ -
\$ 83.00	\$ 3,160	\$ 273.45	\$ (2,367)
\$ 148.90	\$ 13,572	\$ 259.94	\$ (7,190)
\$ 91.40	\$ 4,487	\$ 268.50	\$ (4,134)
\$ 92.40	\$ 4,645	\$ 268.01	\$ (4,309)
\$ 116.00	\$ 8,374	\$ 260.80	\$ (6,883)
Net Gain/Loss			\$ 1,491

Figure 8

TVIX Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 24.98	\$ -	\$ 292.11	\$ -
\$ 31.00	\$ 2,408	\$ 287.05	\$ (1,806)
\$ 43.04	\$ 7,224	\$ 275.55	\$ (5,912)
\$ 40.54	\$ 6,224	\$ 277.00	\$ (5,394)
\$ 51.80	\$ 10,728	\$ 268.80	\$ (8,322)
\$ 46.70	\$ 8,688	\$ 272.44	\$ (7,022)
\$ 38.20	\$ 5,288	\$ 277.19	\$ (5,326)
\$ 42.10	\$ 6,848	\$ 273.05	\$ (6,804)
\$ 48.25	\$ 9,308	\$ 265.78	\$ (9,400)
\$ 34.26	\$ 3,712	\$ 280.28	\$ (4,223)
\$ 53.24	\$ 11,304	\$ 263.37	\$ (10,260)
\$ 54.70	\$ 11,888	\$ 259.40	\$ (11,677)
\$ 73.54	\$ 19,424	\$ 239.04	\$ (18,946)
\$ 72.50	\$ 19,008	\$ 249.56	\$ (15,190)
Net Gain/Loss			\$ 3,818

Figure 9

Figures 8 and 9 compare the profit and loss of a portfolio with \$100,000 invested in the S&P 500 and \$10,000 invested in TVIX. In both situations, TVIX provides effective protection against the market downturn. As we can see from Figure 8, gains in TVIX more than offset the losses in the S&P. The protection offered by TVIX during the October-December correction is even more effective than the VIX futures position touched upon previously. Rather than suffering a 15% loss by the end of 2018, the investor would have actually experienced over a 3% gain due to his position in TVIX! These data show that TVIX can serve as an effective hedge even during prolonged timeframes. Stretches of time in which volatility is high and market sentiment is fearful can negate contango losses in TVIX.

It is equally important to consider the performance of TVIX and VIX futures during periods of calm. Assume an investor incorrectly believes that market turmoil will continue for the next three months, and so they purchase a position in a volatility product in order to protect

their portfolio. Figure 10 and Figure 11 display the performance of the hypothetical portfolio during the period between 01/06/2019-02/24/2019. These months exhibited a strong market rally and a crushing blow to volatility products.

VIX Futures Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 21.85	\$ -	\$ 252.69	\$ -
\$ 19.10	\$ (2,750)	\$ 256.86	\$ 1,489
\$ 18.25	\$ (3,600)	\$ 264.82	\$ 4,330
\$ 18.35	\$ (3,500)	\$ 263.39	\$ 3,820
\$ 17.05	\$ (4,800)	\$ 270.11	\$ 6,219
\$ 16.70	\$ (5,150)	\$ 271.20	\$ 6,608
\$ 16.30	\$ (5,550)	\$ 276.48	\$ 8,493
\$ 15.15	\$ (6,700)	\$ 280.73	\$ 10,010
Net Gain/Loss			\$ 3,310

Figure 10 – Portfolio 1

TVIX Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 60.19	\$ -	\$ 252.69	\$ -
\$ 51.95	\$ (1,368)	\$ 256.86	\$ 1,489
\$ 44.80	\$ (2,555)	\$ 264.82	\$ 4,330
\$ 47.02	\$ (2,186)	\$ 263.39	\$ 3,820
\$ 38.89	\$ (3,536)	\$ 270.11	\$ 6,219
\$ 36.33	\$ (3,961)	\$ 271.20	\$ 6,608
\$ 34.61	\$ (4,246)	\$ 276.48	\$ 8,493
\$ 27.80	\$ (5,377)	\$ 280.73	\$ 10,010
Net Gain/Loss			\$ 4,634

Figure 11 – Portfolio 2

The data show that had an investor incorrectly timed the purchase of their hedge, they still profit significantly from the performance of the S&P. The losses on the volatility positions do not completely offset the gain in the S&P, reflecting the utility of volatility ETPs during tranquil market conditions. As we can see, ownership of TVIX shares or VIX futures can perfectly guard against a crisis and still leave an investor with a profitable position if purchased prematurely. An investor that can strategically time his positioning based on changes in market sentiment can experience significantly higher returns as well.

