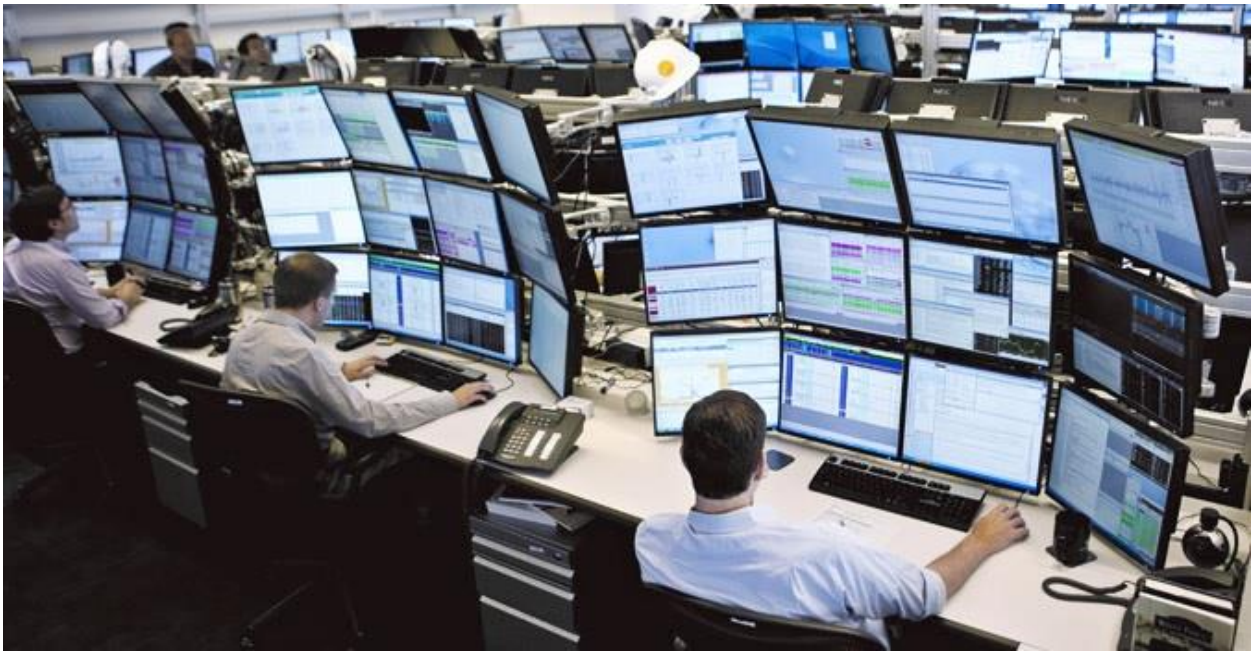
Don’t touch the VIX! Oops.



Proprietary derivatives trading in the last decades

It's a no-brainer; the financial industry has changed a lot over the last decades. There are multiple causes. Among the structural factors, one can mention the rise of technology, the decimalization and electronification of exchanges, the introduction of ECNs for equity, the increases in volume and speed of those exchanges. There were also significant regulatory changes (MiFID, Basel, Dodd-Frank…). Derivatives trading has changed a lot too. But what happened to the VIX on the on February 5th, could be a wake-up call to the industry and generate another wave of deep changes.

A few decades ago, derivatives trading was the monopoly of broker/dealers. Those institutions enjoyed virtually unlimited capital, first-class technology and IT resources, good relations with exchanges/regulators. Derivatives trading was an essential part of their income. For those market-maker and proprietary traders, new trading ideas, supported by innovation in products and in techniques, implemented with know-how and skills, were elating. These activities generated regular and significant profits, fueling a virtuous cycle of talent, imagination, efficiency and products.

Internal supervision was not always able to understand the complexity of these businesses. Compliance & risk officers increasingly relied on trading management for proper decision-making. But as complexities increased, pressure for results also increased well, and management grew more tolerant to complexity, as well as operational and headline risks. As long as profits were there to support the growth and feed the bonus pools, as long as mistakes and losses were minimal or could find a simple explanation, the game was worth it and few people asked too many questions.

