Everybody's Doing It:
Short Volatility Strategies and Shadow Financial Insurers

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Abstract

The extraordinary growth of short volatility strategies creates risks that may trigger the next serious market crash. A low yield, low volatility environment has drawn various market participants into essentially similar short volatility-contingent strategies with a common non-linear risk factor. We discuss these strategies, their commonalities, and the generally unrecognized risks that they would pose if everyone unwinds simultaneously. Volatility selling investors essentially provide "shadow financial insurance." Market participants and regulators would benefit from preparing for large, self-reinforcing technical unwinds that may occur when central banks change policy or when macro or political events affect investor confidence. We also discuss potential mechanisms that might provide stabilization against catastrophic financial outcomes.

Keywords: Volatility strategies, Options, Market crashes, short VIX carry trade, volatility risk premium.

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Traders who sell volatility essentially sell financial insurance. They allow other traders to profit when extreme events occur. The other traders often buy volatility to hedge portfolio risks. The simplest examples of volatility selling involve the sale of put and call contracts. Traders also can sell volatility when they trade products defined on volatility indices such as the VIX. Finally, many traders create short volatility positions when they engage in complex volatility-contingent trading strategies such as risk parity and risk premium harvesting.

Volatility as an asset class was once the exclusive domain of sophisticated hedge fund managers and Wall Street dealers. With the creation of various exchange traded volatility products, almost anyone now can easily trade volatility, and many do. While the total size of these products is still small, in terms of direct impact on the VIX futures markets, these products are now the largest participants by a large margin. Since many other strategies follow the VIX for risk allocation, it is possible for large gyrations in the VIX to impact the behavior of larger investors, creating a classic "tail wagging the dog" outcome. These products allow even retail investors to act as financial insurers as they seek to earn the volatility risk premium in their stock trading accounts. The need for yield combined with the democratization of volatility selling has resulted in multi-decadal lows in volatility. For instance, even though realized volatility in the US equity markets have averaged approximately 18% per year since the early 1920s, the VIX, which measures implied volatility hit a recent low of below 9%. We discuss how the behavior of participants across all investment horizons has been the proximate cause of this, and how the reversal of the behavior will lead to the next volatility spike.

Understanding volatility-contingent investing strategies is important to every investor. While institutional investors are certainly familiar with volatility, they might be surprised at how far volatility trading and option selling has come in the last few years. Many non-institutional investors such as retirees now unknowingly earn a portion of their portfolio returns from income their investment managers generate when they sell options or engage in strategies with option like or short volatility characteristics. A severe market environment could expose everyone to rapid and destructive bouts of unwinding.

Herd-like behavior of investment managers can amplify the risks of short volatility-contingent strategies. Past successes invite imitators and can result in excesses. The excesses create

instabilities that eventually can cause a cascade of risk reduction when the imitative behavior plays in reverse.

To perceptive observers, signs of crowding in the volatility space abound. Most importantly, many investors have no idea that they have entered essentially similar trading strategies. Accordingly, they do not recognize that liquidity may not be available to them when they want to adjust their positions in response to changing market conditions.

Unfortunately, a defining characteristic of most short volatility-contingent strategies is that their hedging and unwinding trades are destabilizing. When traders hedge and unwind in response to changing market conditions, their trades tend to accelerate those changes, which results in more unwinding trades. This positive feedback may prove to be dangerous.

One short volatility strategy—selling VIX through exchange-traded products—is stabilizing over short time horizons. However, the assets deployed in this strategy are small in comparison to those deployed in the other short volatility-contingent strategies. We believe that growth in this small strategy, and the media coverage of its recent success, may be partly responsible for the low realized volatility in the markets over the last few years. However, the low realized volatility has emboldened traders in the other volatility-contingent strategies so that the danger of shifting from a relatively stable local equilibrium to a very different equilibrium is high.

In this paper, we provide an overview of short volatility-contingent strategies. We first identify the strategies and who uses them. We then discuss the commonalities among the strategies and the consequences of these commonalities. The short volatility ecosystem shows the classic property of a complex system: "the possible occurrence of coherent large-scale collective behaviors with a very rich structure, resulting from the repeated non-linear interactions among its constituents: the whole turns out to be much more than the sum of its parts" (see Sornette 2002).

