

VIX, derivatives and possible manipulations

Don't Touch the VIX! Oops.
March 2018, Gontran de Quillacq

NAVESINK INTERNATIONAL

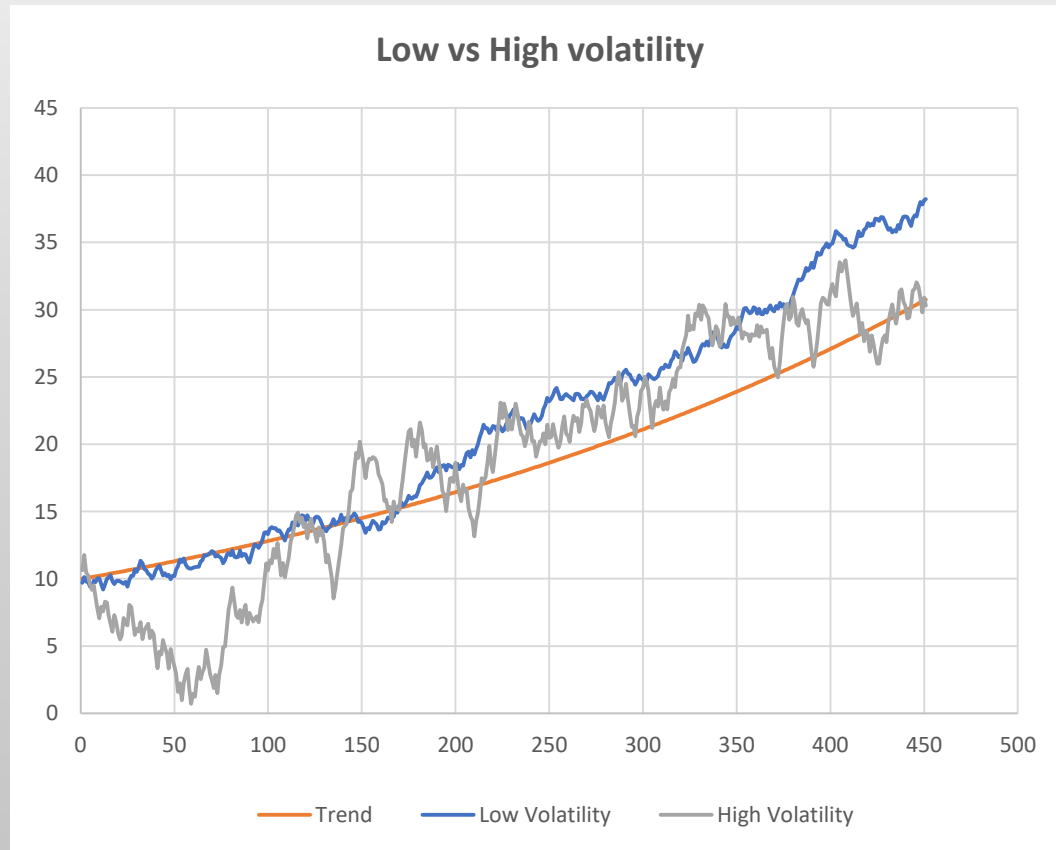


TOPICS

- Volatility, vanilla option pricing and VIX
- Benchmark manipulation 101
- Benchmark manipulation 102 - VIX
- Thirst for quantitative strategies
- Reverse ETFs / ETNs
- XIV/SVXY – Reverse ETFS/ETNs on VIX
- Events of February 5th, 2018
- Outcomes

VOLATILITY AND VANILLA OPTION PRICING

- Definition: Volatility = annualized standard deviation of daily returns.



1% daily move = 16% annualized vol

Typical stock volatilities:

- Utility (low) = 12-15%
 - Regular levels = 18-25%
 - Tech (high) = 30-40%
 - Bio Tech = 40-60%
 - Take-over / special situations 50% +
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- Index: 12-20%,
 - Might spike at 30% for short periods