The derivatives world took a major turn in 2008. Fueled by zealous mortgage brokers, result-oriented rating agencies and a general appetite for leverage, many banks and buy-side investors had filled up

their balance sheets and activities with dubious financial products. The king lost his clothes when Bear Stearns and Lehman disappeared from the world. AIG had a near-death experience. Nobody knew who had those risky assets and who could go bust, initiating a self-feeding market downturn. The Fed saved the day by injecting enormous amounts of liquidities and by bailing major actors out more or less discreetly. Although it could have been much worse, the stupidity of those products had led to a serious financial and economic crisis.

The regulatory blowback was severe. Among many restrictions, Dodd-Frank effectively eliminated prop trading in banks and strongly increased monitoring and compliance. International capital requirements crippled bank risk limits and eliminated huge swath of market-making activities, especially in the fixed income world.

Hedge funds and trading houses filled the void. Luring the most profitable traders with technical resources and budgets, higher payouts and investors' hunger for returns, those nimble structures became and are to this day the core centers of trading activity.

The short vol trade.

During the 2008 debacle, hidden losses and counterparty risks exploded. Lower and less accurate forward company earnings became the norm. Nobody really knew what would happen, 'exuberance' and choppiness reigned. The market eventually went back to normal. Confidence and earnings forecasts came back. Central bank support and the low-rate environment fueled a corrective rally.

Equity volatilities subsided. They actually returned to surprisingly low levels. Although the causes of that low-volatility environment are still debated, fingers point to ETFs and indexing. Huge retail investments moving from discretionary funds to passive index-replication structures reduced local stock mispricing, dispersion and the general volatility. The 'short gamma' players, those who make money when volatility is lower than expected, were the big winners. Most volatility traders would have difficulty shorting on such low levels, but that's the trade that paid. Historical S&P vols around 6-9% were constantly lower than short-term implicits on a contango-type term structure, and way below long-term historical averages (13-15%).

During that rally, quantitative investment strategies gained further attention in the retail, semi-retail and institutional spaces. Let's face it, quantitative strategies bring returns of much better quality than discretionary investments. Macro traders, allocators, discretionary traders in most asset classes struggle to reach a 1 Sharpe. In the statistical arbitrage space, if you do not have at least 2 you are nobody. Good portfolio managers can reach 2.5 or 3. I am not even talking of intraday and HFT players, who reach much higher levels, albeit in much smaller capacities. You can argue that quant strategies have their 'good' and their 'bad' periods, but if you eliminate the mean-reverters, momentum players and factor rotators, there is a solid core of quality returns based on experience and well-researched models.

The technicalities, complexities and diversity of this segment escape most retail and HNW individuals. Banks took advantage of that void with appealing 'quantitative investment strategy' products. This article will not disparage that segment altogether, far from it. Having interviewed hundreds of accomplished portfolio managers and run detailed due diligences on their strategies, I have seen solid

ideas and approaches. I am actually a solid believer in quantitative approaches. Bank strategy desks can provide very good ideas, packaged in very efficient structures. It's just that not all quant strategies make the grade. You need years of research with competent and expensive staff to build proper, original, adaptive quant strategies, which should surmount the test of time while diversifying your portfolio. It is tempting to jump into something that looks good, according to a back-test over the recent years. Over-fitting is not rare, like probably the latest machine-learning fad (at this time). There is an entire gradation of quality.

But somehow, the short-vol trades were recommended for public investments. Yes, they had provided good returns in the always-lower vol environment, but past results are not an indication of future returns and volatility trading is not for beginners. The VIX is a fear gauge, which the general media now loves, but you are committing a solid mistake if you assume that volatility behave like physical assets.

Equity indices are structurally different from volatility indices. Dow and S&P have long-term positive trends. Good year, bad year, they will grow at ~10% per year on average plus dividends. Investors get a return premium over fixed-income instruments for carrying some volatility risk. Nothing new here, this is well-documented. Also, econometrics models and analysis are far from easy, but you still can enjoy some forecasting capacity between asset classes.