1 Who Trades Volatility-Contingent Strategies?

Investors using volatility-contingent strategies lie along a hierarchical continuum based on their investment time horizons. Ordered by their typical investment horizons, they are:

Long horizon investors

- Very long-term investors

- Endowments and pension funds

Medium horizon investors

- Large asset managers
- Risk-parity hedge funds
- Risk premium harvesters
- Target volatility funds and variable annuities

Short horizon investors

- Trend followers
- Volatility ETF and ETN investors
- Market makers

This classification is somewhat arbitrary as some investors engage in multiple strategies. The organization of our hierarchy is not important to the main purpose of this paper. It simply helps illustrate that short volatility exposure is pervasive across all investor horizons.

Before we list volatility sellers who are motivated by the potential for profits, we should mention that the discussion of investors who use volatility-contingent strategies would be incomplete without reference to central banks. Central banks with their infinite time horizons are the largest implicit volatility sellers in the market. In the aftermath of the Financial Crisis they made an implicit promise through their behavior that they will provide what many consider to be a perpetual put against a rapid selloff in the markets. Whether true or not, the belief that market participants have in this promise has been sufficient to keep a lid on volatility while the market believes the promise is alive. By purchasing securities in the open markets and thus maintaining high asset prices and low yields, central banks have suppressed volatility and thereby protected volatility sellers. There are indications that this implicit promise is slowly being withdrawn, which in our view creates a set of conditions that can lead to other market participants behavior more risk-averse and destabilizing.

1.1 Long Horizon Investors

1.1.1 Very Long-Term Investors

The longest horizon volatility investors are mostly institutional investors such as sovereign wealth funds and large public pensions with very long investment horizons. These investors sell

insurance rather than buy it. They supply volatility in the market in exchange for which they earn a premium.

Much of the volatility selling of these long horizon investors is through their purchases of assets with embedded option-like characteristics. Asset-backed credit securities are examples of such securities as they generally have substantial prepayment and default options. Long horizon investors also take short volatility positions when they buy levered companies since these companies become more volatile when values fall. Finally, their investments in private equity funds investments also expose them to volatility because capital calls tend to arrive when they are least welcome. The liquidity premia in these investments provide them long term alpha, but in periods of stress these strategies become correlated with other short volatility strategies.

For these investors, any finite, non-zero option premium makes their investments—which they would likely undertake anyway—more attractive. Accordingly, these investors often are not sensitive to the implied prices of the options in their portfolios. Their long investment horizons make them steady hands in the market. They are unlikely to turn into buyers of options except to cover their existing short option positions under market stress, regulatory change, or capital calls.

1.1.2 Endowments and Pension Funds

Populating the next shorter time horizon are very large pensions and endowments with sophisticated investment staffs who understand the options markets. Given the gigantic size of many of these capital pools, small sold options positions generally will not impair their portfolios in times of large market shocks. By repeatedly selling options over time, they try to enhance their investment yields. In times of market stress, these investors are unlikely to buy options, but they may cut or significantly reduce their option selling programs. In terms of market impact, the practical difference between buying options or refusing to sell options is small. The withdrawal of these participants can substantially increase volatility. We discuss some conditions under which they might withdraw below.

1.2 Medium Horizon Investors

1.2.1 Large Asset Managers

Next in the hierarchy are large asset managers with investment time horizons of three to five years. Investors typically examine track records over such intervals when deciding whether to

give managers assets (or more assets) to manage, which largely determines their fees. These managers generally attract funds by delivering alpha (performance in excess of risk-adjusted returns). To augment their returns, and thereby attract more funds, many of these managers sell volatility. While it is true that most asset managers are limited by investment guidelines and cannot deviate too far away from those guidelines, it is also a fact that guidelines are more permissive today than in the past, and allow for both the inclusion of derivatives and out of index securities. Further, the rapid development of the ETF markets has allowed for products that enable crossover investment. For example, an equity fund can easily access both fixed income exposure, alternative exposure, or even short volatility exposure through an exchange traded instrument that trades on a stock exchange and looks like a stock holding.

