



STEVENS
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Volatility as an Asset Class Update 2

MGT-411

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Overview

- Updated research question and method
- Volatility trading and dispersion overview
- Relevant Literature
- Data analysis
- Naïve Dispersion Implementation
- Index/ETN implementation potential
- Planning our next steps



Research Question and Method

Research Question: How can option volatility be used to help generate uncorrelated returns for an investor's portfolio?

Method:

1. Download option data from Bloomberg
2. Implement option volatility trading strategy (Dispersion) in Python
3. Design ETN/Index that tracks performance of strategy
4. Analyze how ETN performance can add diversification and uncorrelated returns to a variety of portfolios

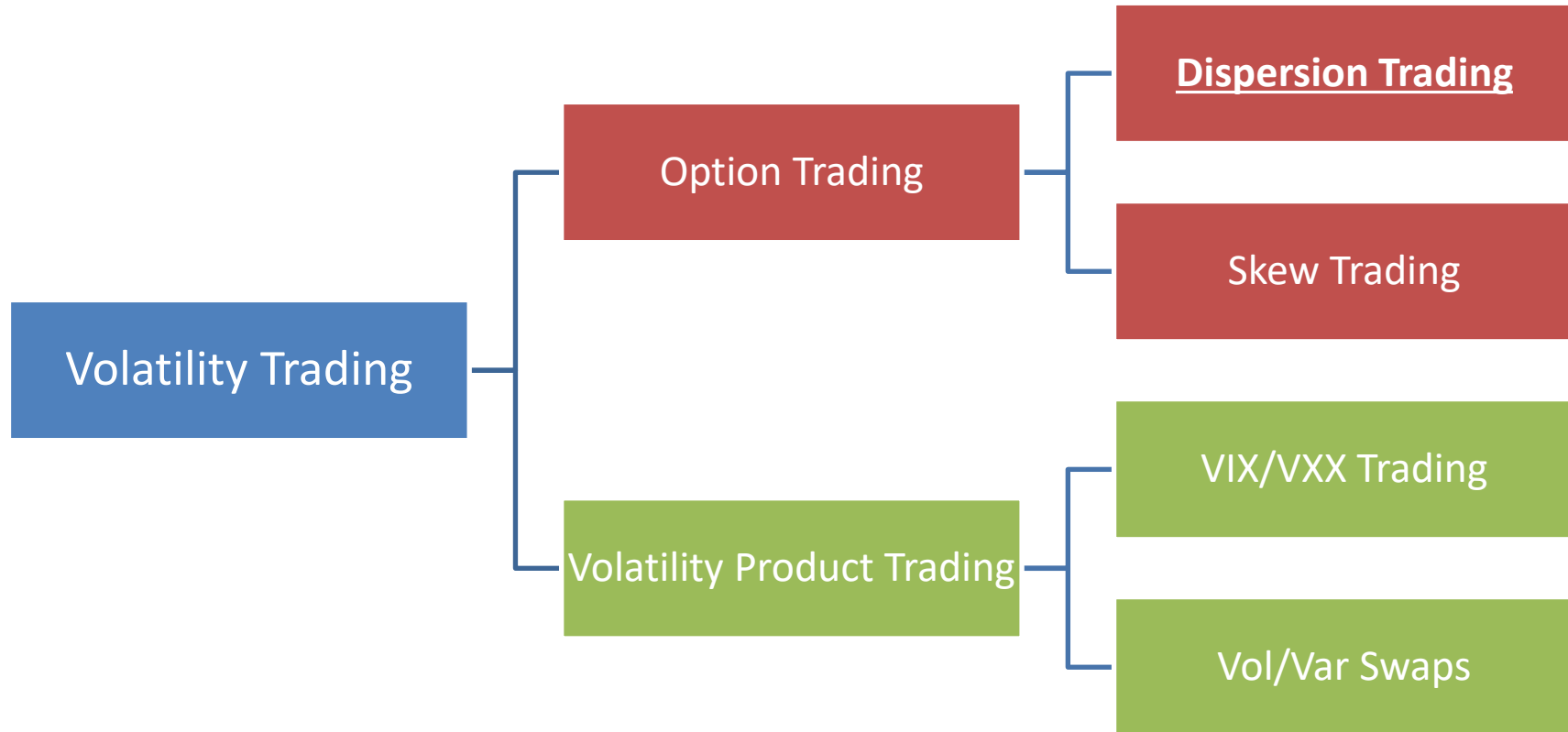


Volatility Trading Terminology

- **Volatility Trading:** Trading that involves options or direct volatility products (VIX, VXX)
- **Implied Volatility (IV):** The market's forecast of a security's volatility derived from option prices
- **Straddle:** Option trade that is long both a call and a put (bet that volatility will be high)
- **Dispersion Trading:** Strategy used to exploit difference between the implied volatility of index options and the index's constituents
 - Strategy is to short straddles on the leg (either index options or constituent options) that has elevated implied volatility and long straddles on the other leg
 - **Index Constituents:** Can refer to either the individual stocks in an index or the overall sectors
 - **Example:**
 - **Index:** SPY
 - **Constituents:** SPDR Sector ETFs (XLK, XLV, XLU, etc.)

