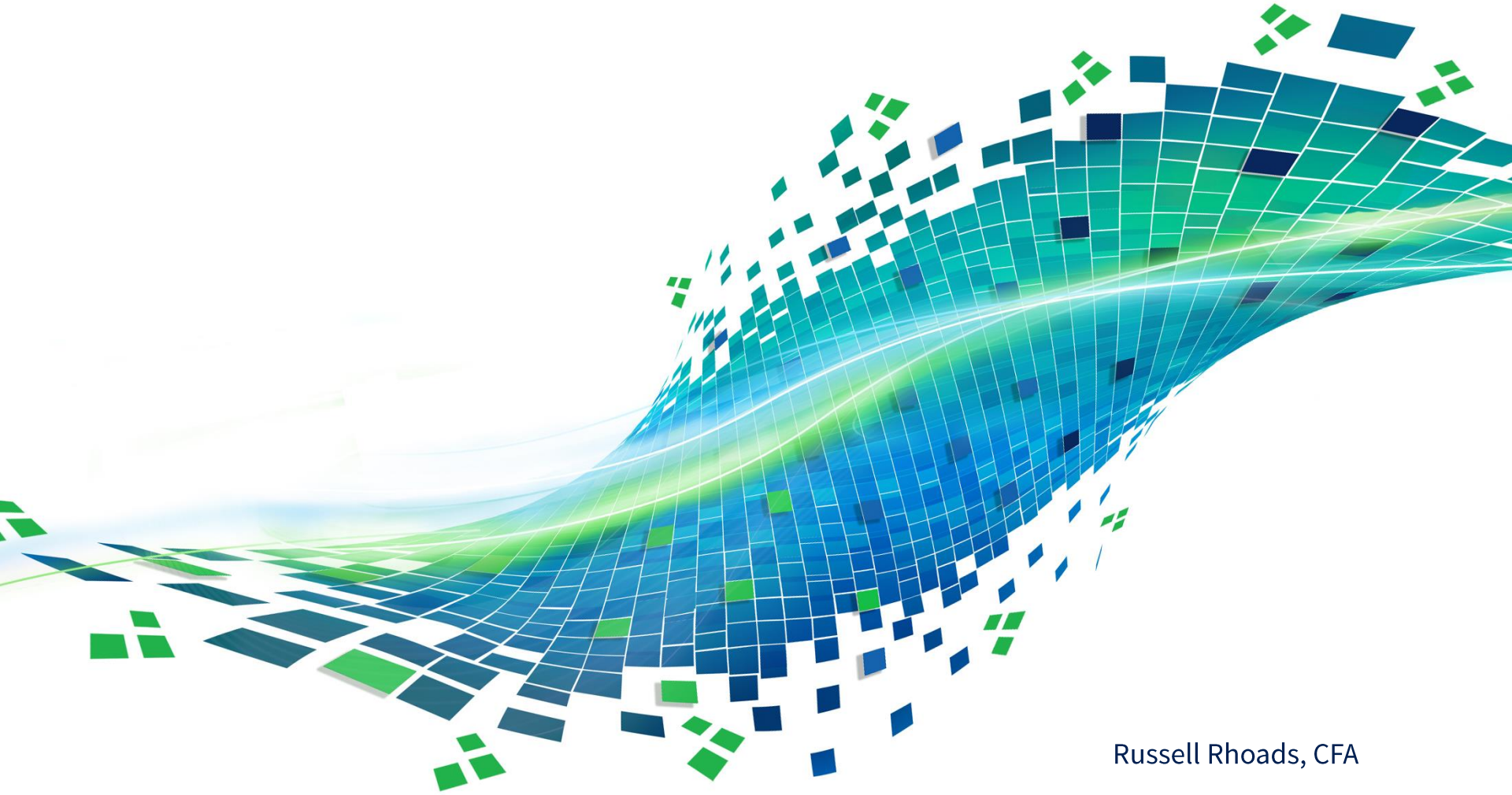
New Developments in Options and Volatility Benchmarks and Indicators