Equity index volatilities, on the other hand, are much harder to forecast. They have no trend, forcing them to mean-revert. Their trajectories are far from oscillating around their average: they tend to gap up and smooth down exponentially. Vol traders know this drill well – buy it cheap ahead of possible events, try to sooth the theta-negative cost with calendar spreads, skew or out-of-the-money positions, and enjoy the fruits of a vol gap up. You then sell short when everybody is scared and wait until it goes back down. Repeat.

CBOE VIX index (2008-2018)

Nowadays, building long / short / leveraged structured products on volatility is not only legal but also easily feasible technically. 'Volatility as an asset class' is within reach of most investors. Even if very few understand its true mathematical nature, the VIX index now appears daily on TV. VIX futures are highly liquid. All investors are expected to assume their responsibilities, but many retail or semi-retail are not really aware of the risks they take with trading pure volatility. How many times have I heard presumptuous amateurs argue how profitable their sale of small puts is. There are hedge funds pushing

this strategy to investors. But picking pennies in front of bulldozers is like IPOs, dot-coms, real-estates stories or now Cryptos. They won't look so good at some point in the future.

And so, reverse ETFs on squared-root-of-fixed-duration-variance (aka the VIX) became retail-accessible products. But as the VIX has a solid capacity to gap up, those products have a solid propensity to gap down. Their dynamic hedging structure actually makes them unfavorable to investors.

Benchmark manipulations

When a trade becomes crowded, margins compress and profits wane. Innovation and ingenuity is the proper way to keep on sourcing alpha – PMs and analysts keep on finding new ideas before they become crowded. This is a rational and legitimate approach, which pushes financial products towards their fair values. Contrarian speculators are beneficial to the markets and society.

Another way to find alpha is to walk into the legal 'grey areas', where fewer actors will wander. Those trades are far from rare and quite valuable if you are open to take some legal/compliance/reputational risks. Benchmark manipulation is one of those.

A benchmark is a mathematical construct which explains the value of a given asset or group of assets, and which can be used as reference for a derivative product. It sounds complicated, but it's like the Dow Jones Index Average or the Russell 2000, which are averages of stock prices. Mutual funds and ETFs replicate or try to beat those indices. It is also the LIBOR, which dictates the regular payments of trillions of interest rate swaps, mortgages and financial contracts. It is the WM/Reuters fixing for foreign exchange, used in many index calculations and contracts. It is also the S&P 500, guiding the value of the world's most liquid assets – the SPY ETF and the S&P futures. The reality is that any numerical figure, from simple to complex, can be used as a reference for a contract definition, provided you pay the appropriate licensing fees. There is an entire cottage industry of index and numerical number providers.

By definition, all derivative products have payouts based on the value of a given underlying benchmark at a given time. If you are able to trade that benchmark at that given time, a trader can hedge himself and guarantee the payout. He can sell derivatives on that number and charge a modest fee for the service. That's good. It is socially beneficial in many ways, and that's what happens almost always.

But a professional trader also knows that if your derivatives exposure is big enough, you will have difficulty sourcing enough hedging asset on that benchmark at that given time. Your size will influence the benchmark. Simply starting to hedge your trade or indicating your size to other players will 'move the market' against you. There is a fine line to find appropriate liquidity when executing or unwinding a client trade without having too much impact. You need to find cash exposure at the right moment to reduce your risk, but you also should source some exposure on correlated products to reduce impact. If you can't find that additional liquidity, then you have to warehouse the risk until the liquidity is sufficient. This is what clients and market participants expect from you. And indeed, most market professionals are 'professional' and do handles this situation efficiently and properly.

But if you read between the lines and have the proper financial incentive, that low liquidity is a great opportunity to generate trading profits, and some traders will jump on the opportunity. Let me explain

how; it's not complicated: Suppose that you are exposed to a benchmark print on a product with a significant size. You know that hedging yourself on that print will move the print. What you can do is buying say 40% of your need on that specific underlying at the specific time, while buying the remainder of your hedge on a different asset or at a different time (before or after). If you 'unfortunately' move the benchmark by 0.50%, you deliver that price for 100% of your size, while 60% of your size is hedged properly. Bottom line, you pocket 0.50% * 60% = 0.30% of profits over a short period. That's far more than the 0.01% or 0.03% you have received from your client or taken when entering the trade in the market (like taking a futures spread or an option calendar spread). It is juicy. Meanwhile, the market or your client loses 0.50% on 100% of the derivatives trade. The remaining 40% of the impact is dissipated to arbitrageurs and other participants.