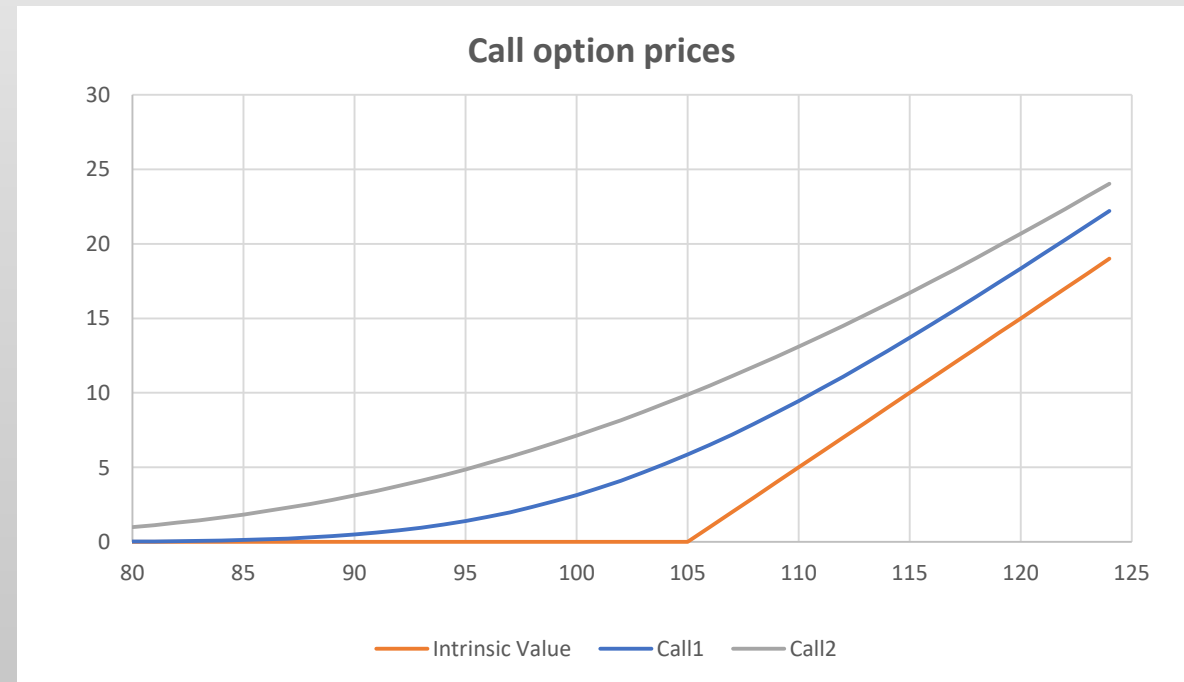
VOLATILITY AND VANILLA OPTION PRICING

- The cost of replicating a pay-out with dynamic stock hedging IS the price of the derivatives.
- How to hedge a call: buy more stock when it goes up, sell when it goes down.
- Black-Scholes formula

$$C = SN(d_1) - N(d_2)Ke^{-rt}$$

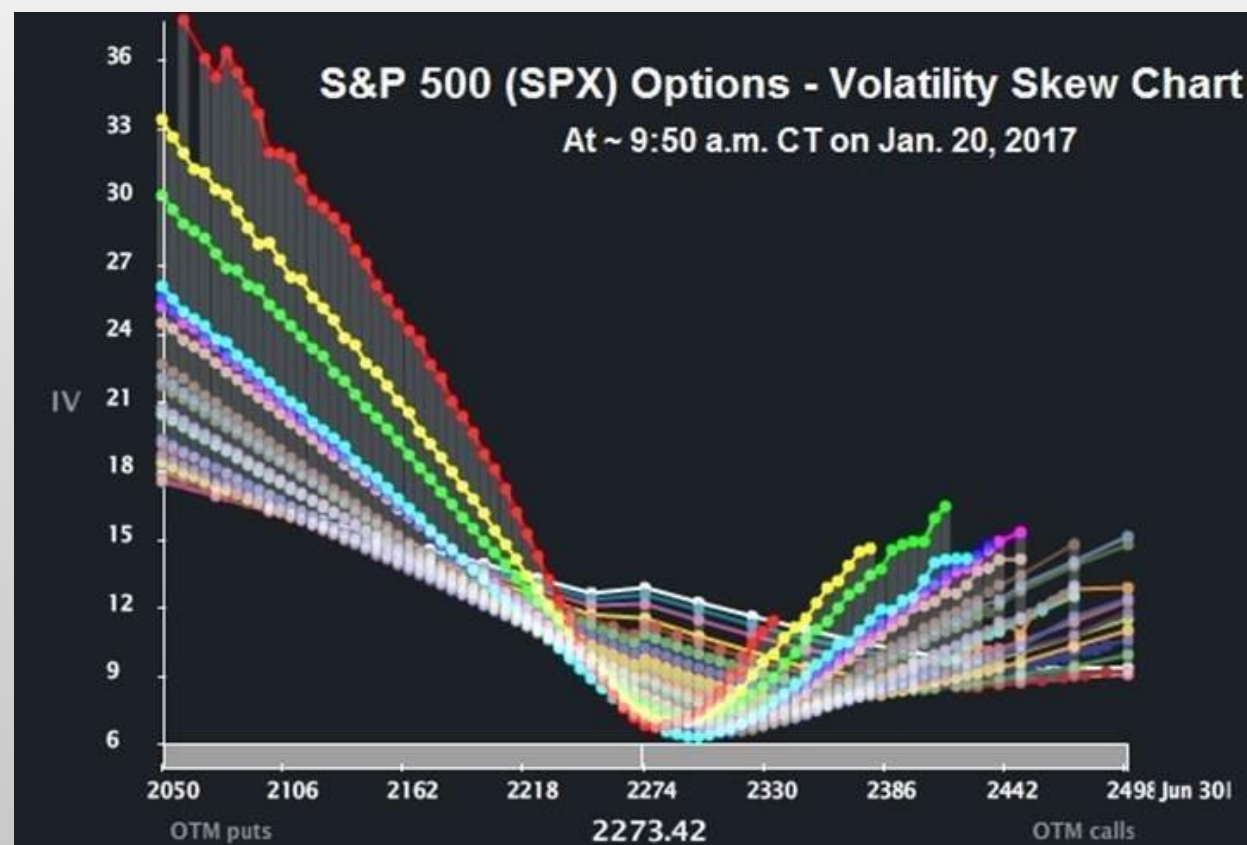
$$d_1 = \frac{\ln(S/K) + (r + s^2/2)t}{s \cdot \sqrt{t}}$$