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November 9, 2017

Forward Looking Statements

This presentation contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995 that involve a number of risks and uncertainties. You can identify these statements by forward-looking words such as “may,” “might,” “should,” “expect,” “plan,” “anticipate,” “believe,” “estimate,” “predict,” “potential” or “continue,” and the negative of these terms and other comparable terminology. All statements that reflect our expectations, assumptions or projections about the future other than statements of historical fact are forward-looking statements. These forward-looking statements, which are subject to known and unknown risks, uncertainties and assumptions about us, may include projections of our future financial performance based on our growth strategies and anticipated trends in our business. These statements are only predictions based on our current expectations and projections about future events. There are important factors that could cause our actual results, level of activity, performance or achievements to differ materially from those expressed or implied by the forward-looking statements.

We operate in a very competitive and rapidly changing environment. New risks and uncertainties emerge from time to time, and it is not possible to predict all risks and uncertainties, nor can we assess the impact of all factors on our business or the extent to which any factor, or combination of factors, may cause actual results to differ materially from those contained in any forward-looking statements.

Some factors that could cause actual results to differ include: the loss of our right to exclusively list and trade certain index options and futures products; economic, political and market conditions; compliance with legal and regulatory obligations; price competition and consolidation in our industry; decreases in trading volumes, market data fees or a shift in the mix of products traded on our exchanges; legislative or regulatory changes; increasing competition by foreign and domestic entities; our dependence on and exposure to risk from third parties; our index providers’ ability to maintain the quality and integrity of their indexes and to perform under our agreements; our ability to operate our business without violating the intellectual property rights of others and the costs associated with protecting our intellectual property rights; our ability to attract and retain skilled management and other personnel, including those experienced with post-acquisition integration; our ability to accommodate trading volume and transaction traffic, including significant increases, without failure or degradation of performance of our systems; our ability to protect our systems and communication networks from security risks, including cyber-attacks and unauthorized disclosure of confidential information; challenges to our use of open source software code; our ability to meet our compliance obligations, including managing potential conflicts between our regulatory responsibilities and our for-profit status; damage to our reputation; the ability of our compliance and risk management methods to effectively monitor and manage our risks; our ability to manage our growth and strategic acquisitions or alliances effectively; unanticipated difficulties or expenditures relating to the acquisition of Bats Global Markets, Inc., including, without limitation, difficulties that result in the failure to realize expected synergies, accretion, efficiencies and cost savings from the acquisition within the expected time period (if at all), whether in connection with integration, migrating trading platforms, broadening distribution of product offerings or otherwise; restrictions imposed by our debt obligations; our ability to maintain an investment grade credit rating; potential difficulties in our migration of trading platforms and our ability to retain employees as a result of the acquisition; and the accuracy of our estimates and expectations. More detailed information about factors that may affect our actual results to differ may be found in our filings with the SEC, including in our Annual Report on Form 10-K for the year ended December 31, 2016 and other filings made from time to time with the SEC.

We do not undertake, and we expressly disclaim, any duty to update any forward-looking statement whether as a result of new information, future events or otherwise, except as required by law. Readers are cautioned not to place undue reliance on these forward-looking statements, which speak only as of the date hereof.

Footnotes applied here

Using Options Benchmarks & Volatility Indicators

As measures of investor sentiment…

- VIX®, Implied Correlation and SKEW℠ Indexes provide a robust view of expected risk based on option prices