It is apparent that TVIX and VIX futures serve as effective hedges if allocated and used appropriately. How do these volatility products compare to others? Volatility ETPs that are not as highly leveraged may offer less downside risk during periods of calm, but may be significantly less effective during periods of crisis. VXX, now replaced by VXXB, was a 2x leveraged ETF that one could have purchased prior to the October-December correction.

VXXB Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 48.47	\$ -	Open Price	\$ -
\$ 42.14	\$ (3,718)	\$ 252.69	\$ -
\$ 39.05	\$ (4,355)	\$ 256.86	\$ 1,489
\$ 37.50	\$ (4,674)	\$ 264.82	\$ 4,330
\$ 38.31	\$ (4,507)	\$ 263.39	\$ 3,820
\$ 33.70	\$ (5,457)	\$ 270.11	\$ 6,219
\$ 33.07	\$ (5,587)	\$ 271.20	\$ 6,608
\$ 33.17	\$ (5,566)	\$ 276.48	\$ 8,493
Net Gain/Loss			\$ 2,927

Figure 12

VXX Position		SPY Position	
Open Price	Profit	Open Price	Profit
\$ 25.98	\$ -	\$ 292.11	\$ -
\$ 29.14	\$ 1,597	\$ 287.05	\$ (1,806)
\$ 34.84	\$ 3,786	\$ 275.55	\$ (5,912)
\$ 34.06	\$ 3,487	\$ 277.00	\$ (5,394)
\$ 38.60	\$ 5,230	\$ 268.80	\$ (8,322)
\$ 36.73	\$ 4,512	\$ 272.44	\$ (7,022)
\$ 33.39	\$ 3,229	\$ 277.19	\$ (5,326)
\$ 35.19	\$ 3,921	\$ 273.05	\$ (6,804)
\$ 37.85	\$ 4,942	\$ 265.78	\$ (9,400)
\$ 32.04	\$ 2,711	\$ 280.28	\$ (4,223)
\$ 40.37	\$ 5,910	\$ 263.37	\$ (10,260)
\$ 40.97	\$ 6,140	\$ 259.40	\$ (11,677)
\$ 47.70	\$ 8,724	\$ 239.04	\$ (18,946)
\$ 47.47	\$ 8,636	\$ 249.56	\$ (15,190)
Net Gain/Loss			\$ (6,554)

Figure 13

Figure 13 displays the performance of VXX, assuming the same allocation of resources as in the previous examples; 384 shares purchased at the open price at the beginning of the period, for a total of approximately \$10,000 with \$100,000 invested in SPY. VXX, due to its lack of leverage, did not experience as high a gain in value during this crisis as TVIX did. Had the investor purchased VXX versus TVIX, he would lose \$6,554 as opposed to enjoying a gain of \$3,818. Figure 12 displays VXXB's performance had the investor purchased the stock in the beginning of January 2019¹. Again, VXXB fails to deliver results superior to that of TVIX or VIX futures. Both TVIX and VIX futures achieve better gains during periods of crisis and periods of calm. Therefore, an investor interested in optimal protection should consider volatility products with higher leverage. Although one could purchase more shares of VXX to achieve the same protection as TVIX, this would mean the investor would be forced to allocate much more

¹ By this time, VXX had been replaced by VXXB.

of his portfolio towards his hedge. Such a strategy would not be as efficient or as profitable as simply purchasing TVIX.

It is no less important to examine volatility ETPs' performance as speculative investments. How does TVIX perform over long time-frames, and how does TVIX compare to other volatility ETPs? We can observe best case scenarios and worst case scenarios over the past year and see how they would impact an investor's portfolio.

As discussed previously, short-selling shares of TVIX can be a very profitable endeavor. The powerful contango effect ensures that over the long-term, an investor will experience a profit even despite major spikes in value due to crisis periods. However, short-shares of TVIX may not always be available at all times and for all brokerages. Some brokerages may have more stringent margin requirements than others. SVXY, a volatility that operates as the inverse of TVIX, is popular among investors who wish to short volatility without having to borrow shares to short or investors who are interested in gaining exposure to the VIX index but wish to limit the volatility of their portfolios. SXVY is an ETF that has leverage of -.5X of daily moves on the VIX futures index, rather than 2X leverage of TVIX. SVXY is also subject to termination risk² and options can be written on the instrument (Harwood, 2019). Both TVIX and SVXY have average daily volumes of approximately 14M-16M shares as well. Therefore, these two exchange trade products are comparable and contrasting the two can grant valuable insight on speculative trades with volatility.