$$d_2 = d_1 - s \cdot \sqrt{t}$$



VOLATILITY AND VANILLA OPTION PRICING

- Problems with this approach
 - Works only for European vanillas
 - Market uses a different interest rate than expected
 - Black-Scholes can't manage dividends
 - Stock returns should have a normal (bell-shaped) distribution
 - Volatility should be stationary
- Implicit volatility depends on
 - Individual asset (dividend estimates...)
 - Rates used – 'repo' adjustment
 - Strike
 - Maturity
 - Timing



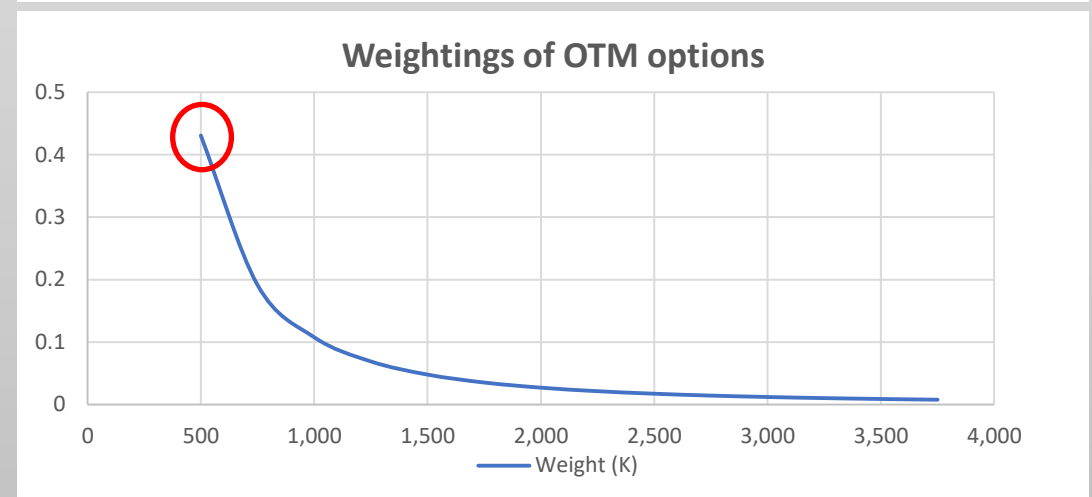
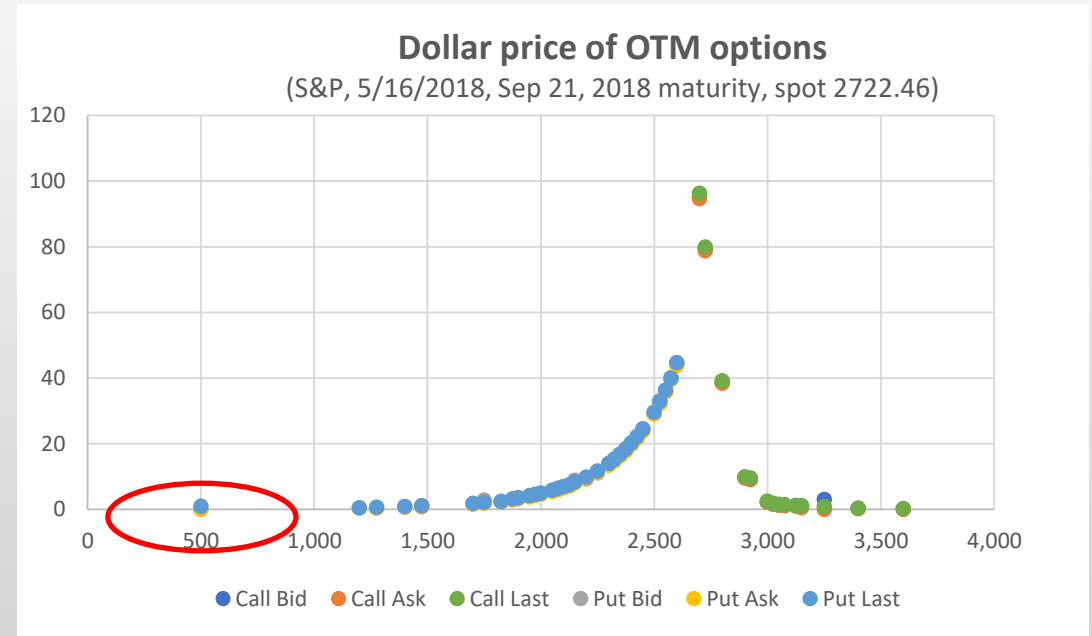
How can we define THE implied volatility of the S&P today?

