

# VIX, derivatives and possible manipulations

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

**NAVESINK INTERNATIONAL**



# DISCLAIMERS

- Educational webinar, not a deposition.
- Attendance includes attorneys/experts involved in VIX/LJM
- No press, recording, quote
- Questions on the way.

# SPEAKER: GONTRAN DE QUILLACQ

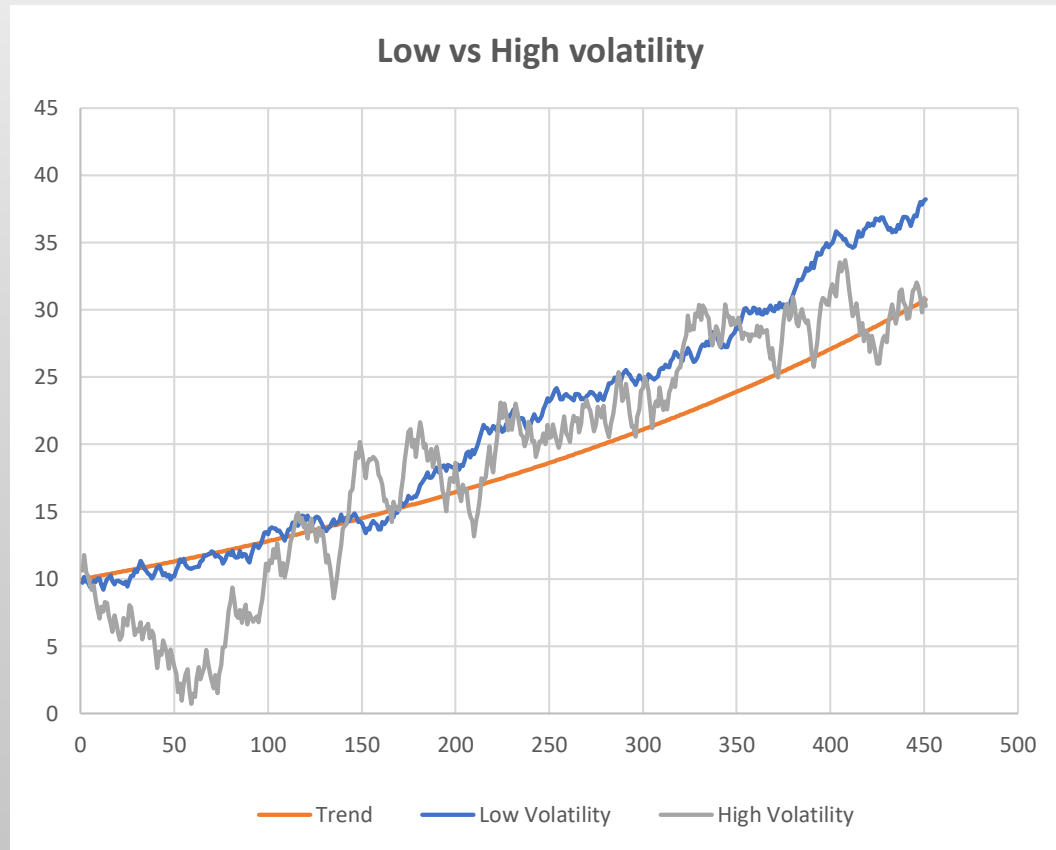
- 20 years of derivatives trading, proprietary trading, quantitative research, portfolio management
  - Institutional employers, in Europe and US
  - Both volatility trading (vanillas, exotics) and DeltaOne (Swaps, ETFs...)
  - Client-facing and proprietary trading (IndexArb, StatArb, Structure Arb)
  - Structured DeltaOne (Lehman, 90's), research content, portable alpha, risk premia
- 5 years of due diligence on investment strategies / personnel
  - Cross-sectional view of hundreds of alternative strategies
  - 2017: Machine learning strategy, raised \$300m capital, business development
- Legal consultant / expert witness
  - HSBC FINRA No. 13-02861, 2013-2015

# 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 5<sup>th</sup>, 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% +
- 
- Index: 12-20%,
  - Might spike at 30% for short periods