How prevalent are such occurrences? Well, most traders are honest and will not do inappropriate trades. They also know that the regulatory and career consequences could be dire. But there is still a sufficiently large number of traders out there to assume that most, if not all, benchmarks are influenced or pushed to some extent. What dictates their presence and their impact is the liquidity of the benchmark and how intelligently the measurements are defined. You would need many billions to move the close or the SOQ of the SPX 500, but lesser known or less liquid benchmarks should be assumed to be influenced. The LIBOR scandal was an extreme case – the traders trusted in defining the LIBOR rates had many billions of swaps resetting every day, and they were talking openly of their directional manipulation intents on Bloomberg chats...

The case for the VIX

The VIX is a complicated index, which is calculated from a large number of S&P 500 options. The square of the VIX is a variance, obtained by averaging the prices of the entire range of S&P options for the given maturity date. The weights are not equal – lower strike options (puts) have increasingly more influence as they are lower (and less liquid). Weights also depend on how far-spaced the options are from each other. Very low puts have a significant influence, although they are worth pennies in price and are very illiquid. Since the VIX has a constantly moving maturity (say 30 days), it is also defined by averaging listed fixed maturities (like February and March, which could be 18 and 42 days away today) around the 30 day target. All-in-all, it's not a standard run-of-the-mill average like the DJIA with static weights and 30 extremely liquid components.

Futures on the VIX have a more complicated settlement price than their day-to-day market prices. The final settlement price is based on the opening prices of the relevant options. If no trade happens, a mid-price of the option is used, until it happens too often and then the following options in the series are ignored.

It already took two paragraphs to superficially explain the math behind the VIX. Without even delving into the details, most investors are already lost on the intricacies. You need to be a professional option trader to correctly understand the math, and you need to have a decent amount of trading experience to fully grasp the risks implied by the formula. Simply said, if most S&P futures traders can and do trade every millisecond the 500 stocks that are needed to hedge their exposures, most option traders will not touch the underlying options of the VIX due to the complexity, infrastructure and risks involved. That's how touchy the index is.

But that moat won't stop everybody. There are major players on the VIX futures and options, who hedge their VIX exposures with the underlying options. Some 'go to cash' to rehedge at maturity. Like any benchmark replicator, if they have a large exposure to hedge, they can trade 40% on the fixing and buy the rest on a related asset and are willing to take some compliance risk… Yes, manipulating the VIX is quite complicated and requires skills and systems, but the trade is less crowded and there are some opportunities to grab, so you should assume that some do. These firms and individuals need to put in place the technology and organization to perform it - the kind of infrastructure, that Chicago-based hedge-funds using co-locations for market-making, or NY-based firms with solid connectivity to option exchanges have. They also need some experienced traders and technicians. There aren't so many firms ticking all these marks.

So how likely is the VIX to be manipulated? Exchanges have the volumes, prices and the names of the traders. They can analyze the numbers. A good research paper (Manipulation in the VIX? J Griffin, A Shams, *The Review of Financial Studies*, Volume 31, Issue 4, 1 April 2018, Pages 1377–1417) has looked into those, concluding it is feasible, and would not be too expensive in terms of trading costs & risks. It is the opinion of the writer, not only an academic but also an experienced arbitrageur and an expert witness, that there is little doubt that the VIX is manipulated on expiry days. The trading pattern of the VSTOXX during its settlement period is a near-perfect demonstration of a similar manipulation.

Reverse ETFs

Most ETFs simply pay the performance of their index, like the SPY simulates the S&P 500. Some ETFs, on the other hand, pay the negative performance of their benchmark. They are called "reverse ETFs". One needs to understand how a reverse product is hedged to understand what probably happened on February 5th.

How do you construct a product that goes up, when its underlying asset goes down? It's not as simple as it looks.