VIX APPROACH

- We can get a volatility without extracting implied volatilities or estimating other parameters
- Summing all \$ prices of OTM calls / puts gives a variance = 'volatility squared'
- Puts are very over-weighted ($1/K^2$)
- Adjust for the spacing of the options, maturity

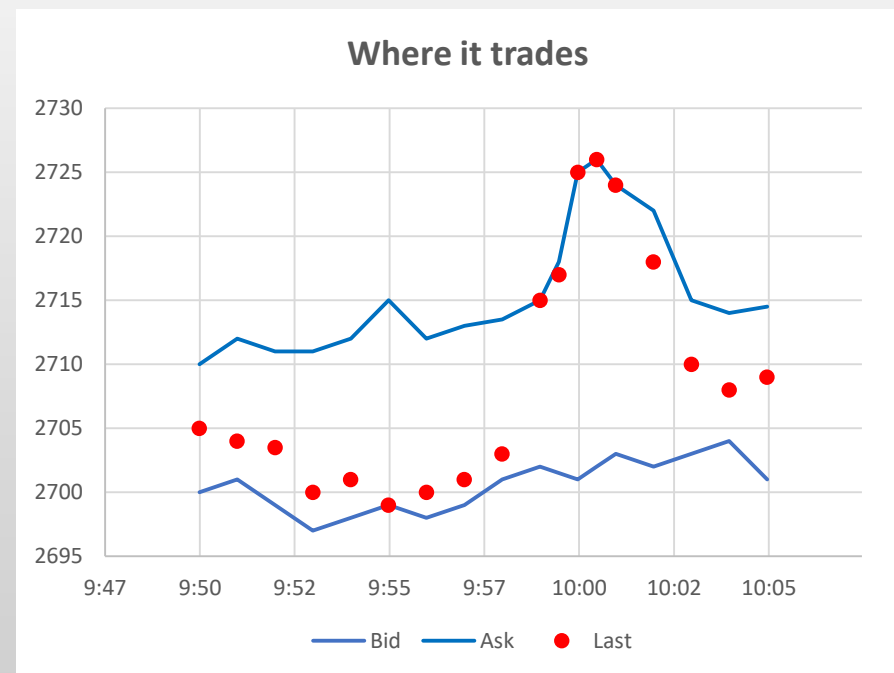
$$\sigma^2 = \frac{2}{T} \sum_i \frac{\Delta K_i}{K_i^2} e^{R_i} Q(K_i) - \frac{1}{T} \left[\frac{F}{K_0} - 1 \right]^2$$

- Atypical: no trend, mean reverts, gaps/decay, illiquid, hard to trade, non replicable (SQRT)