Since non-linear option selling strategies are generally market neutral, in the short run, such strategies look like they do not have any market beta, at least to linear risk models such as the CAPM. For example, assume that a manager sells both puts and calls simultaneously in the form of a straddle or a strangle with strike prices centered on the current underlying asset value. These combinations have essentially zero delta at inception and thus zero contribution to market beta so that they do not add to the beta budget. Unless a risk monitor considers nonlinear risks, the income earned from selling such options can look like alpha, which provides the manager a performance advantage over competitors who do not sell volatility, as long as the market does not move too much.

Fund managers who sell volatility to augment their returns create a Peso Problem for their investors. They obtain a small, regular augmented return at the cost of rare very large potential losses.

1.2.2 Risk-Parity Funds

Other medium-term volatility participants include investment managers and hedge funds who follow the risk-parity strategy. This strategy equalizes risk contribution across portfolio assets by levering up low volatility assets. These managers do not explicitly sell volatility. Instead, their portfolio composition decisions—which depend on estimates of volatility—are sensitive to changes in volatility and implicitly make them behave as though they are short volatility.

A typical risk-parity fund operates as follows:[1] Assume that a fund that invests in equities and bonds has an overall target volatility level of 14%, and that volatilities for equities and bonds respectively are 20% and 5%. To obtain risk parity, the portfolio can lever up its bond portfolio by four times so that its bond portfolio has the same volatility as its equity portfolio. If the correlation between bonds and equities is zero, portfolio weights of approximately 0.5 and 2.0 will produce the 14% target portfolio volatility with equal risk exposures to bonds and equities. When the correlation between equities and bonds is negative, as is usually assumed, the total risk of the portfolio benefits from diversification and the manager can take larger weights in both assets classes. If equity volatility then falls, the manager must allocate more to equities to maintain the same portfolio volatility target, and conversely if equity volatility rises.

Since falling volatility has historically accompanied rising equity markets, risk-parity strategies respond to rising markets as if they are short volatility, i.e. they buy more equities as equity volatility falls to target the same overall portfolio volatility. The systemic danger, of course, lies in the converse. When markets fall, volatilities rise, and these funds sell equities which exacerbates the fall. Although risk-parity funds do not try to replicate options as do the funds implementing the portfolio insurance strategy, their response to market movements is the same. According to credible and independent estimates from markets, the estimated target leverage in risk parity funds is currently at all time highs of approximately 2.8 times invested capital. The open interest of the S&P e-mini futures contracts, which are used for expressing the equity exposure are also close to all-time highs and currently imply high implied financing costs (70-80 basis points over libor).

1.2.3 Risk-Premium Harvesters

Risk-premium harvesting funds appear next in the continuum. Financial theory going back to work by Ross in the 1960s shows that risk averse investors pay more risk-tolerant investors a premium for risk transfer. Risk-premium strategies grew rapidly with the democratization of trading technology and the widespread availability of risk-factor models. Many participants now implement this strategy in a form popularized by Ilmanen (2011).

[1] For a more complete description, see Bhansali etc. al. (2012).

In broad terms, risk premium funds are designed to harvest profits from transferring risk. They attempt to earn the term premium from the fixed income yield curve, the dividend premium in equities, the carry premium in currencies, and even the contango or backwardation premium in commodities. Thus the risk transfer can be implicit as discussed above or explicit, e.g. selling delta-hedged straddles. Some strategies included momentum, and possibility "tail-hedges" to mitigate the risks from this short volatility bias. There are indeed variations and many factor based risk premium strategies, especially in equities do not explicitly engage in carry trades. However, the core engine that generates returns depends on compensation for bearing volatility risk since risk-premiums are basically earned for risk transfer at the fundamental level.[2]

1.2.4 Volatility Targeting

Volatility targeting is a close cousin of risk parity. Volatility targeting arose when the Financial Crisis exposed the equity market tail risk of many variable annuity providers. Regulators then required these providers to demonstrate that another such event would not create the same magnitude of financial distress. Providers can satisfy this obligation by purchasing long-dated equity put options or by engaging in dynamic trading strategies that effectively produce protective put options.