You can construct your ETF to be worth "$200 – P", where P is the price of your stock (assumed to be worth $100 to start with). When P goes to $95, the ETF is now worth $200- $95 = $105. If your stock goes up to $108 instead, then the ETF goes down to $200 -108 = $92. If the stock goes back to $100, your ETF also goes back to $200 - $100 = $100. It looks all good mathematically, but what will you do if your stock goes to $210 three years down the road? Your ETF now has a negative price of E = $200 - $210 = -$10. Try to settle that product… Try to advertise it… "My product is so good, I will GIVE you $10 to take it". Serious headache. That road doesn't work.

The solution is to adjust every day the value of your ETF by the performance of stock of that day. If the stock moves down by 5% to $95, you increase the value of your ETF by 5%. In this example, we have ETF = $100 x (1 - 5%) = $105. If the stock then goes up by 8% to $95 x 108% = $102.6, your ETF goes down by 8% to E = $100 x (1-5%) x (1+8%) = $96.6, etc. With this daily mechanism, the price of your ETF will almost never goes to zero, even if the stock double over one year. The ETF actually can only go below zero if your stock doubles in price within one day, an extremely rare event.

That's how a reverse ETF works. There are several consequences for this mechanism. The first one is that the ETF will underperform the asset.

On a simple numerical example:

Stock	Variation	ETF
$ 100.00		$ 100.00
$ 95.00	-5.0%	$ 105.00
$ 102.60	8.0%	$ 96.60
$ 100.00	-2.5%	$ 99.05

When the underlying goes back to its previous price, the ETF doesn't. It has lost some value on the way. Reverse ETFs have a drag. The more volatile the underlying asset, the bigger the drag.

More importantly, that ETF structure has an impact on how the ETF market-maker hedges himself. The trader, who never wants to carry market exposure, needs to adjust his exposure every time the ETF is readjusted. On day one, when the ETF is worth $100, so he has to short $100 of stock against it. On day two, when the ETF is now $105 but the stock is now worth $95, he needs to sell a bit more of that stock, to have again $105 of stock short exposure. To be more precise, he needs to sell another $10 of stock, or about TWICE the variation of the stock on his notional of ETF. Conversely on day two, when the stock price goes up by 8%, he has to buy back some stock, once again TWICE the variation of the stock or 16% of his ETF exposure, etc… The bigger the move of the stock, the more re-hedging the market-maker has to trade.

You will also notice that when the stock goes up, the market maker has to buy. When the stock goes down, the market maker has to sell. In both cases, he is trading in the same direction as the market. That is the cause of the performance drag - it's generally not a good idea to buy high and sell low. It's also pretty bad to run after your stock when your size is large. If your need increases when the movement amplifies, it's really not great.

This reweighting is done at the end of the day, when the market closes. To avoid taking risk, the trader also has to trade right on the close. Let's take a more significant example: if the stock goes up by 40% during the day, he has to buy-back 80% of his short exposure…. That's when liquidity can become a problem.

The case for the XIV and the SVXY, the reverse ETFs on the VIX.

The XIV and the SVXY are two reverse ETFs on the VIX index. As we have seen:

- The VIX is not a standard asset. It is a volatility index, which tends to gap up and move down slowly.
- Unlike most indices, it is extremely hard to trade the underlying options composing the VIX index. For most participants, your only possible directional hedging instrument is the VIX future.
- When the underlying of a reverse ETF goes up, all the reverse ETF market-makers have to buy the underlying, pushing its price even further up.

- The market-makers have to trade on the close, in a size equal to twice the variation of their hedge. If the variation of the VIX index is large that day, all the market-makers have to purchase a significant amount of VIX exposure, for which the futures market might not be liquid enough.

If reverse ETFs are acceptable for slowly moving and liquid physical assets, selling reverse ETFs on the VIX is a recipe for disaster. That disaster happened on February 5th. On that day, the market took conscience of a possible interest rate rise, which would be associated with a market downturn. The S&P 500 lost 4% in a few hours. The fear gauge VIX gapped up. It had closed at 17 on Feb 2nd (already quite up), but the more the VIX moved up a lot that day in % terms. The more VIX exposure market-makers had to buy, the further up they pushed the volatility futures, and the more futures they had to buy. It is estimated these two instruments had $5bn of exposure before that day. Each time the VIX index moved up 1 point, market-makers had to buy 2 x $1 / $17 x $5bn = $0.6 bn of VIX futures. At 5 points up, market-makers had to buy $3.0 bn, etc.