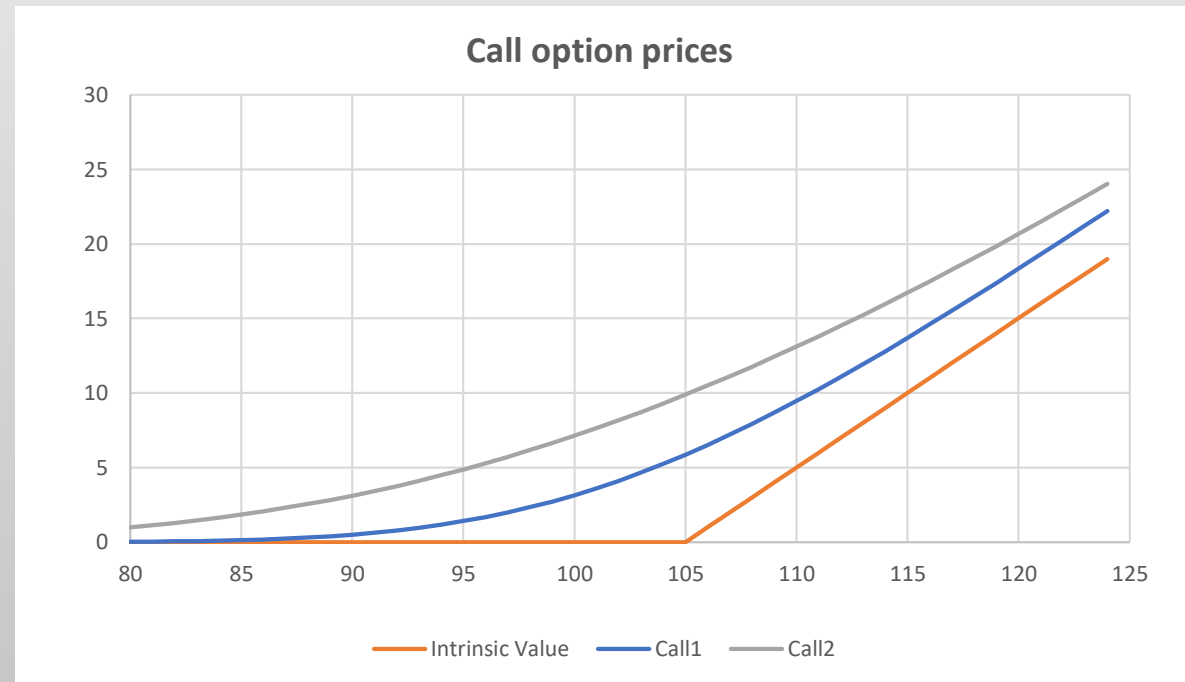
# VOLATILITY AND VANILLA OPTION PRICING

- 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

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

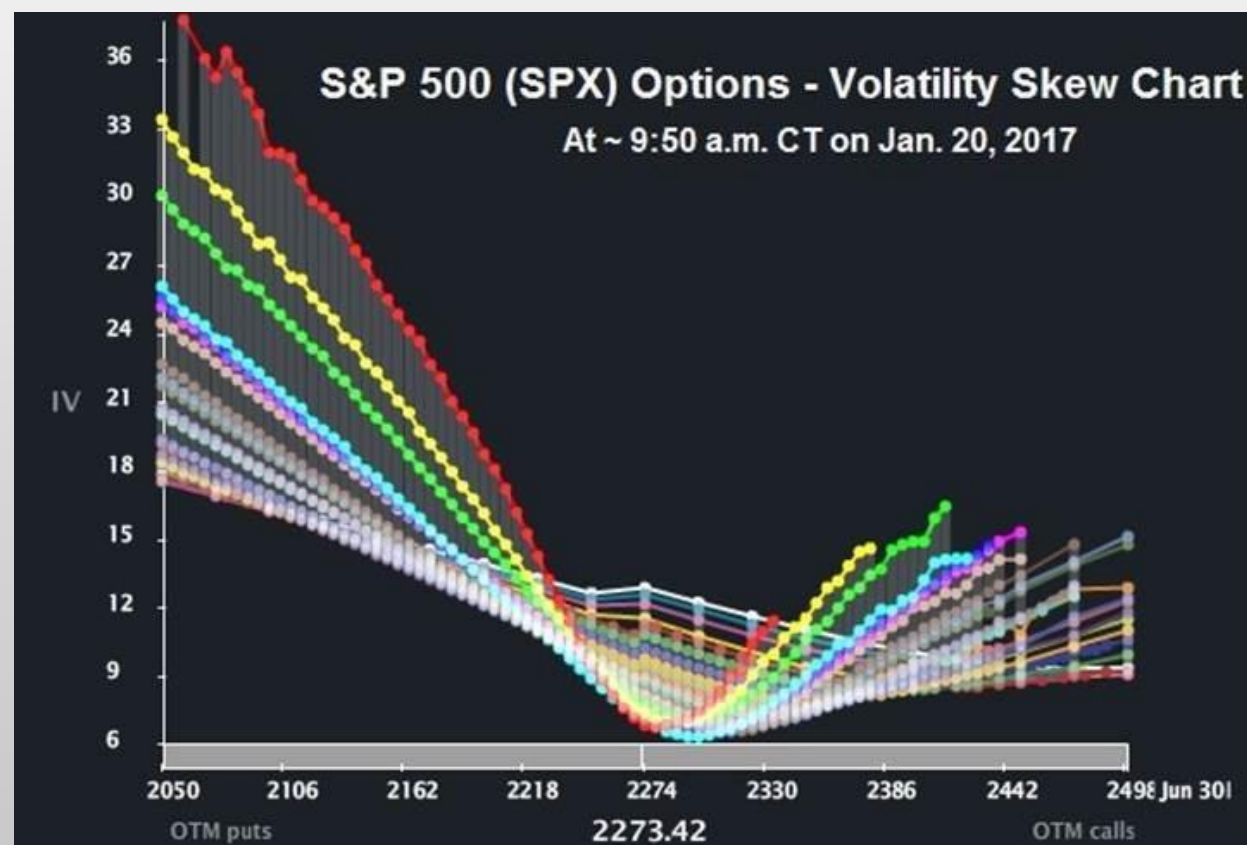
$$d_1 = \frac{\ln(S/K) + (r + s^2/2)t}{s \cdot \sqrt{t}}$$