Since purchasing puts is very expensive, most annuity providers use dynamic trading strategies. To target a given level or range of overall portfolio volatility, the simplest strategy systematically sells equity index futures (say S&P 500 Index futures) if volatility rises, and buys the futures if volatility falls. Since the response function is driven by changes in volatility (usually with reference to VIX), this strategy also is implicitly short volatility. For instance, when volatility rises, volatility targeters will sell futures to lower portfolio volatility to its target on the assumption that increased volatility will accompany market declines as it has in the past. Like risk parity, this strategy is destabilizing to the market and thus poses a systemic risk.

1.3 Short Horizon Investors

1.3.1 Trend Followers

Next in the volatility continuum are the trend followers. Since Fung and Hsieh (2001) show that trend follower return distributions look like those of long volatility strategies, at first glance

[2] See Bhansali (2012) for a model of the relationship of currency carry and volatility.

analysts might assume that their trading does not contribute to the short volatility behaviors that we are discussing. Here it is important to understand that volatility plays a dual role in portfolio construction. A diversified trend follower has many different assets in their portfolio, and the relative weightings are determined by the relative volatilities. But like volatility targeters, most trend followers also target overall volatility in their portfolios. Thus if the volatility of a specific asset class such as equities falls, they scale up the weight of that asset in their portfolios. Conversely, when volatility rises (which usually accompanies equity market selloffs), trend followers do the reverse as they reduce their positions in equities. If the volatility of all asset classes falls, then due to the overall volatility targets, all asset classes are levered. Thus in scenarios where equity volatility is very low, and all other asset classes also have low volatility, the exposure to equities increases from both the relative weighting and also the overall portfolio weighting. Their overall behavior thus is like other short volatility players in the market for sharp turns in the market and volatility changes. But trend followers are likely to "catch-up" after the initial selling of equity exposures, and if volatility levels remain high, are likely to amplify market selloffs.

1.3.2 Volatility ETFs and ETNs Investors

The introductions of exchange-traded volatility products—the VIX futures contracts in 2004, listed VIX option contracts in 2006, and volatility ETFs and ETNs in 2009—facilitate short-term volatility trading by traders at the fast end of volatility investor continuum. Before these developments, traders wishing to sell volatility had to sell many calls and puts, and roll these positions when they expired.[3] Now ETF and ETN providers package esoteric volatility strategies into securities that trade on stock exchanges.[4] These instruments allow retail and institutional traders to easily sell volatility, most simply by taking long positions in inverse volatility ETFs, or by shorting the long volatility EFTs.

Both strategies allow them to participate in the positive expected returns and high Sharpe ratios historically associated with selling volatility. Mechanically, these returns are due to the normally

[3] Large institutional traders could also sell volatility swaps.

[4] Volatility ETFs and ETNs track synthetic volatility indices that are based VIX futures prices. The ETFs mechanically provide exposure to these indices by following a prescribed VIX futures rolling strategy while the issuers of ETNs hedge their positions using similar strategies. For instance, the ETF SVXY uses the inverse of the S&P Short Term VIX Futures Index as its reference.

upward-sloping VIX futures term structure: When the market is stable or rising, short-term volatility is low but long-term volatility stays high due to the purchase of insurance by risk averse investors. Selling VIX futures thus creates roll-down profits as time passes if volatility does not change much. The roll-down profit, of course, is the premium earned for selling insurance upon which no claims are made.

While selling VIX futures and rolling down the curve has long been a popular strategy for hedge funds, retail investors and most investment advisors could not easily implement this strategy until ETFs and ETNs came along. Many traders now engage in these strategies, influenced in large part by the academics and practitioners who have written much about their potential profit opportunities.