BENCHMARK MANIPULATION 101

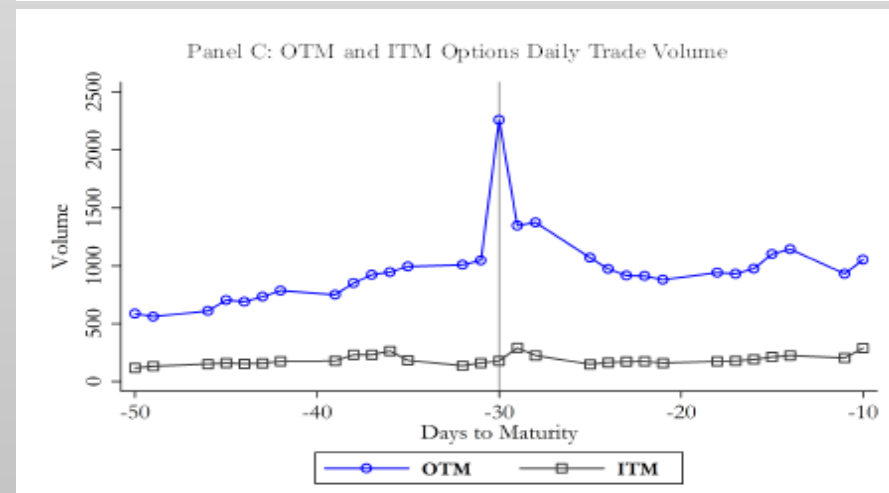
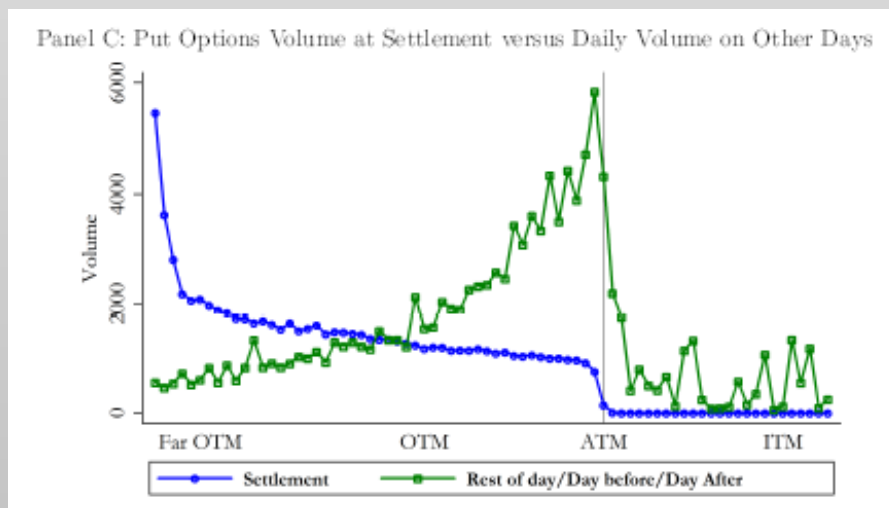
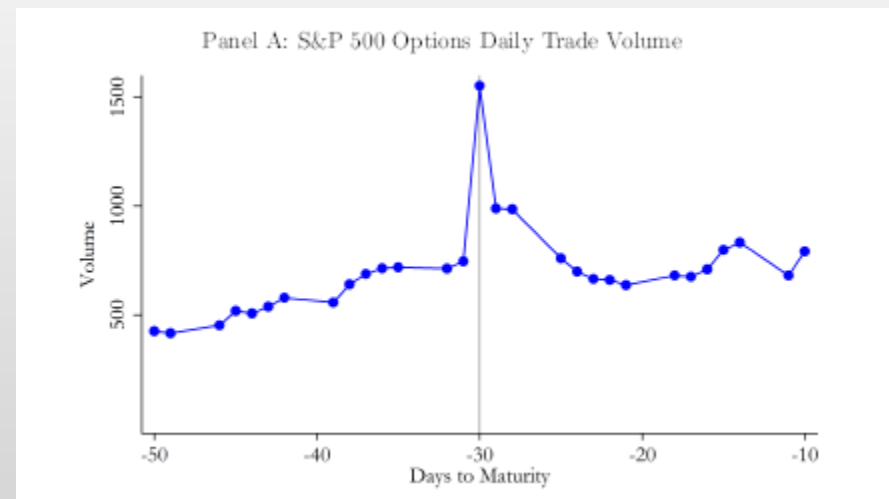
- How to make profit against a benchmark
 - Derivatives pay an asset performance between start and end
 - “Start” and “end” have to be defined precisely: when, where, how
 - Example 1: client buys a call on the MOO ETF. We will use the price on Bloomberg at 10:00 AM.
 - Example 2: client unwinds an S&P call during the day. We will execute with futures on ‘best efforts and adjust for basis.
 - Example 3: BNP has an option maturing today on the FTSE close (last). He can only hedge with futures. SG has access to the cash. BNP and SG can’t agree on the basis to cross futures...
 - Example 4: FTSE futures EDSP = average of FTSE cash from 10:10 to 10:30, calculated every 15 seconds by exchange...
- “Liquidity management” & professionalism