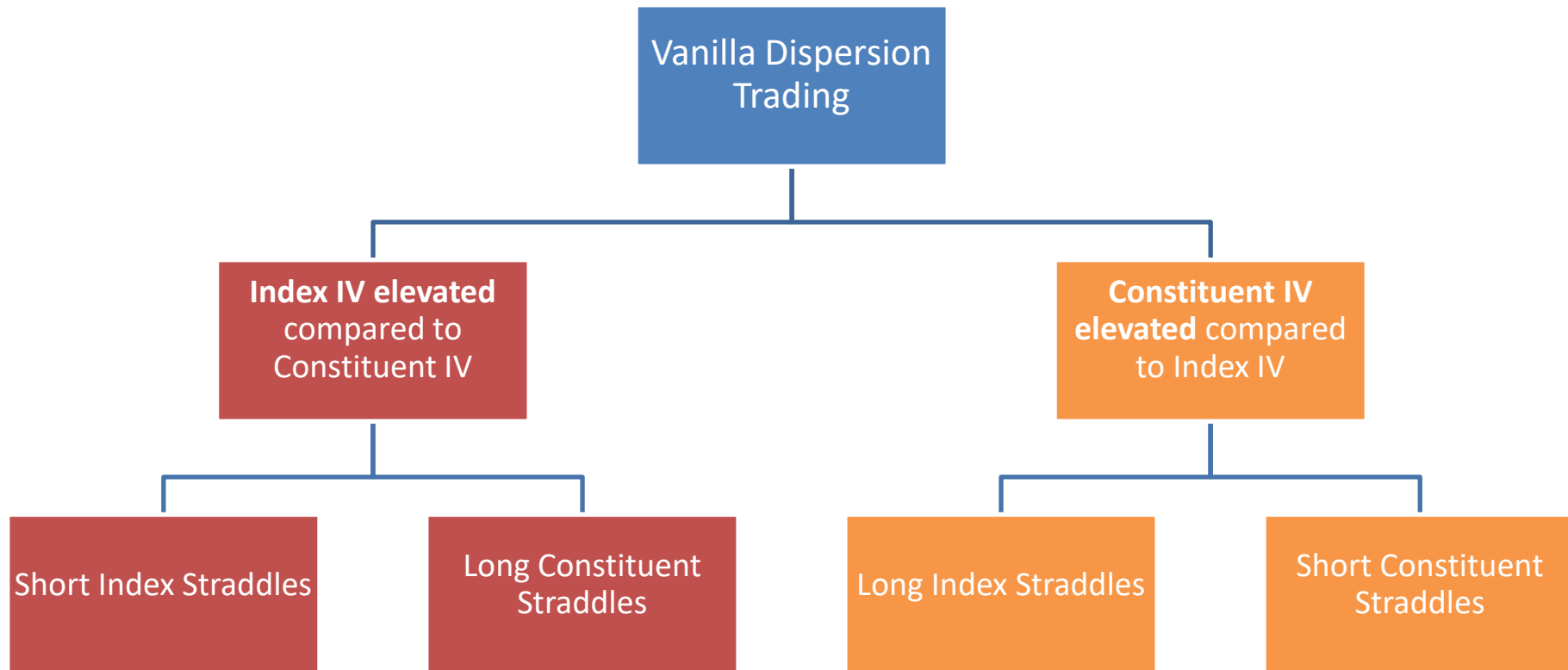


Volatility Trading





Dispersion Trading

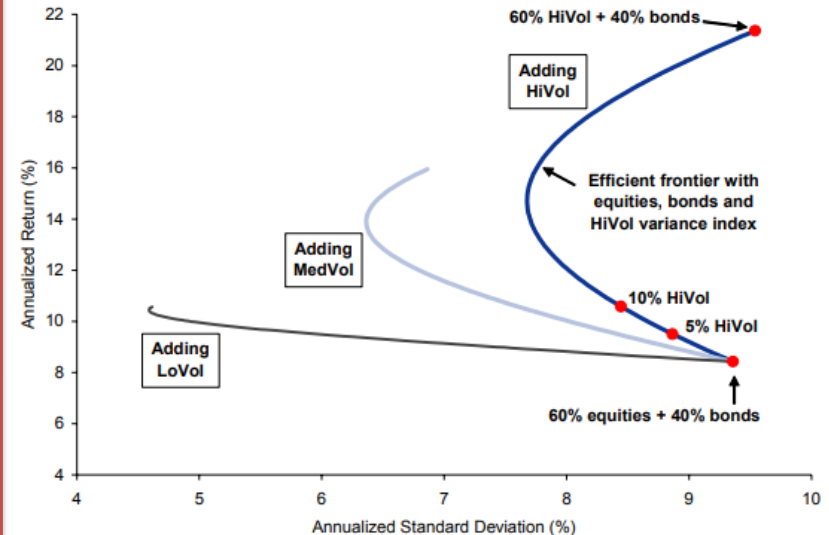




Literature Overview: Volatility as an Asset Class

Goldman Sachs, Stoxx Limited, and Allianz

- **Goldman Sachs: Volatility as an Asset**
 - Explains how equity volatility meets the definition of an asset class and can be used for asset allocation.
- **Stoxx Limited: Volatility as an Asset Class**
 - Stoxx is a European Global Index Provider.
 - Negative correlations between volatility and traditional investments can be used to smoothen investor returns across business cycle.
- **Allianz Global Investors: Volatility as an Asset Class**
 - Created VPT index that tracks selling volatility via variance swaps to give investors access to vol as an asset class.
 - We will expand on Allianz's model to create our own ETF.



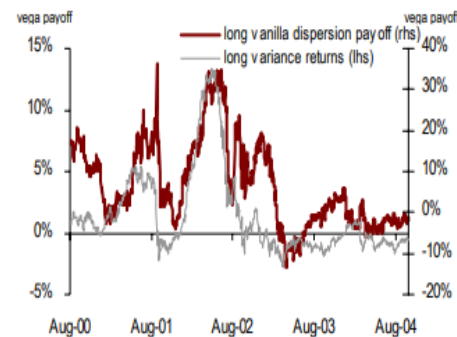
- Goldman Sachs illustrated how selling index volatility can shift the efficient frontier of a bond, equity, and volatility portfolio.
- Returns were large enough to justify a nontrivial allocation into the strategy.
- This is just from being short vol but serves as a proof of concept for what we are doing.