The incredible success of short volatility strategies over the last year substantially increased interest in the strategy as many traders tend to follow trading profits. For example, due to the secular decline in volatility (and a technical compounding effect), the inverse volatility ETF SVXY (ProShares Short VIX Short-term Futures ETF) has been one of the best performing assets over the last year with a Sharpe ratio of approximately 4! During the year ended September 30, 2017, the equity invested in SVXY doubled. As of early February, 2018, short volatility ETFs were commanding a significant portion of the total volatility risk (or "vega") in the VIX futures complex. The most recent estimates showed that short volatility ETNs had a net short vega of $100MM per one point move in the front VIX futures contract. In addition, due to the specific rebalancing process of inverse and levered ETNs, these estimates also showed that the ETN providers would need to buy almost $50 million additional vega for a one point increase in the VIX futures contract. Since these ETNs are agents and price insensitive, they usually rebalance near the close of the market. The current total open interest in the VIX futures contract complex is approximately 650,000 contracts, i.e. close to 15% open interest would be bought by the inverse volatility ETFs just for rebalancing purposes if done via the VIX futures contracts.

1.3.3 Market Makers

Both Wall Street dealers and high frequency market makers provide liquidity to volatility sellers by buying the options that they sell. To recoup the time decay of the long option positions they inherit, these participants usually engage in continuous delta hedging of the positions. For small

fluctuations in the market, the strategy of delta hedging requires them to buy if the market goes down, and sell if the market goes up. By doing so, they locally act to stabilize the markets. However, many dealers also sell other options that are further out of the money to manage the overall time decay and volatility exposures, so for large movements in the markets, they are likely to also behave like other short volatility participants.

Having listed the main participants in the volatility selling ecosystems, we are aware of the fact that technically "everybody" cannot be selling volatility. Since for every seller there has to be buyer, there must be someone who is taking the other side. Indeed, dealer desks, hedgers and asset allocators in many cases have been buyers, and they have been able to buy volatility for the last few years at rapidly decreasing prices. The clearing price for options has thus fallen at an increasing pace, and as discussed below, creates an asymmetry in the risk vs. reward from short volatility positions under a rapid regime shift. Indeed in 2017 the VIX and many other indicators of volatility across asset classes hit multi-decadal lows, illustrating that there were indeed more eager sellers to sell at lower prices than there were buyers who were willing to step up to buy at higher option prices.

We should also add that the current short volatility bias is extreme in the historical context, and there is a tendency for such extremes to reverse quickly and violently. Indeed, the inverse is also true. In the aftermath of the 2008 financial crisis, there was a corresponding bias towards buying volatility, which included many of the same participants listed above. This excess demand for tail insurance and hedging resulted in the price of volatility to be much higher and extreme. At the time many participants including one of us held the view that such high levels of volatility would likely result in risk premium profits to volatility sellers, that has largely been the case since the financial crisis.

2 Could a Volatility Cascade Lead to a Correlated Asset Market Crash?

The possibility that the above participants may act in concert is alarming as uncoordinated but correlated behavior could trigger a significant volatility event. Rises in implied volatility would likely cause many of the above traders to sell securities to adjust their hedges. Such selling

would increase implied volatility, which would lead to more asset sales. A crash would occur if this feedback loop exhausted the normal liquidity that stabilizes markets.

Here are some issues that should elevate concerns:

The assets under management in volatility-contingent strategies is large. Adding implicit volatility sellers such as risk parity funds (estimate $500B), volatility targeting funds ($350B), risk premium harvesting fund ($300B), and trend followers ($300B), to explicit sellers such as pension overwriting funds ($50B), dedicated option funds ($10B), ETPs and ETNs ($3B) and VIX-related strategies ($3B) yields a total invested in short volatility-contingent strategies of over $1.5T. Recent estimates by credible market sources[5] suggests that this sum is large enough to present a credible risk should they all trade in the same direction. We admit that these estimates are imprecise, and could be off by a factor of two. The main thrust however is that the exposure is extremely large, and a potential de-leveraging by many of these investors at the same time could be a significant event that would challenge the liquidity of the markets.

The assets in short volatility-contingent strategies continue to grow. Low levels of realized volatility make low levels of implied volatility appear reasonable and allow managers to justify selling volatility at low prices. Low yield levels also drive growth in short volatility strategies as managers seek to meet yield targets. Low realized volatility also makes long volatility positions less attractive for delta hedgers who might otherwise offset volatility selling.[6]

Confidence in selling volatility continues to grow. Managers base their volatility selling activities on back tests and on many academic studies that show that selling volatility is a positive expected return activity. Such research provides cover to managers engaged in risky risk-premium harvesting strategies. The absence of recent significant volatility also emboldens investors. Many investors now undoubtedly confuse low volatility for low tail risk despite that fact that different factors determine the middle and tails of the return distribution.