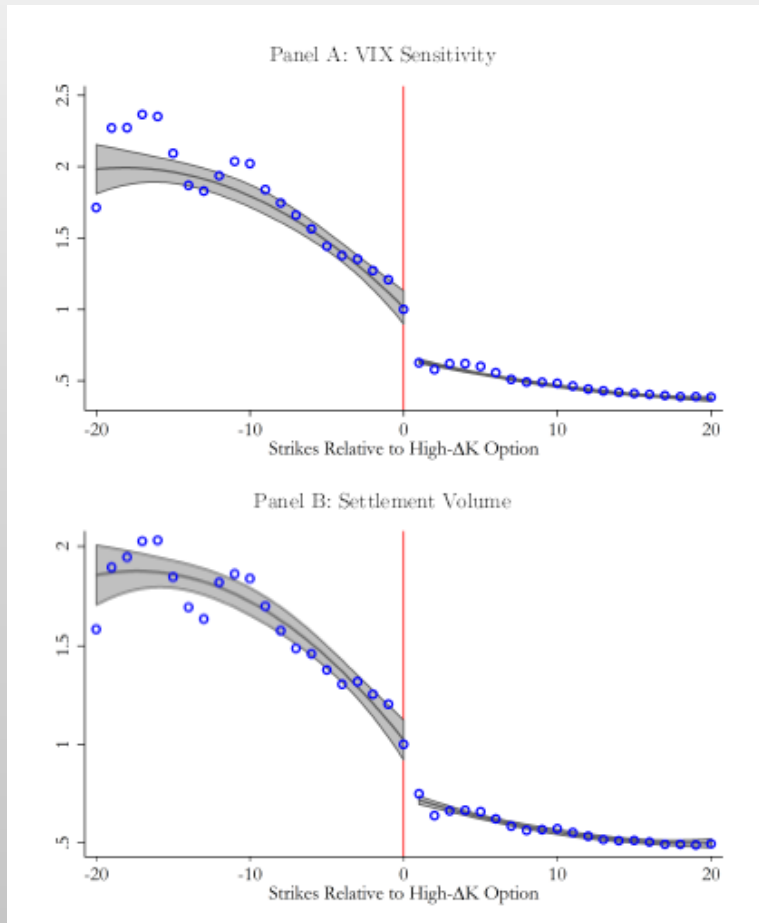
Hedge	70%	2702
	30%	2724
	aver	2708.6
Client Settlement	100%	2725
=> Profit	\$	16.4
	%	0.60%

BENCHMARK MANIPULATION 102 - VIX

- EDSP = sum of prices of options on opening quote (auction)
 - If no trade on open, use the mid-price after opening, as long as no more than two strikes without opening price
 - Weighted by the same calculation formula ($\Delta K/K^2$)
- Where/how much do these options trade that day? Are the trading patterns normal that day?
- Manipulation in the VIX?, Griffin, Shams, April 2018, *Review of Financial Studies*, volume 31, Issue 4, p. 1377-1417



MANIPULATION 102: VIX EXPIRIES



THIRST FOR QUANTITATIVE STRATEGIES

- A dozen type of alternative strategies, from fundamental to systematic:
 - Private equity / credit, physical assets, project finance, real estate:
 - Illiquid, long-term investments. Hard to put a Sharpe. More long/only than L/S.
 - Discretionary L/S Equity, usually organized by sectors:
 - Concentrated positions
 - Mostly value exposure, sometimes growth
 - Sharpe 1- – stocks are always more correlated
 - Global macro
 - Poor performance recently – low rates, QE, politics, low quality data...
 - Credit, structured credit, structure arbitrage / events
 - Emerging markets, commodities
 - Quantitative / systematic / model-driven
 - HFT: high Sharpe (5+), low capacity, perform better in volatile environments, costly infrastructure
 - Volatility trading: high Sharpe (5+), decent capacity, costly infrastructure, operational risks
 - Statarb: most equity markets, large diversity of approaches, Sharpe 2-3+, large capacity, crowding
 - CTA: large capacity, mostly trend-following or reverse, Sharpe 1.

THIRST FOR QUANTITATIVE STRATEGIES

- General alternative environment:
 - Discretionary have difficulty beating a Sharpe 1
 - Global macro have difficulties with low rates, political meddling, poor stats
 - Quantitative strategies are growing, perform well
 - General Banking environment:
 - Higher capital requirements, regulations, risk controls, competition for profits
 - Smaller balance sheets, margins, new wave of technologies
 - No more prop trading, but infrastructure in place for quant strategies
 - Family offices / UHNW / retail distribution needs differentiation, innovation, marginable products
- => Packaging of quantitative strategies into retail / structured products
- All you need is a few researchers. Younger is cheaper. “Juniorization”
 - “Commoditization” of quant strategies from institutional, to UHNW, to retail

THIRST FOR QUANTITATIVE STRATEGIES

- Examples of structured quantitative strategies:
 - Risk premia: value, quality, growth, momentum, carry
 - Volatility: call over-write, skew/term arbitrage, mean reversion, relative value
 - Cross-asset: systematic allocation
- Approach: create a strategy based on systematic rules, express it with an index. Structure derivatives on this index. Distribute, secondary market
- Providers contribute: Call overwrite strategies & VIX from exchanges, custom / complex allocation indices from index providers
- Sell-side organization: multiple floors, large silo-ed divisions / teams
 - Organization by asset classes + new cross-asset research/structuration
 - Equity: dynamic underlying: Delta One have experience
 - Equity: complex payouts: options and exotics have experience