Literature Overview: Dispersion Trading

Academic Studies, JP Morgan, and Pine River Capital Management

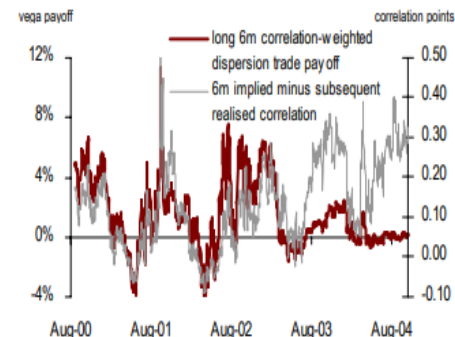
- **Qiang Deng: Volatility Dispersion Trading**
 - Builds a naïve dispersion model and expands on model by including hedging, correlation, and PCA.
 - Paper attempts to explain where dispersion profits are derived from.
- **JP Morgan: Correlation Vehicles**
 - Expands on vanilla dispersion to include correlation weighted trades.
- **Pine River Capital Management: Correlations Between Stocks and Between Sectors**
 - Hedge fund presents way to implement dispersion trade.
 - Analyzes implied correlation relationships and weights trade vega-neutral at the start.

Figure 3: vanilla dispersion payoff is closely related to long variance returns ...



Source: JPMorgan

Figure 4: ... whereas the correlation-weighted dispersion payoff is more related to correlation



Source: JPMorgan

- JP Morgan weights dispersion trades vega-neutral at the start.
- Vega-neutral enables trader to capitalize on incorrect correlation pricing.
- Optimal entry point of trade is found by looking at difference between average single-stock volatility and index volatility.

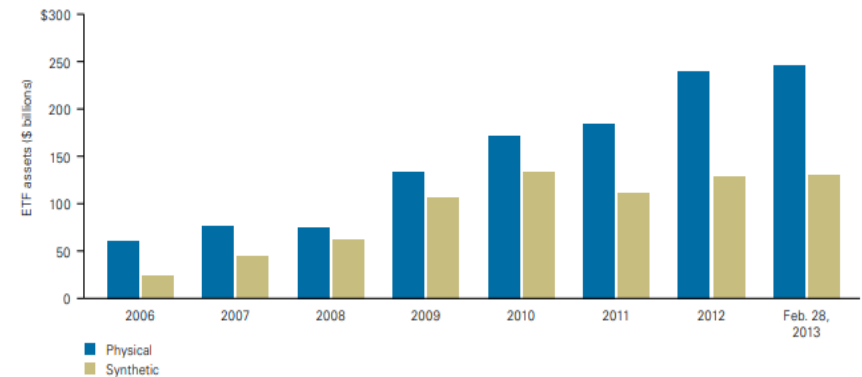


Literature Overview: Sources

Other Sources Used

- **Colin Bennett: Trading Volatility**
 - Textbook that introduces various option vol trading strategies
- **Juan Bueno: S&P Skew Trading**
 - Analyzes strike-volatility relationships to make trades
- **Vanguard: Understanding Synthetic ETFs**
 - Outlines synthetic ETFs and risks to be weary of as an investor
- **Christophe Hurlin: Counterparty Risk Exposure of ETF Investors**
 - Analyze how synthetic ETFs subject investors to their own counterparty risk

Figure 2. Growth of ETFs in Europe, by ETF structure (\$ billions)



- Vanguard emphasizes growth of ETFs in the 21st century
- ETFs and ETNs have become the most popular way to implement alternative strategies



Data Overview

Current Collection Process

- Collecting 3-month at-the-money option data from Bloomberg
 - Using Python script to communicate with Excel Add-in
 - Strikes are based on underlying price 3-months before expiration
- Interpolating missing option data with Black-Scholes
 - Using average implied volatility for sigma input
 - Data points at expiration are filled with expiration values
 - Interpolation only used for analysis of paths
- Solving for implied volatility using secant method
- Moving Forward:
 - Need unadjusted stock prices for individual stock options



Data Collection

Python Script

- We have a Python script that can create an Excel file we can use to download any option data in Bloomberg
- Collecting 3-month at-the-money option prices for SPDR ETFs

```
In [1]: 1 import os
        2 from excelGen import excelOption

c:\users\gregg\appdata\local\programs\python\python38-32\lib\site-packages\pandas_datareader\compat\__init__.py:7: FutureWarning: pandas.util.testing is deprecated. Use the functions in the public API at pandas.testing instead.
  from pandas.util.testing import assert_frame_equal
```

```
In [2]: 1 tickers = ["SPY", "XLK", "MSFT"]
        2 start_date = "2015-01-01"
        3 end_date = None
        4
        5 data = excelOption(tickers, start_date, end_date)
        6
        7 bloomberg_functions = data.generateData()
        8
        9 bloomberg_functions["SPY"]
```

```
Out[2]:
```

	SPY 3/20/15 C205	SPY 4/17/15 C201	SPY 5/15/15 C211	SPY
0	=BDH("SPY 3/20/15 C205 Equity", "PX_LAST", 20150...	=BDH("SPY 4/17/15 C201 Equity", "PX_LAST", 20150...	=BDH("SPY 5/15/15 C211 Equity", "PX_LAST", 20150...	=BDH("SPY Equity", "PX_L



Data

Bloomberg Excel Data

- When Excel file generated in Python is opened with Bloomberg Excel Add-In, historical option data for all tickers is generated
- We can then save this data to our machines locally with all data points