[5] See e.g. Morgan Stanley QDS, Feb. 1, 2018.

[6] Delta hedgers buy call options and sell the underlying. When underlying prices rise, they sell more of the underlying and they repurchase the underlying when prices fall as dictated by the option's gamma. The strategy thus sells high and buys low and is most profitable when substantial transitory volatility regularly moves the markets.

Asset class diversification has broadened the scope of volatility selling. Volatility selling strategies are now widespread across asset classes as short volatility investors seek diversification. As a result, implied volatility has collapsed across all assets. If we think of selling financial insurance as a shadow insurance operation, then just like a multiline insurance company, diversifying across different lines of insurance business makes rational economic sense.

All short volatility strategies are similar. Regardless of investment horizon, the inverse of volatility is the main factor driving the dynamic portfolio rebalancing associated with short volatility strategies. In a volatility shock, with one small exception discussed below, each strategy will respond in the same direction so that the response of the whole will be larger than the sum of the parts, and larger than most participants would expect based on analyses of only their own strategies. This self-similarity is an important factor in inducing endogenous long-range correlations between participants at different time horizons.

Investors are not generally aware of the extent to which their strategies are correlated. Each participant believes that they have some edge or specific mechanism to control downside risk. However, the success of these strategies depends on the liquidity available to them. Traders who do not recognize that they will compete for liquidity with investors who are trading strategies that are seemly different, but essentially the same, will oversize their positions.

Mechanized trading is common. Many managers use machine-driven algorithms to implement their volatility trading strategies automatically. The mechanization ensures that reactions to market moves will be tightly coupled, quick, and price insensitive, three properties that greatly increase the probability and severity of market crashes.[7]

Participants continue to sell volatility despite declining prices and obvious risks. Several reasons may explain the persistence of short volatility strategies: low yields elsewhere (substitution), the need for relative performance compared to peers (herding), increasing expected returns as the futures term structure steepens, and a belief that the economy somehow is now different than before.

[7] See Bookstaber (2007) for a discussion of the importance of tight coupling to market crashes.

2.1 A Simple Model of Instability

To illustrate how option selling at low volatilities can result in large instabilities, consider the purest form of volatility selling, the option straddle. Speculators sell volatility using a straddle when they sell call and put options simultaneously at the same strike and for the same expiration. For this example, consider a one-year straddle on the S&P 500 Index.

When option implied volatility is 30%, the price of this one-year straddle is 23.4% of the Index value. The delta of the straddle (the rate of change of the value of the two options with respect to the underlying index value) is close to zero because the deltas of the put and the call largely cancel. However—this fact will be important in a moment, the rate of change of the delta (gamma) is 2.5. A gamma of 2.6 indicates that the straddle delta will rise 2.6% points or fall 2.6% points if the S&P 500 Index respectively moves up or down by 1%.

When option implied volatility falls to 20%, which is close to the long-term average for the S&P 500 Index, the price of the straddle falls from 23.4% to 15.7%, which is a 33% reduction of premium. To generate the same yield from option selling, the seller now must sell 50% more straddles. Now note that the gamma per notional straddle at this lower volatility increases from 2.6 to 3.9. For the same income, increasing the notional size results in a total gamma that is 2.26 times larger than the gamma for the 30% volatility case. It is larger because the gamma per straddle and the number of straddles both grew.

When volatility is at 10%, the price of the straddle falls from 15.7% to 7.8%, a further 50% reduction in price. To maintain the same income as before, the seller must now double the number of straddles, which will require three times as many straddles as when volatility was at 30%. The gamma of the straddle with volatility at 10% is 7.8, so with the additional contracts, the gamma of the equal yielding position is 23.4, or nine times larger than that of the original position.

To understand how this dynamic plays out in time, recall that volatility rose to above 50% in the Financial Crisis. Those who sold volatility before the Crisis lost substantially and many withdrew. In the immediate aftermath of the Financial Crisis, volatility dropped to 30% and traders selling volatility obtained an attractive risk-reward tradeoff. Over the next three years,

volatility dropped to its long-term average of 20%, and those traders selling volatility since the Crisis had a three-year track record of making excess returns.