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



# 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?

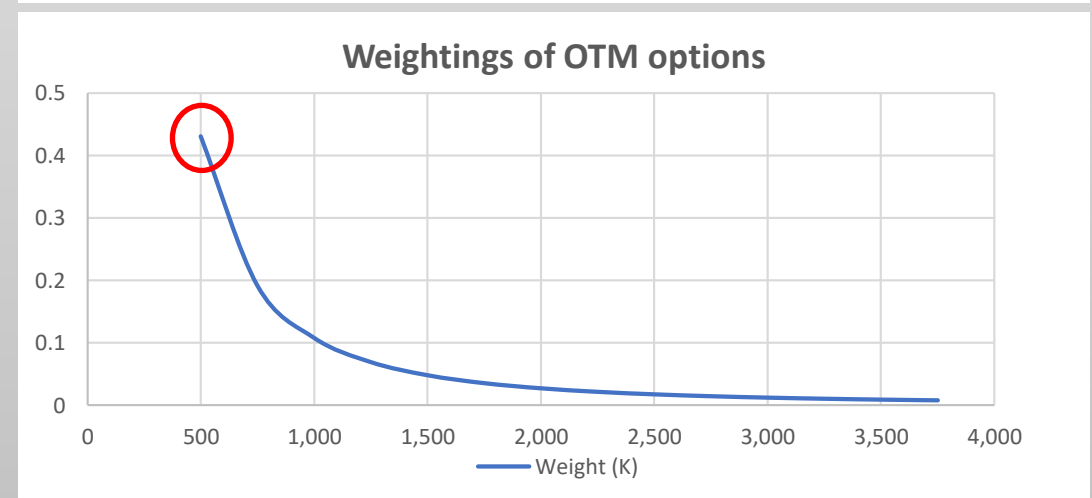
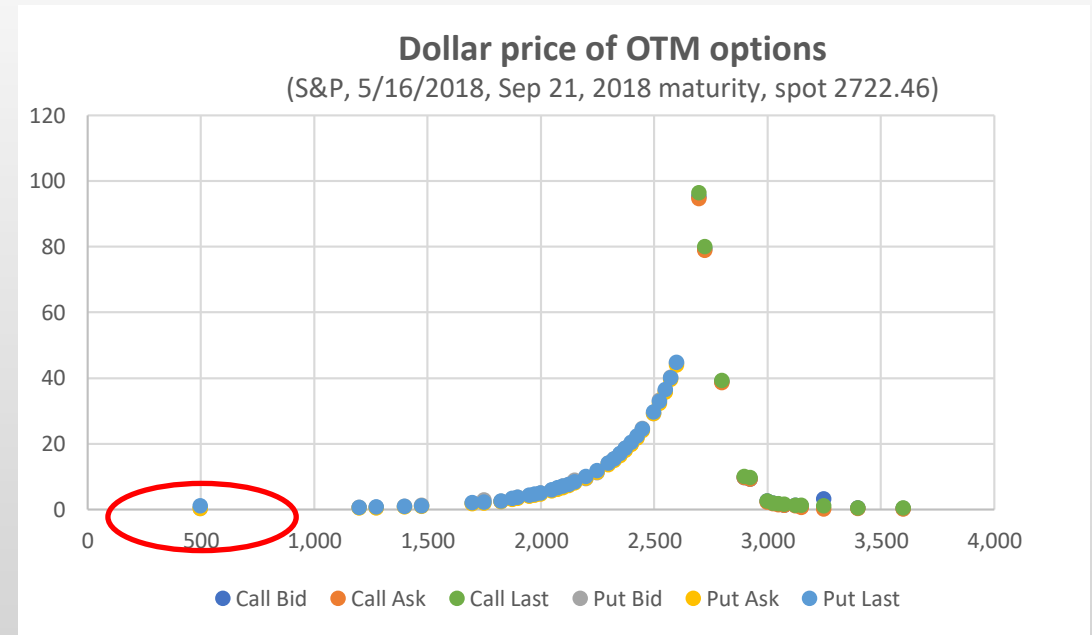