=BDH("SPY 3/20/15 C205 Equity","PX_LAST",20150102,20150320,"cols=2;rows=54")									
B	C	D	E	F	G	H	I	J	
SPY 3/20/15 C205		SPY 4/17/15 C201	SPY 5/15/15 C211		SPY 6/19/15 C205		SPY 7/17/15 C210		
1/2/2015	5.72	2/2/2015	6.53	3/2/2015	4.86	4/1/2015	6.15	5/1/2015	
1/5/2015	4.15	2/3/2015	7.77	3/3/2015	4.37	4/2/2015	6.39	5/4/2015	
1/6/2015	3.45	2/4/2015	7.25	3/4/2015	3.89	4/6/2015	7.12	5/5/2015	
1/7/2015	4.31	2/5/2015	8.7	3/5/2015	3.98	4/7/2015	6.8	5/6/2015	
1/8/2015	5.84	2/6/2015	8.39	3/6/2015	2.72	4/8/2015	6.91	5/7/2015	
1/9/2015	4.85	2/9/2015	7.76	3/9/2015	2.98	4/9/2015	7.4	5/8/2015	
1/12/2015	4.4	2/10/2015	9.01	#####	1.77	#####	8	#####	
1/13/2015	4.19	2/11/2015	8.74	#####	1.72	#####	7.5	#####	
1/14/2015	3.6	2/12/2015	10.03	#####	2.45	#####	7.3	#####	
1/15/2015	2.9	2/13/2015	10.72	#####	1.95	#####	8.19	#####	
1/16/2015	3.84	2/17/2015	10.98	#####	2.84	#####	8.14	#####	