Nothing attracts imitation like success. By late 2010, many more sophisticated investors were selling volatility. The strategy naturally found its way into the broader marketplace as the financial industry happily created products—for example XIV in November of 2010 and SVXY in October 2011—that allow anyone to sell volatility by buying an exchange traded product. Volatility selling became institutionalized and many traders had large short volatility positions.

The potential problem concerns the total gamma of these positions, which is now much higher than it was in 2010. The total gamma increased because gamma increased nine-fold due to the decrease in volatility from 30% to 10%, traders increased their positions to maintain their yields, and new traders started selling volatility.

The substantially increased gamma has strong implications for the quantity of hedging trades that short-volatility traders will do when underlying index values fall. These trades will much be larger in aggregate than when volatility was at 30%.

Here is the fear: When a decrease in the underlying index causes the delta of the straddle to drop, the delta of the short straddle position (which is equal and opposite in sign) will rise. Short volatility sellers must sell the market index to restore the overall delta of their positions. These hedging sales are destabilizing. Enough such trading could trip the markets into a cascade as the hedgers overwhelm the capacity of the markets to absorb their sales.

2.2 The Volatility Crisis Scenario

Putting all these concepts together yields the following potential volatility crisis scenario:

- Some unknown event or constellation of events causes index values to drop or VIX to rise, or both. The events may involve geopolitical, political, or central banking issues, uncertainties about which all have risen substantially in the last year.
- A sharp drop in the index causes the delta of short option positions to drop so that short volatility sellers sell the market index to restore the overall delta neutrality of their positions. These sales are destabilizing.

- As values fall, implied volatilities rise as they have in the past as investors try to ensure against potential losses. Their purchases of puts cause put writers to sell the underlying index to hedge their positions. These sales exacerbate the problem.
- Institutions that implement mechanical volatility-contingent strategies for which VIX is a major input parameter (such as risk-parity, volatility targeting, and trend following) then reduce their asset exposures as they follow their design specifications and rules. Many of these institutions sell equity index futures as did many of the 1987 portfolio insurance algorithms. Some also buy volatility at higher prices for safety. These trades further exacerbate the problem.
- Increases in volatility cause investors using volatility selling strategies (shadow insurance companies), to back off from selling insurance. Some volatility sellers buy-in their positions to control their losses. These purchases increase implied volatilities. The increased volatilities feedback to the risk-parity traders who sell more, which exacerbates the problem.
- Some volatility insurers repurchase volatility through exchange-traded products. The resulting repricing of these products causes arbitrageurs and ETN providers to buy back VIX futures or volatility derivatives.
- As volatility expectations rise, arbitrageurs bid up the prices of the options so that the actual value of VIX rises.
- Some fearful investors also sell assets to pare their risk exposure. Their sales further exacerbate the problem.
- Simultaneous institutional selling puts pressure on the equity index futures markets, which cause arbitrageurs and others to sell index stocks and other correlated stocks.
- As stocks sell off, other markets (such as high yield, corporate credit, etc.) feel the impact. Widening credit spreads could lead to liquidations by credit instrument holders. As credit becomes less available, further liquidations occur in the real economy.

In the worst-case scenario, this shock would cascade across markets and regions forcing widespread liquidations and rising credit spreads everywhere like we saw in the last crisis. In the best-case scenario, a lender of last resort would step in and stops the liquidations before they threaten systemic instability.

These effects can work in the other direction too, but with some caveats. A rapid rise in the market would cause volatility sellers to buy the underlying. These purchases would increase underlying values. In the long run, they may lead to less volatility as traders feel safe.

But in the short run, quickly rising volatility might lead to greater volatility if investors buy puts to lock-in their gains, or buy calls to cover their short call option positions. And the losses that volatility sellers would experience from an increase in the underlying might cause some to buy-in their positions as discussed above. These two effects might cause volatility to rise further, at least in the short-run, even though asset values are increasing. The high volatilities might feedback to assets values through the processes discussed above, potentially overwhelming the gamma hedging effect and thereby reversing the increased asset values or even causing asset values to fall.