² The same kind of risk that resulted in the termination of XIV in February of 2018

The first time period to consider is a year of record low volatility. Assuming an investor sold short \$50,000 worth of TVIX and bought long \$50,000 worth of SVXY at the open prices on January 1st, 2017, how would these two positions compare by the end of the year?

	TVIX	SVXY
Open Price - 01//01/2017	\$ 871.00	\$ 189.42
Open Price 12/24/2017	\$ 56.00	\$ 512.04
Percentage Change	-1455%	63%

Figure 14

Figure 14 displays the percentage change of TVIX and SVXY between the beginning and end of 2017 with prices adjusted to account for reverse and forward splits. An investor that decided to short-sell TVIX in the beginning of 2017 would experience nearly a 1500% return! It is no wonder that returns of this kind provoked an influx of retail short-sellers that inevitably contributed to the volatility explosion of early 2018. SVXY, despite having significantly lower leverage, achieved a 63% gain for the year. Although much less than the gain experienced by TVIX, this is nothing worth scoffing at.

It is vital to consider the returns of these positions during a period of crisis. What kind of loss can an investor expect during a market panic? One time-frame certainly worth examining is the market correction of late 2018. A major slide in the S&P provoked a dramatic increase in VIX, and short-sellers of volatility were hard hit by poor market sentiment. Figure 15 provides a complete breakdown of the losses experienced by an investor with \$50,000 short-shares of TVIX and \$50,000 long-shares of SVXY, purchased at the beginning of October 2018 and held until March 30, 2019. The data show that SVXY, thanks to its lower leverage, is much less prone to extraordinary changes in value as TVIX. The worst loss faced by the investor in this scenario is a total loss of -194.40% on December 24, 2018. It is also important to consider that the weekly

open prices do not display the worst drawdowns. TVIX reached a high of \$86.50 on December 27, 2018. This represents a loss of -246.28%! It is easy for an investor to be terribly frightened by such losses and to prematurely close their positions to avoid further losses. However, by the end of March 2019, TVIX and SVXY have nearly reached their pre-crisis level prices. Losses sustained by SVXY were not nearly as severe as TVIX; SVXY suffered a loss of approximately 31% during late December, eight times less than that of TVIX.

The data reveal several critical components of speculating on volatility instruments, the primary consideration being an investor's willingness and ability to last through periods of dramatic drawdowns in account value and portfolio performance. Sudden and dramatic increases in volatility can deliver staggering losses to a short-seller of volatility. However, the effects of contango and the inevitable growth and recovery of the S&P will bring volatility ETPs back down to normal price-levels and behaviors. Investors who can financially endure draw-down periods will profit over the long-term; this requires holding enough equity in the account to cover any margin-calls issued by the broker. A rule of thumb that can be followed by a savvy volatility speculator is to hold approximately twice as much equity as one's volatility position. During crisis periods, TVIX can double in value. During the February 2018 and October-December 2018 calamities, TVIX soared over 200% in price. Assuming the investor shorted at record lows, he would need twice as much equity in order to cover any margin calls. This is assuming a worst case scenario. In many cases, the speculator of volatility will not be so unlucky as to short at record low prices! Individuals interested in gaining exposure to volatility can also purchase SVXY. The data show that SVXY is prone to less severe drawdowns. The trade-off here is that the gain is substantially less during periods of tranquil market conditions. SVXY makes a good alternative to shorting TVIX for those unwilling or incapable of enduring massive losses; rather

than holding twice as much equity in one's brokerage account, the volatility speculator could hold up to 50% in order to cover any margin-calls during a worst case scenario.

As previously discussed, periods of low volatility can bring tremendous gain to a speculative investor. Both TVIX and SVXY were excellent investments in the year of 2017, as well as during years prior in which the market was calm and sentiment was positive. The scenarios discussed display basic and mostly passive investment strategies; investors who wish to actively change their positioning based on price changes and shifts in market conditions can certainly achieve an enhanced return and avoid periods of major drawdowns. Had an investor accurately predicted a major drawdown in the S&P, they could avoid losses in their speculative short-sales by covering for a profit and waiting for a spike in volatility to short once again. Alternatively, the investor could have opened a long position on TVIX to profit immediately from a correction in the S&P.