XLK 3/20/15, Strike: \$41



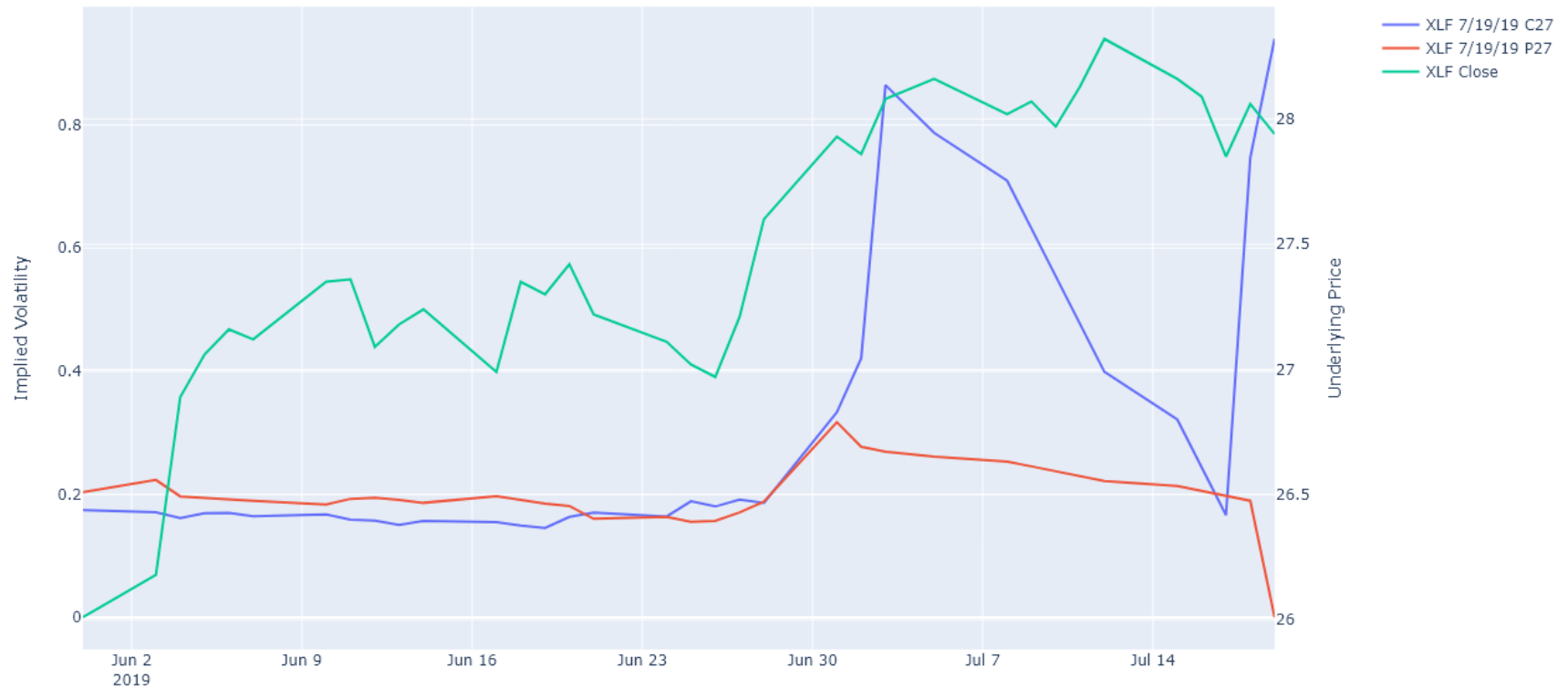


SPY 10/16/20, Strike: \$328



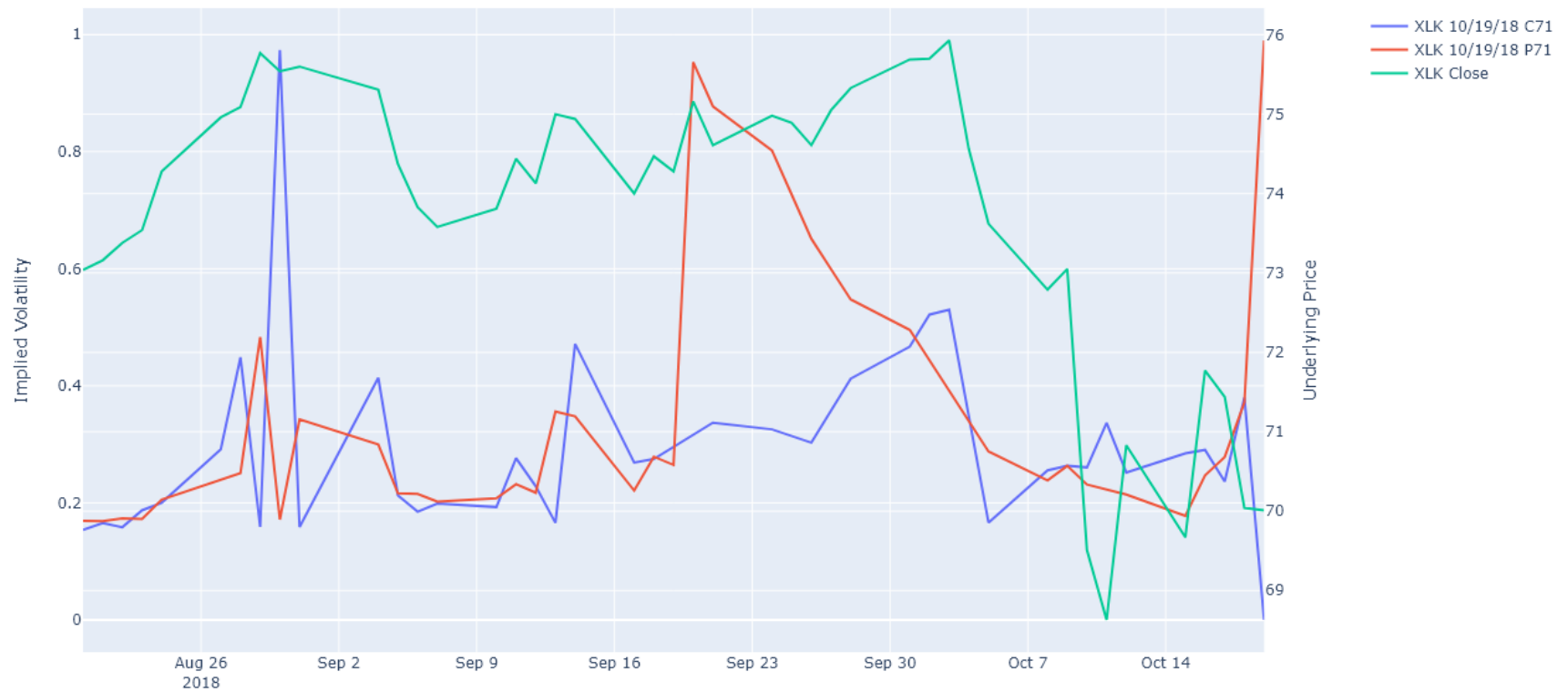


Implied Volatility XLF 7/19/19, Strike: \$27





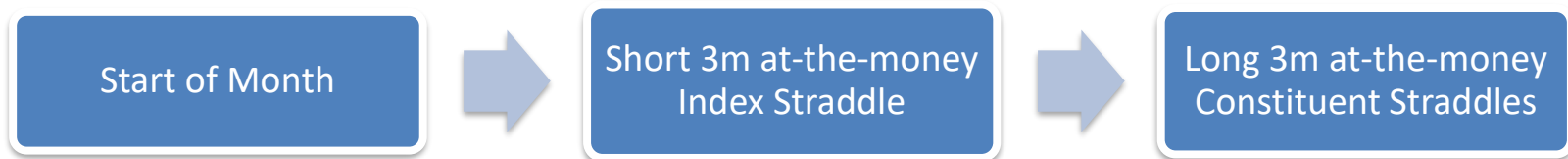
Implied Volatility XLK 10/19/18, Strike: \$71



Naïve Dispersion Implementation

Vanilla Weighting

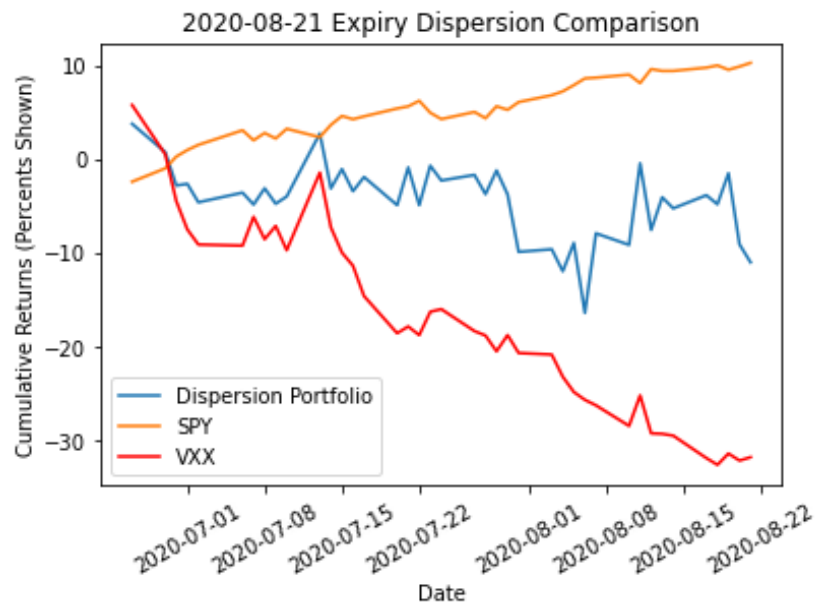
- Following Deng's model with slight variation:



- **Index:** SPY
- **Constituents:** XLK, XLF, XLY, XLV, XLI (SPDR Sector ETFs)
 - Weight constituent straddles based on the sector weights of the S&P 500
- **Amount of capital in long and short leg should be approximately equal**
- Naïve strategy includes no hedging or volatility analysis

Naïve Dispersion Initial Results

- Corrections need to be made for identifying at-the-money options
- Basic results from running naïve strategy since 2015



Metric	Value
Annual Return	12%
Annual Vol	30%
Correlation SPY	-40%
Correlation VIX	50%



Expanding Dispersion Implementation

Utilize Implied Correlation and Hedging

- Dispersion trades make implicit bets on correlation
 - Find areas of elevated/low implied correlation
 - **If implied correlation is high, index variance will be inflated** (make trade accordingly)
- Delta hedge throughout life of trade
 - We want protection from underlying security movements
- Weight trade as **vega** neutral at start
 - Gain more exposure to correlation moves (JP Morgan)
 - Vega neutrality is reached by properly weighting constituent legs