# VIX APPROACH

- 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

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

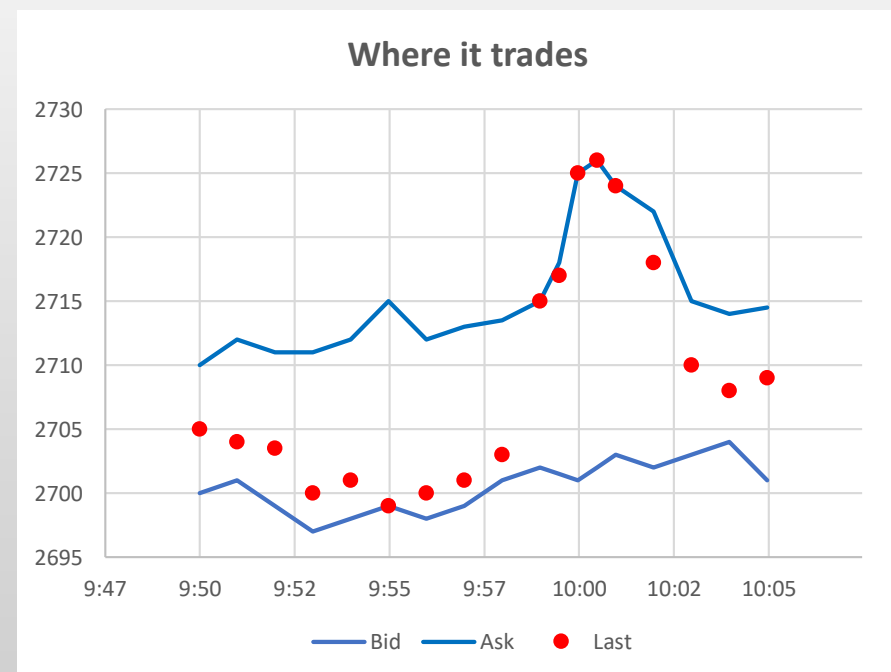
- Atypical: no trend, mean reverts, gaps/decay, illiquid, hard to trade, non replicable (SQRT)