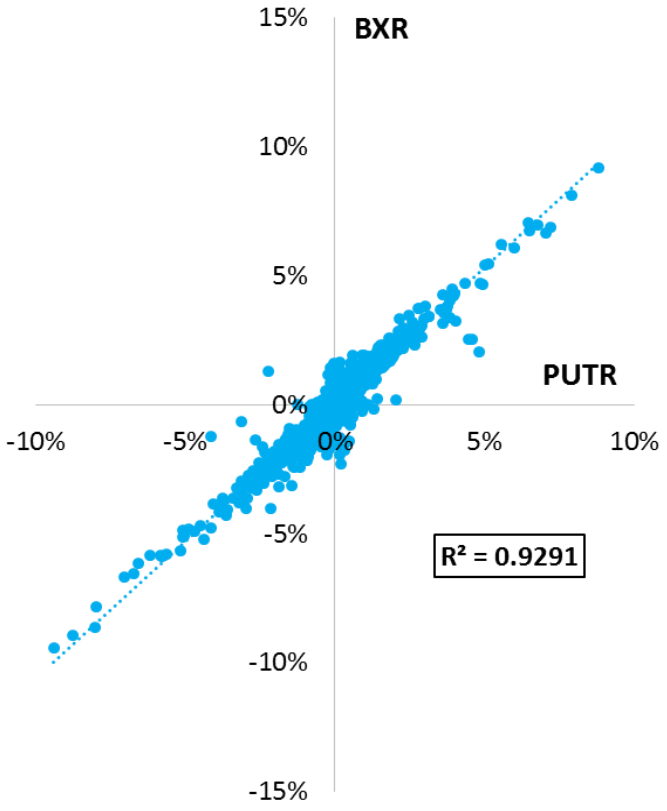
As the basis for investment strategies…

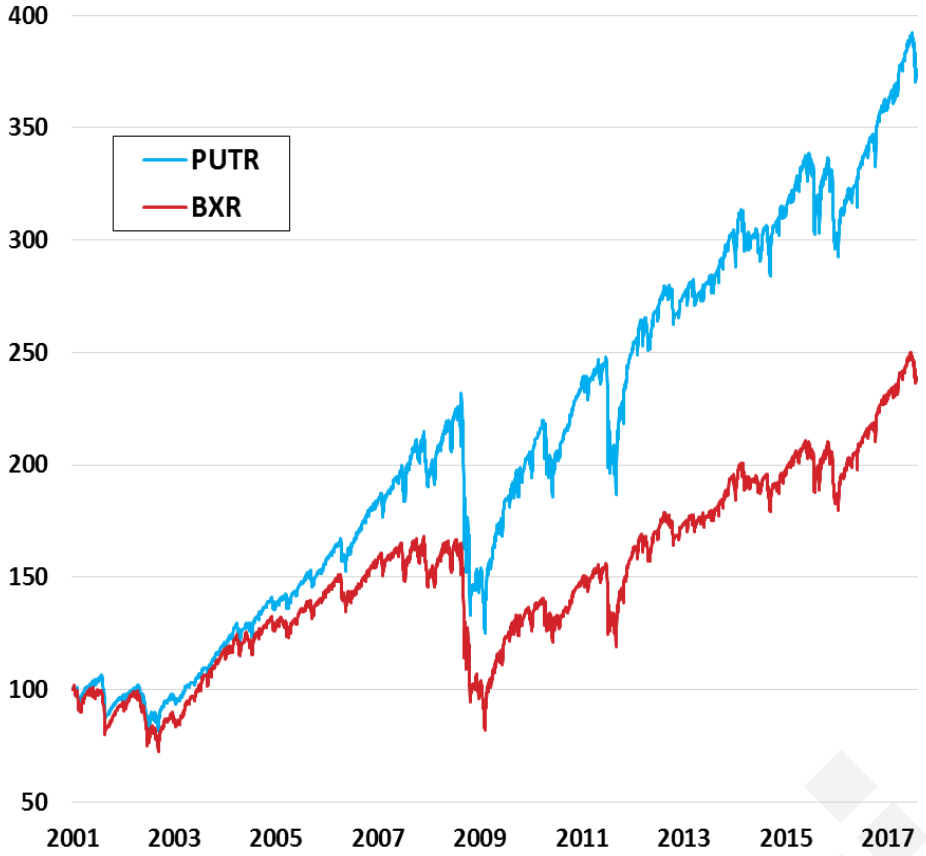
- Option Strategy Benchmarks can provide attractive risk-adjusted returns
  - Virtually limitless combinations
  - Benchmark construction matters
- Implied Volatility, Skew have predictive power that can generate trading signals for investment strategies
  - Need to carefully define the object of prediction and investment objective

Impact of Option Benchmark Design

Breaking the Laws of Put / Call Parity?