Index Variance

$$\sigma_I^2 = \sum_{i=1}^N \omega_i^2 \sigma_i^2 + 2 \sum_{i=1}^N \sum_{j>i} \omega_i \omega_j \sigma_i \sigma_j \rho_{ij}$$

Implied Avg. Correlation

$$\bar{\rho} = \frac{\sigma_I^2 - \sum_{i=1}^N \omega_i^2 \sigma_i^2}{2 \sum_{i=1}^N \sum_{j>i} \omega_i \omega_j \sigma_i \sigma_j}$$



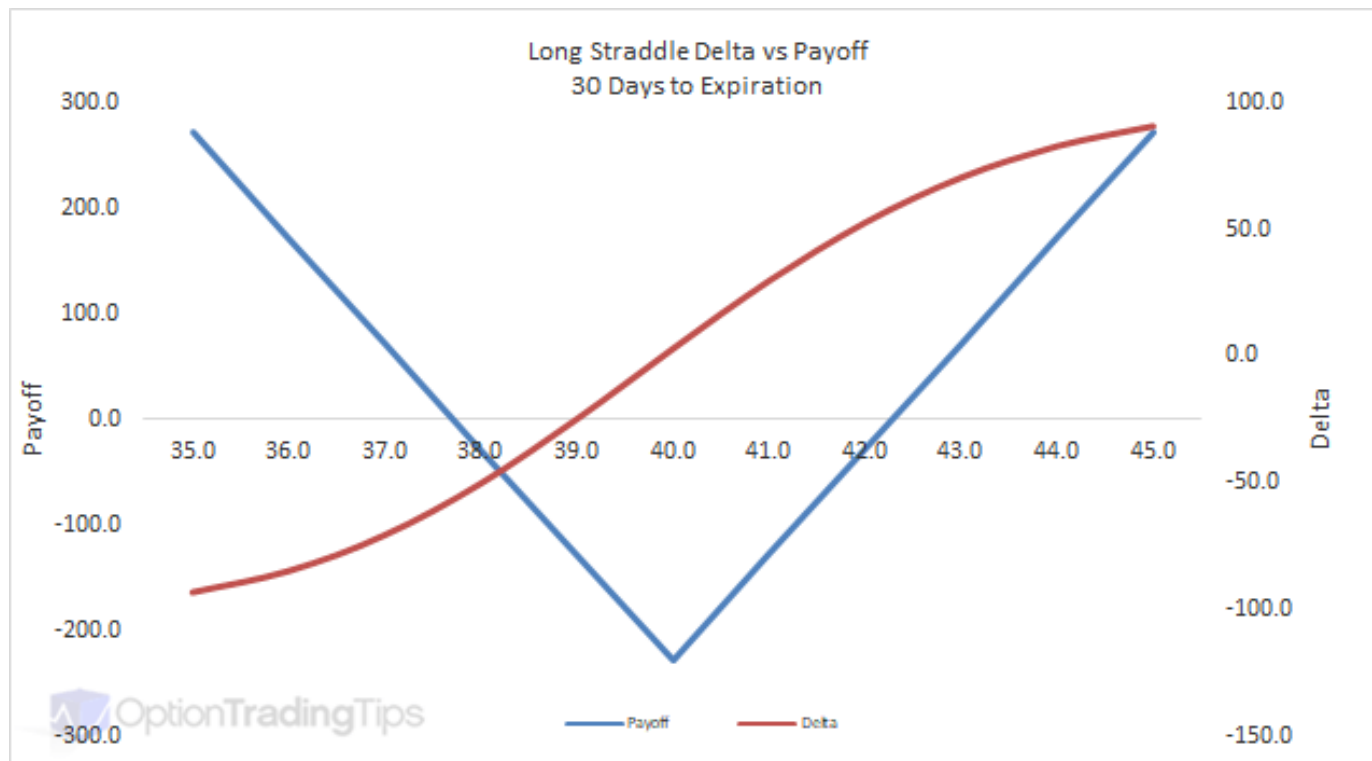
Example Trade Fill

- **Source:** Pine River Capital Management
 - CBOE Risk Management Conference

TICKER	SECURITY DESCRIPTION	OPTION TICKER	SHARE QUANTITY	BID	ASK	FILL	LIQUIDITY COST	PREMIUM	DELTA %	DELTA	GAMMA	VEGA
SPY US	SPDR S&P 500 ETF Trust	SPY US 09/18/15 C200.5	-1,162,600	1.46	1.48	1.46	-\$23,252	-\$1,697,396	43.20%	-\$100,694,040	-\$45,410,219	-\$51,768
		SPY US 09/18/15 P200.5	-840,000	2.45	2.50	2.42	-\$42,000	-\$2,032,800	-59.07%	\$99,470,387	-\$28,063,195	-\$37,543
XLY US	Consumer Discretionary	XLY US 09/18/15 C77	366,800	0.58	0.63	0.55	-\$18,340	\$201,740	46.79%	\$13,228,478	\$5,655,019	\$6,348
	Select Sector SPDR Fund	XLY US 09/18/15 P77	304,700	0.72	0.83	0.83	-\$33,517	\$252,901	-55.38%	-\$13,005,896	\$4,377,957	\$5,397
XLP US	Consumer Staples	XLP US 09/18/15 C48	423,000	0.27	0.32	0.23	-\$21,150	\$99,405	48.39%	\$9,841,595	\$6,443,189	\$4,145
	Select Sector SPDR Fund	XLP US 09/18/15 P48	334,000	0.46	0.50	0.50	-\$13,360	\$167,000	-59.58%	-\$9,569,047	\$3,334,449	\$3,613
XLE US	Energy Select Sector	XLE US 09/18/15 C65.5	219,300	0.58	0.65	0.46	-\$15,351	\$99,782	49.45%	\$7,124,925	\$3,022,086	\$3,003
	SPDR Fund	XLE US 09/18/15 P65.5	186,500	0.84	0.87	0.87	-\$5,595	\$162,255	-55.82%	-\$6,839,427	\$1,797,335	\$2,705
XLF US	Financial Select Sector	XLF US 09/18/15 C23.5	1,366,800	0.26	0.28	0.19	-\$27,336	\$258,325	52.17%	\$16,822,807	\$5,405,050	\$7,098