There's only so much the VIX future can take. The lemurs followed each other and jumped off the cliff together. In fine, the VIX moved so much that the two ETFs had lost 90 and 95% of their worth. In one day. In hindsight, building a reverse ETF on such a complicated, difficult to hedge and unstable underlying will probably not be remembered as the smartest idea.

VelocityShares Daily Inverse XIV Short-Term ETN

Was there a VIX manipulation? What would it mean?

Was the VIX voluntarily pushed up to bring the reverse ETFs to oblivion? To answer the VIX manipulation question, whether it is on a VIX expiry or a regular day, you have to look at the trade data for the underlying S&P options. The information is quite big in size and the analysis will take resources. At the time of writing this article, it is not possible to state if or how the VIX movements were induced to influence the reverse ETFs. They could very well be two mechanically independent events.

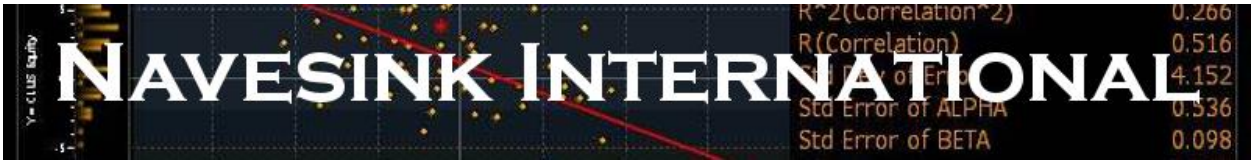
The questions to answer are:

- Was there abnormal prices or trades on the S&P options, especially the lower-strike puts, which could have pushed the VIX index up?

- Did someone short the reverse ETFs or buy significant put positions on these ETFS in the days or hours before?
- Are these firms related?

This article cannot pretend to have the answer. But it can suggest the consequences for the industry if there was indeed a manipulation. The 2008 mortgage crisis resulted in severe regulatory pressure for the broker/dealers. Benchmark manipulations resulted in huge fines for their perpetrators and their employers. There is little doubt that traders are manipulating the VIX on expiry days. An official inquiry will no doubt result in serious legal penalties and significant regulatory changes, which could impact the whole alternative and derivative industries.

To the hedge-funds out there, don’t touch the VIX!
And if you among those who do. Oops. It’s time to lawyer up.



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Gontran de Quillacq, consultant / expert witness

Gontran de Quillacq has over 20 years of experience in portfolio management, derivatives trading, proprietary trading, structured products and investment research. He has worked with top-tier banks and hedge funds in both London and New York.

Background Experience - After reaching PhD and MBA level through six global Ivy leagues, Mr. de Quillacq traded derivatives for two decades, from vanillas to exotics, both proprietary and client-facing, at top-tier banks in the square mile and on Wall Street. As a portfolio manager, he researched and managed investment strategies, delivered both in hedge fund and in structured note formats. He initiated the distribution of investment strategies through derivatives, an activity now called 'portable alpha' and 'smart beta'. For the following five years, Mr. de Quillacq ran due diligence on investments strategies and selected senior investment personnel for some of the world's most famous and most demanding hedge funds and asset managers. In 2017, he co-founded a quantitative activity deploying the latest machine learning techniques in global long/short equities.

Litigation Support - Mr. de Quillacq's own investment experience and his cross-sectional review of other professionals give him unique experience on what can be done, what should be done, what should not be done, and the grey areas in-between. During a personal case, his legal team was so impressed by his wide and thorough knowledge in finance, his capacity to explain complicated ideas in simple terms, and his strong performance on the stand, that they strongly recommended he expand into litigation support services. Mr. de Quillacq is now a FINRA/NFA arbitrator, a member of the Securities Expert Roundtable and an IMS Elite Expert. He has consulting affiliations with **Barrington Financial Consulting Group** and **Ankura** (Navigant).

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