2.3 The Exception(s) to the Rule

Speculators who short VIX (as opposed to the underlying index options) tend to stabilize index prices. These speculators sell VIX by shorting VIX futures, bullish VIX ETFs and ETNs, and VIX swaps. They also sell VIX when they buy inverted VIX products. Many of these traders hedge with short index positions because VIX tends to rise when the index falls.

When the index falls, these traders buy the index because the correlation of VIX with changes in the index breaks down when VIX is high and thus not likely to rise further. These purchases tend to stabilize index values. The trading of these short VIX speculators thus helps explain the low realized volatility observed in the last few years.

Now consider who is on the opposite side of their trades when they initially establish their short VIX positions: Their counterparties are long VIX speculators, asset hedgers worried about downside tail risk, or arbitrageurs who hedge in the options markets. If arbitrageurs, the ultimate other side are asset insurers who are buying puts.

How do these counterparties respond to a drop in the index? When the index drops and VIX rises, the long VIX speculators sell VIX to realize their gains. The asset hedgers who are long VIX may sell VIX because VIX is not likely to rise further (as the correlation breaks down). The asset insurers who bought puts eventually sell or exercise those puts.

These transactions would lower VIX. Many of the traders who accommodate these transactions (by buying VIX) would buy the index to hedge their trades, which would be stabilizing. Those buying back puts or buying the underlying when allocated a put exercise presumably already would be hedged so that these closing transactions would not have much net impact on the index market.

These observations suggest that short VIX speculation could stabilize the index, at least when index values and volatilities do not change much. However, note that open interest in exchange-traded VIX products is small compared to the assets under management in the other short volatility-contingent strategies. Accordingly, the effect of this stabilization will likely be limited. In the event of a large move, the destabilizing trading of the other short volatility-contingent traders would likely overwhelm the stabilizing trades of these short VIX speculators. To us, the VIX futures ETNs are the tail that can provide the signal for the larger systematic sellers to de-risk at the same time. In making this conclusion, parallels from the "small" sub-prime market of the financial crisis that brought large institutions to their heels comes to mind.

In concluding this section, we should ask whether the possibility of a coordinated unwind today is different than in the past. While the fundamental nature of markets to oscillate between extremes has not changed, there are at least three reasons why the coordinated risk is a larger issue today than in the past. First, the ability of both institutional and retail investors to access volatility selling strategies has never been higher. Second, information is available to all market participants in real-time and they can react in an increasingly continuous trading environment. Finally, both the levels of yields and volatility are at unprecedented extremes and emanate from the same ultimate common factor, which is the easy policy of central banks globally. This trifecta of mutually self-reinforcing conditions has not existed in the same form in the past.

3 Conclusion

A low yield, low volatility environment has drawn market participants with different horizons into essentially similar volatility-contingent strategies based on a common non-linear volatility risk factor. The growth of these correlated short volatility strategies creates risks that may trigger the next serious market crash. The risk is greater than most would think because most

traders are unaware of the extent to which their trading strategies are correlated with those of others who engage in seemingly different strategies.

The stabilizing trades of short speculators in the VIX index may partly explain the recent low realized volatility of the market. But assets in these strategies are relatively small compared to assets in volatility-contingent strategies that use the VIX as an input; the latter being many magnitudes larger. It is a case of the VIX tail wagging the asset allocation dog. Whatever the cause of the low realized volatility, the low volatility has emboldened traders who trade short volatility-contingent strategies. The expansion of their strategies suggests that an unwind could be quite painful.

Market participants and regulators can both benefit from being prepared for large, self-reinforcing technical unwinds that may occur when events cause these traders to reevaluate their risk tolerance. And, investors should remember that selling insurance, upside or downside, without reference to the price or the risk inherited can prove to be very expensive indeed. While this paper is not intended to provide financial advice, a proper stress shock of strategies under different correlation and volatility assumptions should be provided by every investor to ensure that the balance of short volatility bias is not so large that they are forced to liquidate in the next bout of increased volatility.

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IMPORTANT DISCLOSURES

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