	SPDR Fund	XLF US 09/18/15 P23.5	1,382,300	0.27	0.28	0.28	-\$13,823	\$387,044	-50.26%	-\$16,388,613	\$4,553,658	\$7,657
XLV US	Health Care Select	XLV US 09/18/15 C72	524,500	0.44	0.47	0.47	-\$15,735	\$246,515	40.68%	\$15,331,298	\$7,101,050	\$8,139
	Sector SPDR Fund	XLV US 09/18/15 P72	352,200	0.84	0.88	0.73	-\$14,088	\$257,106	-60.52%	-\$15,315,303	\$4,494,241	\$5,739
XLI US	Industrial Select Sector	XLI US 09/18/15 C52.5	412,600	0.37	0.44	0.36	-\$28,882	\$148,495	48.59%	\$10,541,208	\$5,261,562	\$4,675
	SPDR Fund	XLI US 09/18/15 P52.5	336,100	0.52	0.61	0.61	-\$30,249	\$205,021	-55.82%	-\$9,864,838	\$3,127,375	\$4,084
XLK US	Technology Select	XLK US 09/18/15 C41	1,446,200	0.21	0.27	0.27	-\$86,772	\$390,474	38.28%	\$22,634,800	\$11,057,421	\$12,938
	Sector SPDR Fund	XLK US 09/18/15 P41	878,000	0.50	0.56	0.45	-\$52,680	\$395,100	-61.93%	-\$22,231,979	\$6,079,051	\$7,785
XLB US	Materials Select Sector	XLB US 09/18/15 C43.5	189,000	0.23	0.28	0.28	-\$9,450	\$52,920	37.15%	\$3,043,104	\$1,485,767	\$1,656
	SPDR Fund	XLB US 09/18/15 P43.5	104,500	0.60	0.75	0.59	-\$15,675	\$61,655	-62.90%	-\$2,848,625	\$652,885	\$974
XLU US	Utilities Select Sector	XLU US 09/18/15 C42.5	130,700	0.33	0.39	0.28	-\$7,842	\$36,596	52.01%	\$2,899,957	\$1,451,379	\$1,149
	SPDR Fund	XLU US 09/18/15 P42.5	117,900	0.50	0.70	0.59	-\$23,580	\$69,561	-57.43%	-\$2,888,370	\$711,026	\$1,146
TOTALS			11,077,700				-\$498,677	-\$238,302		\$1,292,420	\$2,537,085	-\$1,060

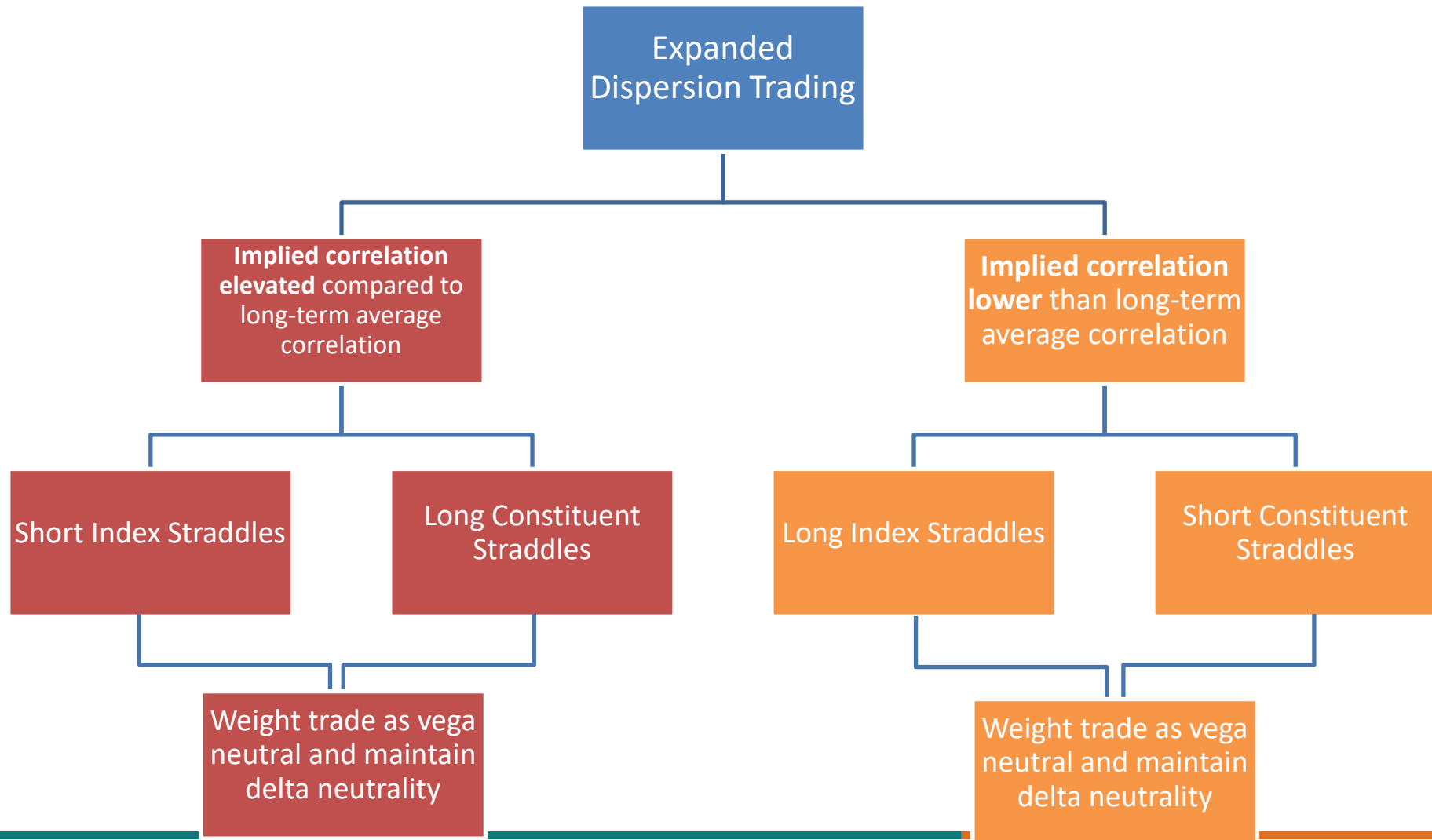
Delta of Straddles

- Throughout life of each straddle, must maintain delta neutrality by buying/selling underlier