REVERSE ETFs / ETNs

- How do you structure a product that goes up when the underlying goes down?
 - For ANY type of underlying, including dynamically changing (strategy), in large size
- Solution 1: Options - deep ITM put, K=200
 - volatility risk, but no hedge
 - If P close to \$200, optionality can be large.
 - What if P > \$200 ? Call back and issue a new one?
- Solution 2: “\$200 – P”
 - Not volatilitistic, large liquidity, static hedge
 - If P > \$200, ETF < \$0, bad brand, settlement
- Solution 3: Today = Yesterday * (1- P%)
 - Not volatilitistic, decent liquidity, can do 2x leverage
 - Needs daily rehedging (2 x P%), wrong way, on close
 - Performance drag
 - The bigger the move, the bigger the rehedging

	\$200 - P		Stock		ETF	
			Price	Variation	\$200 - P	
Day 1	\$	100.00			\$	100.00
Day 2	\$	95.00		-5.0%	\$	105.00
Day 3	\$	102.60		8.0%	\$	97.40
Day 4	\$	100.00		-2.5%	\$	100.00
(...)						
Day 500	\$	250.00			\$	(50.00)

	Stock		ETF			Stock		ETF		
	Price	Variation	Variation	Price		Price	Variation	Variation	Price	
Day 1	\$	100.00			\$	100.00			\$	100.00
Day 2	\$	95.00	-5.0%	5.0%	\$	105.00	-2.0%	2.0%	\$	102.00
Day 3	\$	102.60	8.0%	-8.0%	\$	96.60	4.1%	-4.1%	\$	97.84
Day 4	\$	100.00	-2.5%	2.5%	\$	99.05	-2.0%	2.0%	\$	99.76

REVERSE ETFs / ETNs ON VIX: XIV / SVXY

- Business environment
 - Demand for innovation, quant strategies, in lowering margins
 - VIX has gone down for years. Good backtests made by junior researchers.
 - Growth of ETFs
 - Institutional -> UHNW -> retail
 - “Volatility as an asset class”

⇒ Reverse ETFs / ETNs on VIX are created, listed on exchange

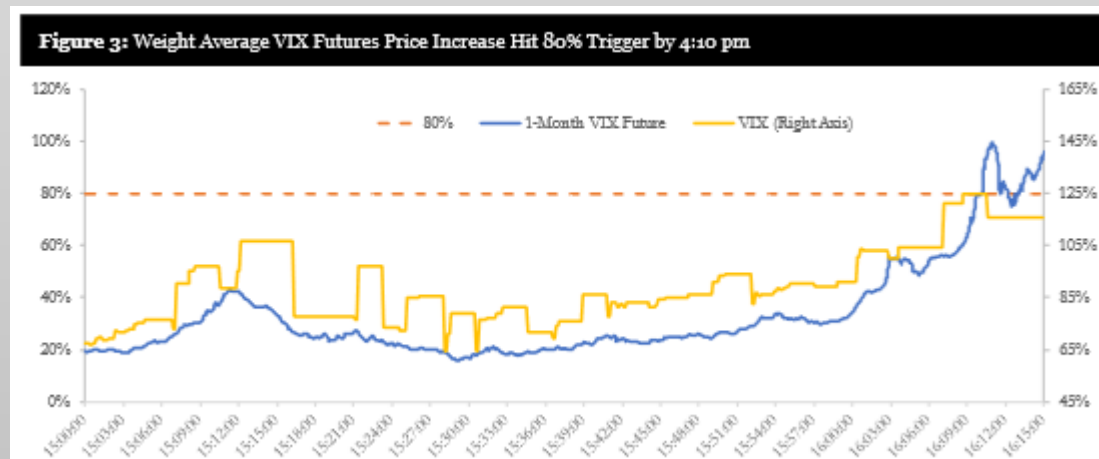
- Issues:
 - Researchers / structurers are young, inexperienced
 - Daily reheding: can't trade VIX => futures. Bigger the move bigger the hedge.
 - Futures has limited liquidity
 - Delta One traders manage ETFs, little experience in vol trading
 - VIX is not a regular asset class: cash untradable, futures illiquid, gaps up
 - Smelled a rat: termsheets have many caveats.