# BENCHMARK MANIPULATION 101

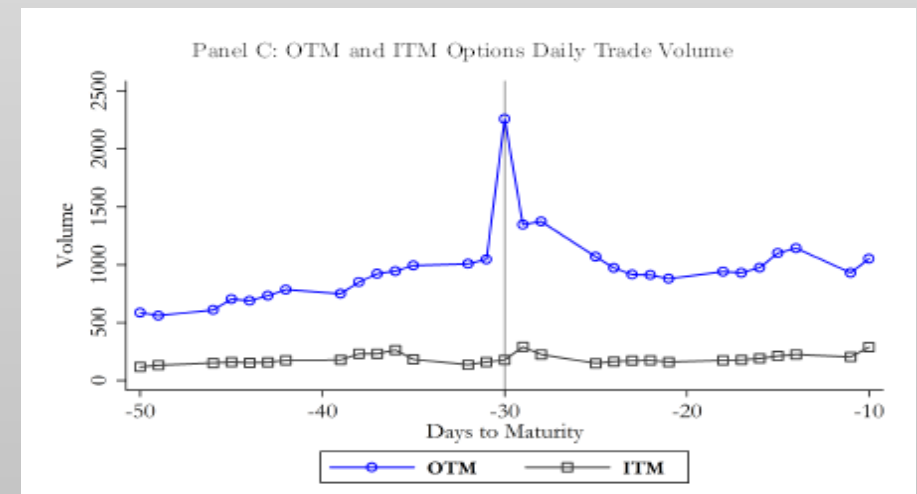
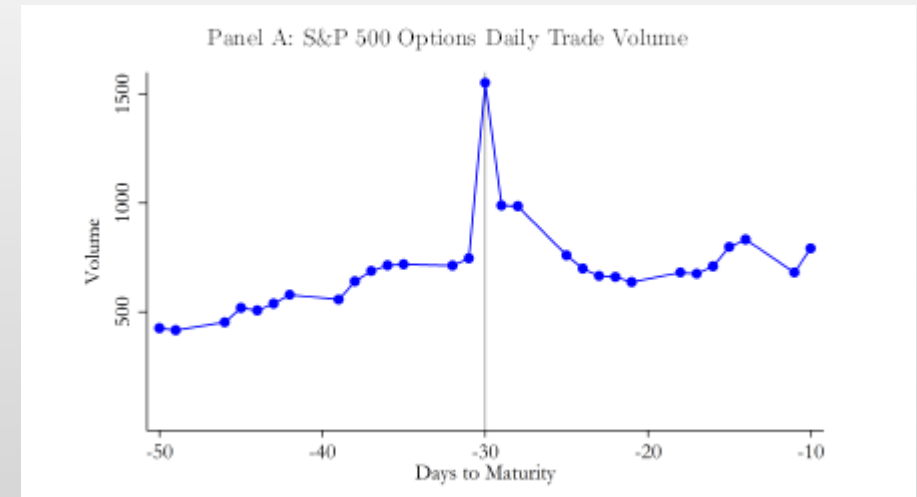
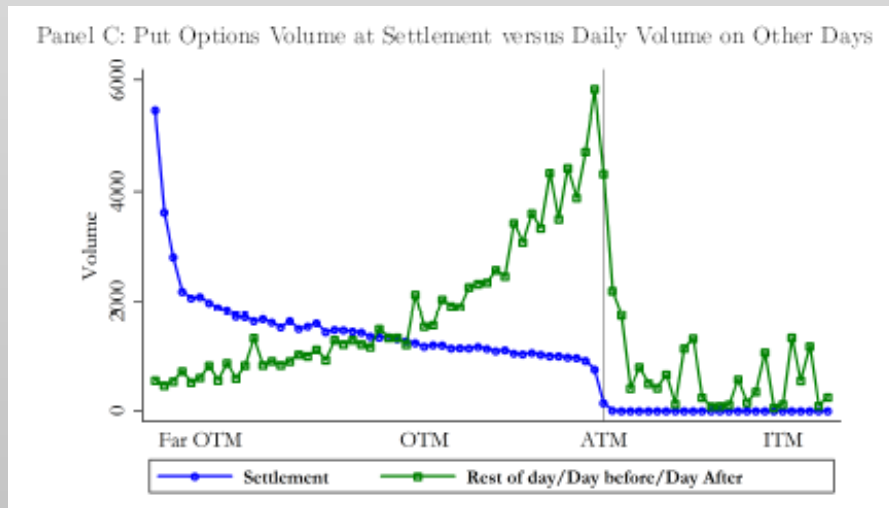
- How to make profit against a benchmark
  - Derivatives pay an asset performance between start and end
  - “Start” and “end” have to be defined precisely: when, where, how
  - Example 1: client buys a call on the MOO ETF. We will use the price on Bloomberg at 10:00 AM
  - Example 2: BNP has an option 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 3: FTSE futures EDSP = average of FTSE cash from 10:10 to 10:30, calculated every 15 seconds by exchange...
- “Liquidity management” & professionalism