Expanded Dispersion Visual





ETN/Index Analysis

Exchange Traded Notes

Exchange Traded Notes (ETNs)

- Want to make research accessible to investors
 - Plan to create ETN that will capture volatility as an asset
- **ETN:** unsecured debt obligations that seek to track the return of an underlying index or benchmark, net fees
 - Question: What benchmark should we reference?
- ETNs do not carry a NAV like ETFs, rather they are valued based on their indicative value, an approx. of its intrinsic value
- Look to track our total returns and calculate value based on that
- ETNs also have maturity and can be redeemed, seems to differ between various ETNs, **need further research**

Why not ETFs?

- We'd be looking to create a synthetic ETF
- Returns would be guaranteed by a counterparty
- These were effectively banned in the US
- "starting in 2010, the U.S. Securities and Exchange Commission has not allowed the launch of new synthetic ETFs, unless an asset manager was already sponsoring synthetic ETFs before 2010"
- Synthetic ETFs are still a popular option in Europe and Asian markets, we could continue to test out our option ETF following their guidelines

Synthetic ETF Examples

Following UCITS (Euro) Guidelines

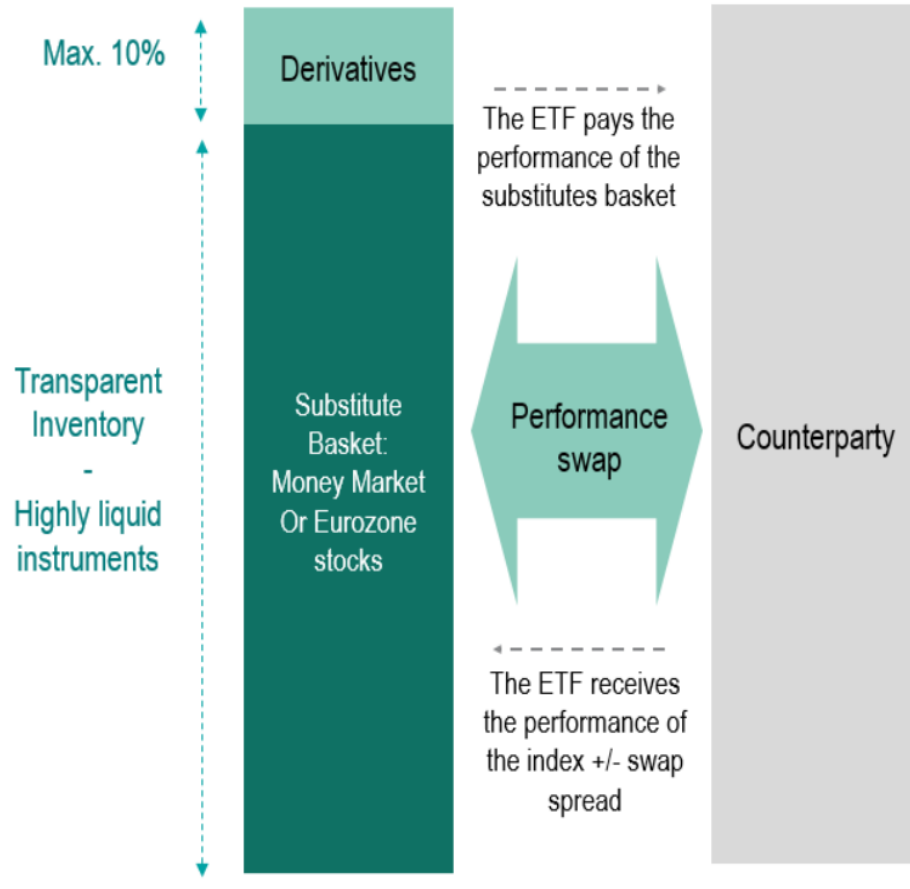


Figure 11. Counterparty exposure and swap reset example

Day	Index value	Collateral basket value	ETF gain/loss	Counterparty exposure (%)
1	\$100	\$100	\$0	0.0
2	104	100	4	3.8
3	107	104	3	2.8
4	103	104	-1	-1.0
5 (end)	111	101	10	9.0
6 (start)	111	111	0	0.0

Note: This hypothetical example does not represent the return on any particular investment. It assumes swap reset at 9% counterparty exposure.

Source: Vanguard.



Outlook

Next Steps and Risks/Questions

Next Steps

- Continue to backtest dispersion trading
 - Elaborate our current results and continue to test various periods
 - Expand on naïve strategy to include correlation and hedging
- Further data collection
 - Add in option volume data
 - Incorporate unadjusted stock volume data
 - Work on missing data
- Continue research
 - ETN structure, fees, further examples
 - Underlying index that it tracks
 - Skew trading, VIX trading, vol/var swaps

Risks and Questions

- Is the ETN path viable?
- How to interpolate option data without compromising strategy?
- Do we begin exploring other strategies and compile the results into one portfolio/ETN?



Conclusion

- Refined methodology for implementing volatility as an asset class
 - Use of ETN for investor portfolios
- Data collection method nearly completed
 - Method needs refinement to ensure options are at-the-money
- Successfully implement naïve dispersion model
 - Basic model will make expanding much easier
- Must continue to research ETN viability and work through data speed bumps