Despite high correlation, CBOE Russell 2000® PutWrite Index (PUTR^{SM}) substantially outperforms CBOE Russell 2000® BuyWrite Index (BXR^{SM})





Practical Considerations for Options-Based Strategies

BXR & PUTR Index Methodologies Compared

	BXR	PUTR
Exposure:	• Long Russell 2000 Index (RUT); • Short 1M RUT at-the-money **call** option	• 1M Treasury Bill (Cash); • Short 1M RUT at-the-money **put** option
Dividends:	• Re-invested in BXR "units" on dividend "ex-dates"	• No dividends to re-invest; expected dividend priced into put option
Option Roll:	• 3rd Friday every month; • Expiring option settles to cash based on Special Opening Quotation ("SOQ") of RUT; • New option strike based on RUT level at 11 a.m. ET; • New call struck **just above** RUT 11 a.m. ET level	• 3rd Friday every month; • Expiring option settles to cash based on Special Opening Quotation ("SOQ") of RUT; • New option strike based on RUT level at 11 a.m. ET • New put struck **just below** RUT 11 a.m. ET level
Option Sale:	Deemed sold based on 30-minute VWAP from 11:30 a.m. – 12:00 noon	Deemed sold based on 30-minute VWAP from 11:30 a.m. – 12:00 noon

Exploring BXR & PUTR Methodology Differences

Strike prices for RUT call and put options are not the same

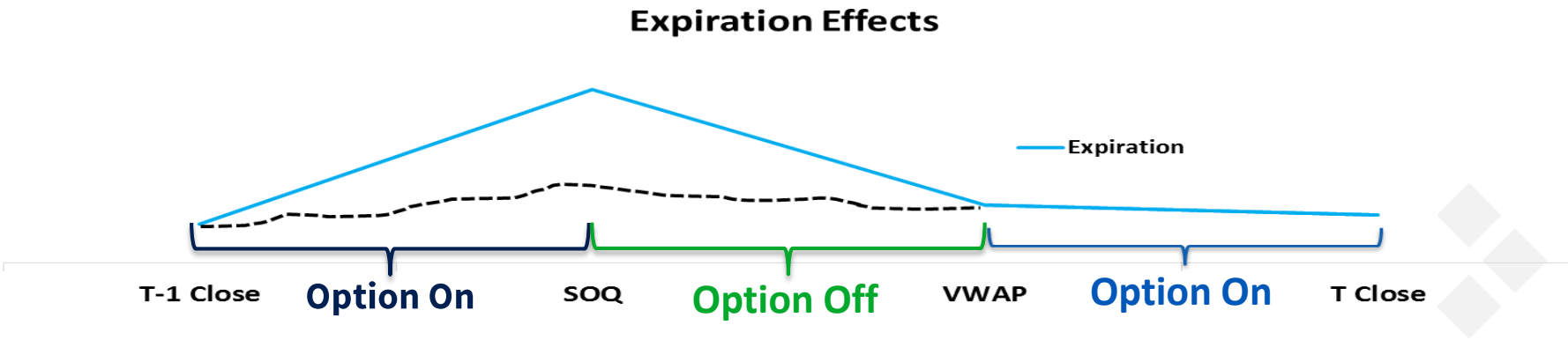
- Call strike for BXR just above RUT level at 11 a.m. ET; call is slightly out of the money
- Put strike for PUTR just below RUT level at 11 a.m. ET; put is slightly in the money
- PUTR put implied volatility is consistently higher than BXR call implied volatility