FEBRUARY 5TH, 2018 - FACTS

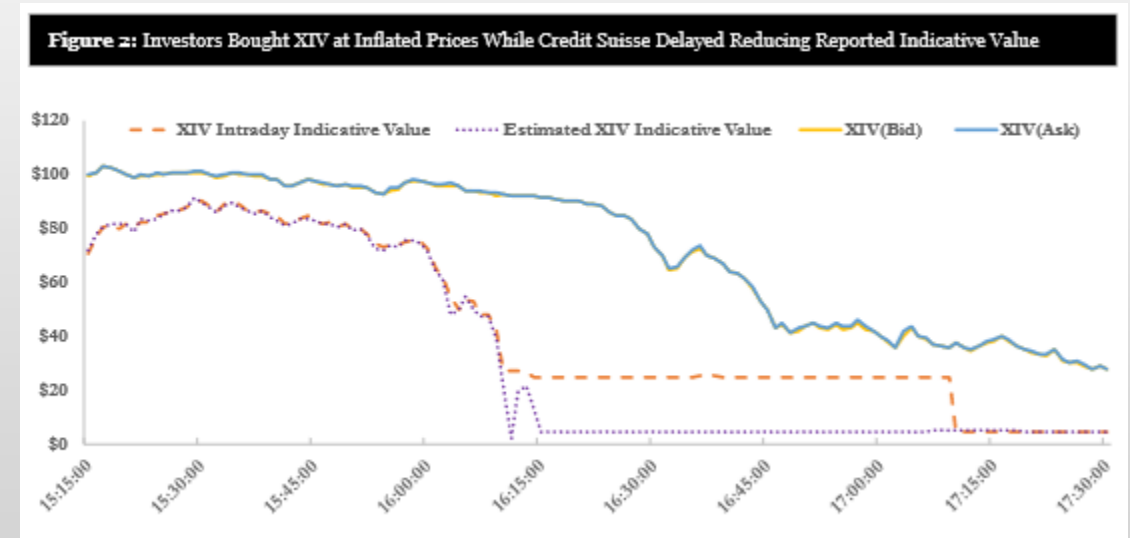
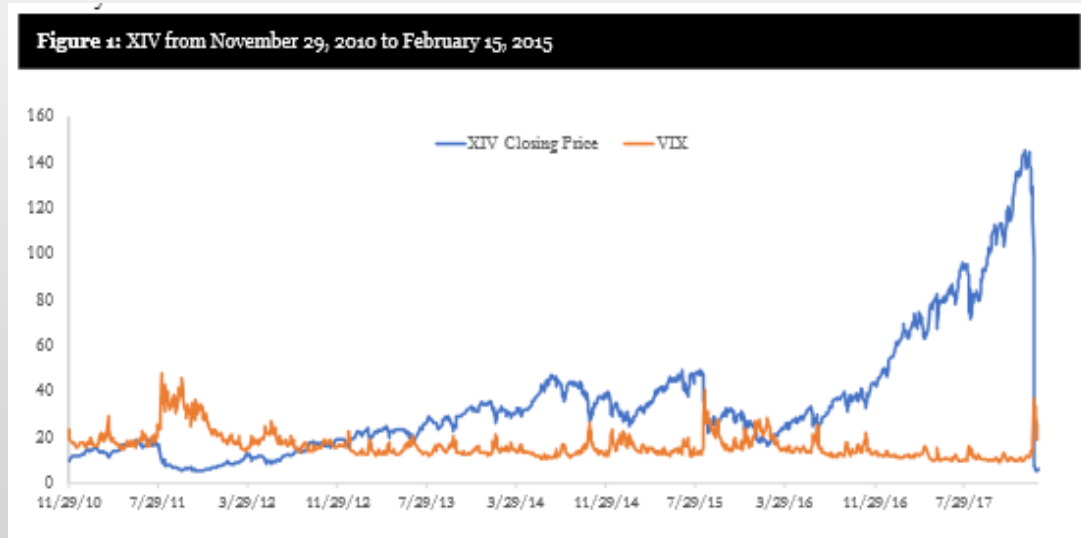
- That day:

- Rates are going to rise, fears of down trend, S&P down 4% in a few hours
- VIX futures up to 30%, from 17% (February 2nd, up from February 1st) = +80% !
- Estimated ETF notional \$5bn

=> ETF market makers have to buy \$ 5bn x 80% x 2 = \$ 8bn on the close



FEBRUARY 5TH, 2018 - OUTCOMES



- CS did not indicate correct NAV for an hour, could have suspended the XIV.
- Can we sell products of that complexity to retail, even with disclaimers?
- Did the CBOE exchange know that the VIX was manipulated? Illiquid? 25% of its revenues (volumes -30%).
- Rumor: CS would have pushed up the VIX. Was there manipulation? On futures expiries or that day?
- Who is manipulating the VIX? Major regulatory blowback to expect.
- Litigation state: ~15 class actions, against “John Doe”, against CBOE Exchange

THANK YOU

CONTACT DETAILS:

Gontran de Quillacq

Legal Consultant / Expert Witness

W: 646-844-1789, C: 732-533-9066

gdequillacq@NavesinkInternational.com

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