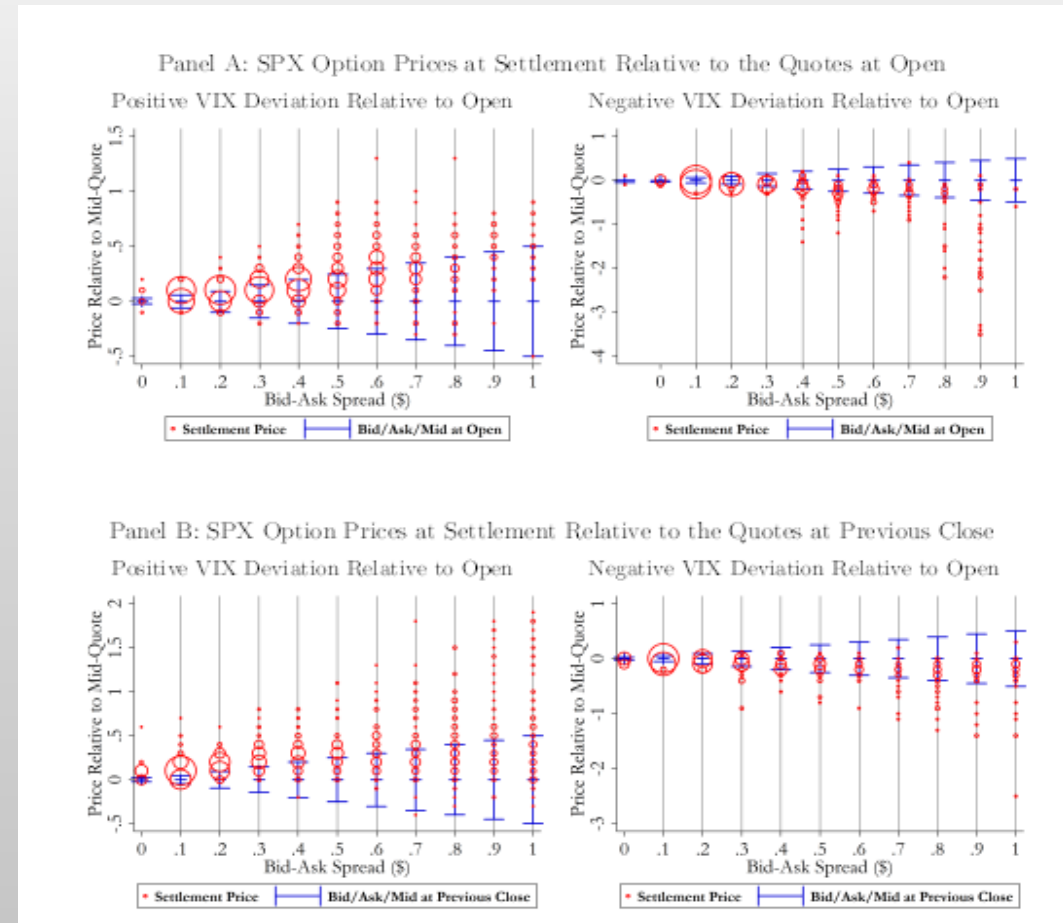
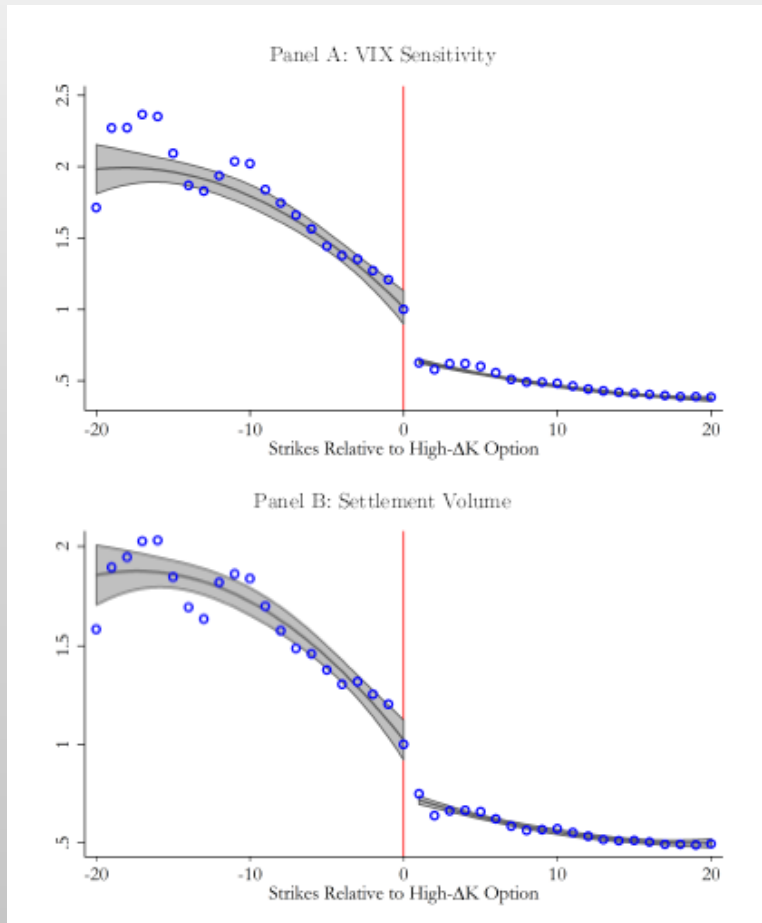
Hedge	70%	2702
	30%	2724
	aver	2708.6
Client Settlement	100%	2725
=> Profit	\$	16.4
	%	0.60%