Option Roll Mechanics & Expiration Day Effects

- Historically, SOQ for index options has exhibited an upward bias
  - Dealers, market makers tend to be sellers of index puts and buyers of index calls, making them long the market
  - Unwinding hedges at expiration tends to create buy imbalances in stocks
- PUTR benefits from this expiration day effect; BXR does not

Expiration Day Effects

	BXR	PUTR
Expiration Day Return Calculation	$R_{BXR, EXP} = R_A \times R_B \times R_C$;where R_A = Return from previous close close to SOQ R_B = Return from SOQ to VWAP option sale – long stock position uncovered R_C = Return from VWAP option sale to expiration day close	$R_{PUTR, EXP} = R_A \times$ "R_{GAP}" $\times R_B$;where R_A = Return from previous close close to SOQ "R_{GAP}" = Period from SOQ to VWAP option sale – cash position uncovered R_B = Return from VWAP option sale to expiration day close



Methodology Differences Matter

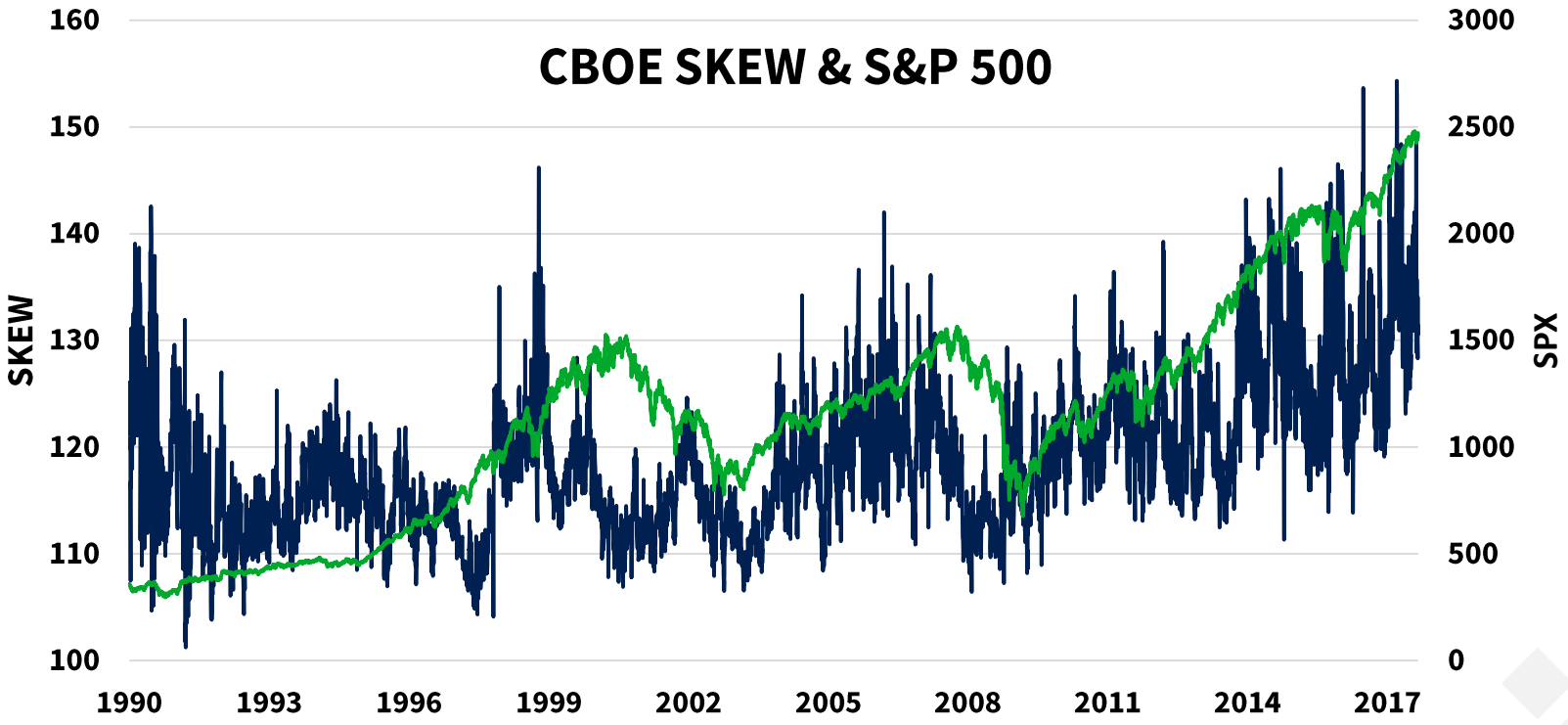
- Expiration day effects, on average, have accounted for substantial outperformance of PUTR relative to BXR
- Average overnight RUT return on expiration days (i.e., T-1 Close to SOQ) was 0.245%, followed by reversal of -0.282%
  - Easier to sell puts in a falling market than calls
- Higher "moneyness" & implied volatility for puts in PUTR strategy contribute to the outperformance, but not significant