Conclusion

A wide variety of volatility instruments are now actively traded on the market and exist as opportunities for investors to gain special exposure to changes in market sentiment. TVIX, SVXY, VXXB, and VIX futures can be traded and allocated in a number of ways in one's portfolio to hedge against catastrophe or to enhance one's profit through speculation. By adopting even the most basic strategies and asset allocation methods, investors can shield themselves against some of the most severe market turnarounds. Through an appropriate allocation of assets, average retail investors can use sophisticated investment products such as volatility ETPs to protect most, if not all, of their profit against market drops, as well as experience gain from tranquil market conditions. Most investors have little protection against

market risk. Portfolios largely allocated to track the S&P, blue chip stocks, and other assets often have little to hedge against systemic risk. Collapse of entire industries and draw-downs experienced by the entire market will weigh down all assets, regardless of an individual company's intrinsic value. Volatility products are a contrarian investment that offer investors the ability to combat this kind of risk. There are few products that can offer the same kind of market exposure as the VIX index.

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Appendix

Date	TVIX Position			SVXY Position		
	Open Price	Profit		Open Price	Profit	
1-Oct-18	\$ 24.98	\$ -	% Gain/Loss	\$ 59.80	\$ -	% Gain/Loss
8-Oct-18	\$ 31.00	\$ (12,046)	-24.10%	\$ 56.35	\$ (2,884)	-6.12%
15-Oct-18	\$ 43.04	\$ (36,138)	-72.30%	\$ 50.92	\$ (7,424)	-15.76%
22-Oct-18	\$ 40.54	\$ (31,136)	-62.29%	\$ 51.21	\$ (7,181)	-15.24%
29-Oct-18	\$ 51.80	\$ (53,667)	-107.37%	\$ 48.00	\$ (9,865)	-20.94%
5-Nov-18	\$ 46.70	\$ (43,462)	-86.95%	\$ 49.12	\$ (8,928)	-18.95%
12-Nov-18	\$ 38.20	\$ (26,453)	-52.92%	\$ 51.40	\$ (7,022)	-14.91%
19-Nov-18	\$ 42.10	\$ (34,257)	-68.53%	\$ 49.95	\$ (8,235)	-17.48%
26-Nov-18	\$ 48.25	\$ (46,563)	-93.15%	\$ 47.96	\$ (9,898)	-21.01%
3-Dec-18	\$ 34.26	\$ (18,569)	-37.15%	\$ 52.00	\$ (6,521)	-13.84%
10-Dec-18	\$ 53.24	\$ (56,548)	-113.13%	\$ 45.90	\$ (11,620)	-24.67%
17-Dec-18	\$ 54.70	\$ (59,470)	-118.98%	\$ 45.58	\$ (11,888)	-25.24%
24-Dec-18	\$ 73.54	\$ (97,169)	-194.40%	\$ 42.15	\$ (14,755)	-31.32%
31-Dec-18	\$ 72.50	\$ (95,088)	-190.23%	\$ 42.11	\$ (14,789)	-31.39%
7-Jan-19	\$ 60.19	\$ (70,455)	-140.95%	\$ 43.83	\$ (13,351)	-28.34%
14-Jan-19	\$ 51.95	\$ (53,967)	-107.97%	\$ 45.49	\$ (11,963)	-25.39%
21-Jan-19	\$ 44.80	\$ (39,660)	-79.34%	\$ 47.16	\$ (10,567)	-22.43%
28-Jan-19	\$ 47.02	\$ (44,102)	-88.23%	\$ 46.26	\$ (11,319)	-24.03%
4-Feb-19	\$ 38.89	\$ (27,834)	-55.68%	\$ 48.55	\$ (9,405)	-19.96%
11-Feb-19	\$ 36.33	\$ (22,711)	-45.44%	\$ 49.36	\$ (8,728)	-18.53%
18-Feb-19	\$ 34.61	\$ (19,270)	-38.55%	\$ 49.72	\$ (8,427)	-17.89%
25-Feb-19	\$ 27.80	\$ (5,643)	-11.29%	\$ 52.40	\$ (6,186)	-13.13%
4-Mar-19	\$ 27.59	\$ (5,223)	-10.45%	\$ 52.52	\$ (6,086)	-12.92%
11-Mar-19	\$ 32.89	\$ (15,828)	-31.67%	\$ 50.04	\$ (8,159)	-17.32%
18-Mar-19	\$ 25.96	\$ (1,961)	-3.92%	\$ 53.12	\$ (5,584)	-11.85%
25-Mar-19	\$ 31.17	\$ (12,386)	-24.78%	\$ 50.09	\$ (8,118)	-17.23%
29-Mar-19	\$ 26.82	\$ (3,682)	-7.37%	\$ 52.02	\$ (6,504)	-13.81%

Figure 15