# 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
    - CTA: large capacity, mostly trend-following or reverse, Sharpe 1.
    - Statarb: most equity markets, large diversity of approaches, Sharpe 2-3+, large capacity, crowding
    - Volatility trading: high Sharpe (5+), decent capacity, costly infrastructure, operational risks
    - HFT: high Sharpe (5+), low capacity, perform better in volatile environments, costly infrastructure

# 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, performing well
  - General banking environment:
    - Higher capital requirements, regulations, risk controls, competition for profits
    - Smaller balance sheets, margins, new wave of technologies
    - Prop trading now forbidden, 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: large silo-ed divisions / teams
  - Organization by asset classes + new cross-asset research/structuration
  - Equity: Delta One have experience in dynamic underlying
  - Equity: options and exotics have experience in complex payouts & volatility

# 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, sensitive to volatility
  - 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 back-tests 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:

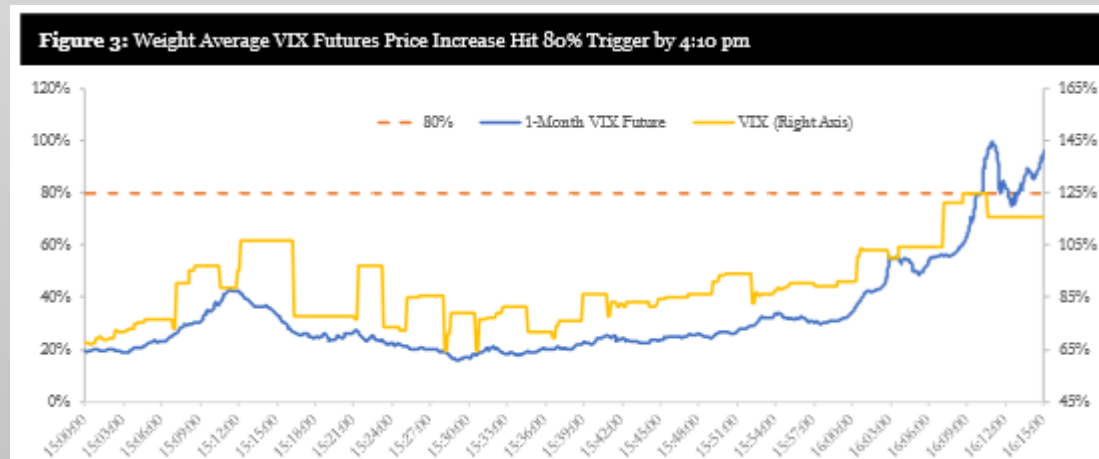
- Researchers / structurers are young, inexperienced
- Daily rehedging: can't trade VIX => futures. The bigger the move, the bigger the hedge
- Futures has limited liquidity
- Delta One traders manage ETFs, little experience in vol trading
- VIX is not a regular asset class: cash untradable, futures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