	BXR	PUTR
R_A (Option On)	0.081%	0.058%
R_B or R_{GAP} (Option Off)	**-0.282%**	**0.000%**
R_C (Option On)	0.089%	0.039%
Expiration Day Return - R	***-0.117%***	***0.097%***

Trading Signals from Options-Based Indicators

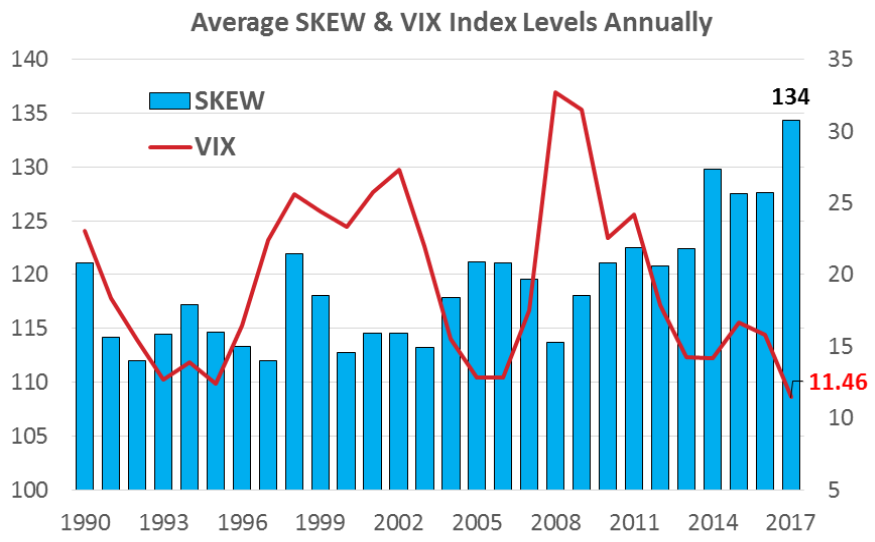
CBOE SKEW Index ("SKEW")

- Derived from SPX option prices, SKEW measures expected "tail risk" of SPX
- SKEW has been increasing since 2008, possible structural, regulatory explanations