# FEBRUARY 5<sup>TH</sup>, 2018 - FACTS

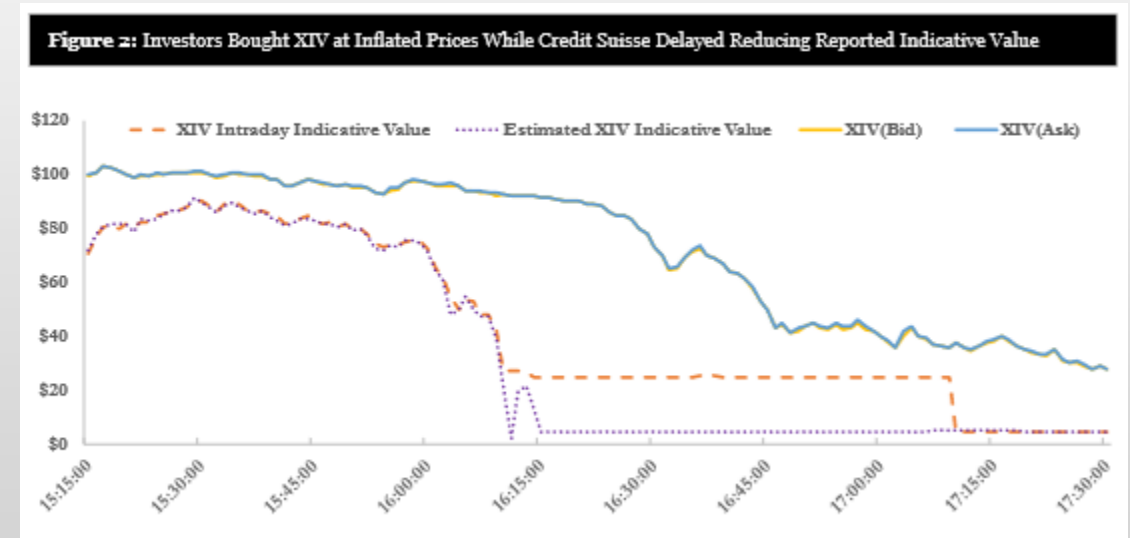
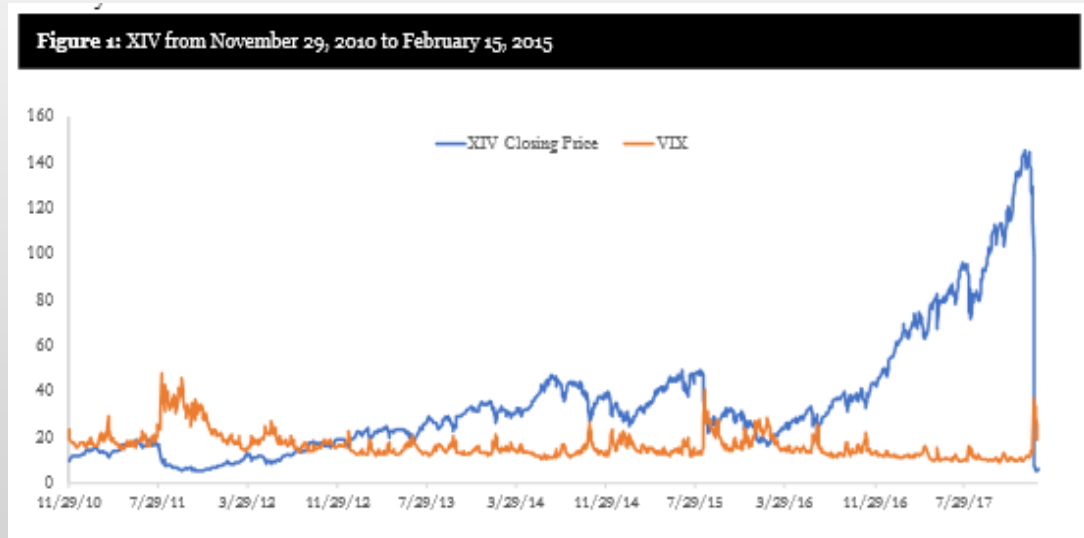
- That day:

- 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 2<sup>nd</sup>, up from February 1<sup>st</sup>) = +80% !
- Estimated ETF notional \$5bn

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



# FEBRUARY 5<sup>TH</sup>, 2018 - OUTCOMES



- \$800m of XIV exchanged after hours, at prices away from iNAV and final settlement value.
- 95% move is large and rare. Significant option losses.
- VIX calculation methodology, leverage of SXVY have been changed

# FEBRUARY 5<sup>TH</sup>, 2018 – LEGAL ISSUES

- Litigation state:
  - ~20 class actions almost over with MDL, turning two independent class actions
  - against CS/Janus, and against CBOE Exchange, HFs/Financials, John Does. LJM separate.
- Credit Suisse:
  - did not indicate correct NAV for an hour, Who is calculating agent?
  - could have suspended the XIV. Information asymmetry.
  - Rumor: CS would have pushed up the VIX. Was there manipulation? Just that day?
- Can we sell to retail products of that complexity, worthless in the long term, even with disclaimers?
- Can we sell options on such assets (Index or ETFs)? To retail? On margin?
- Who is manipulating the VIX on expiries? Major regulatory blowback to expect.
- Did the CBOE exchange know that the VIX was manipulated?
  - VIX = 30% of its revenues + secondary revenues.
  - New rules on index definition, information dissemination

# THANK YOU

**CONTACT DETAILS:**

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