What SKEW is saying about perceived risk…

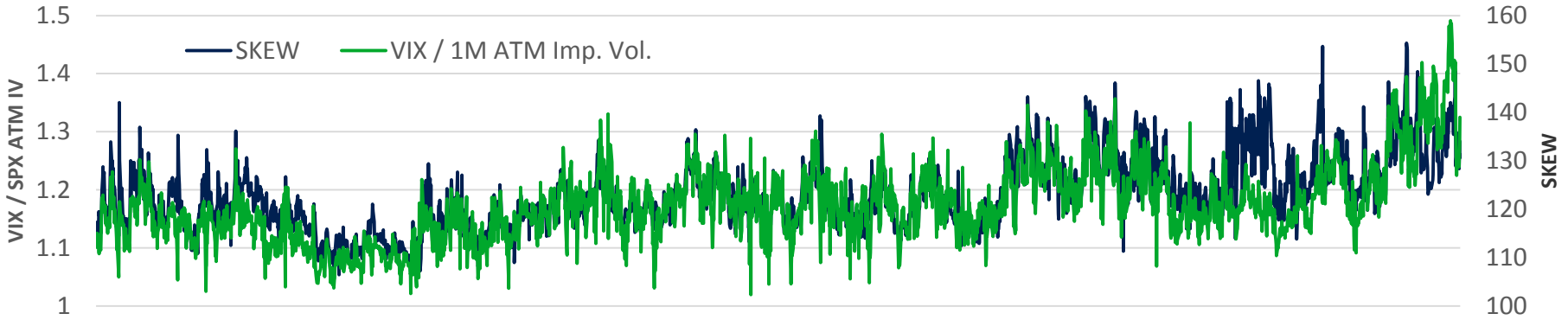
- SKEW measures the *cost* of hedging tail risk
- Supply of out-of-the-money ("OTM") puts limited by high cost of capital and risk management practices
  - Few customers can sell uncovered OTM puts
  - Liquidity providers demand more edge
- SPX minimum tick size of $0.05

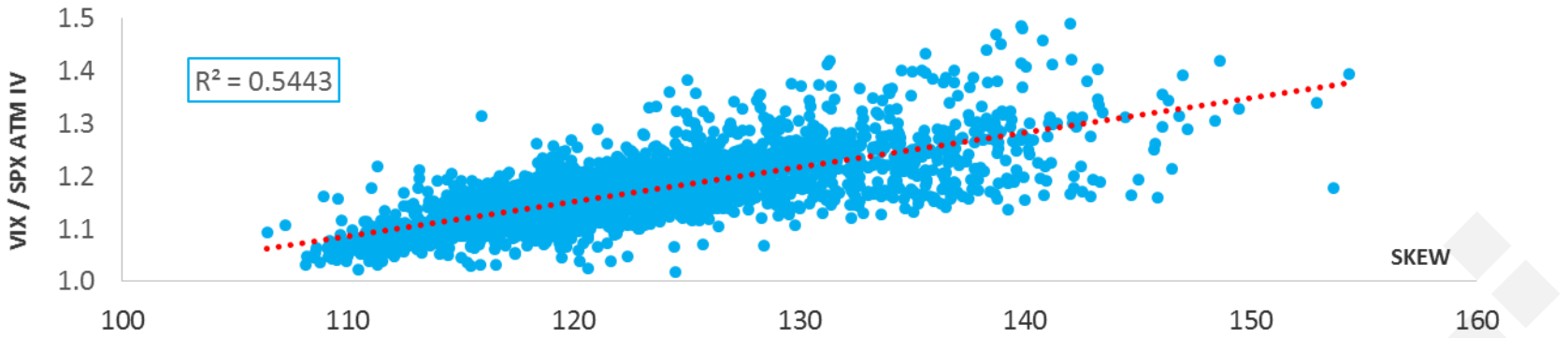


SKEW	2 SD Move Prob.	3 SD Move Prob.
100	2.30%	0.15%
105	3.65%	0.45%
110	5.00%	0.74%
115	6.35%	1.04%
120	7.70%	1.33%
125	9.05%	1.63%
130	10.40%	1.92%
135	***11.75%***	***2.22%***
140	13.10%	2.51%
145	14.45%	2.81%
150	15.70%	3.10%
155	17.05%	3.40%

Relationship between the VIX and SKEW Indexes

- VIX Index is calculated using prices of OTM SPX puts and calls, which reflect the expected left-leaning skewness of the S&P 500 Index
- Expect VIX values to reflect a premium over SPX ATM implied volatility; premium should correlate with SKEW, and suggests a way to "trade" SKEW

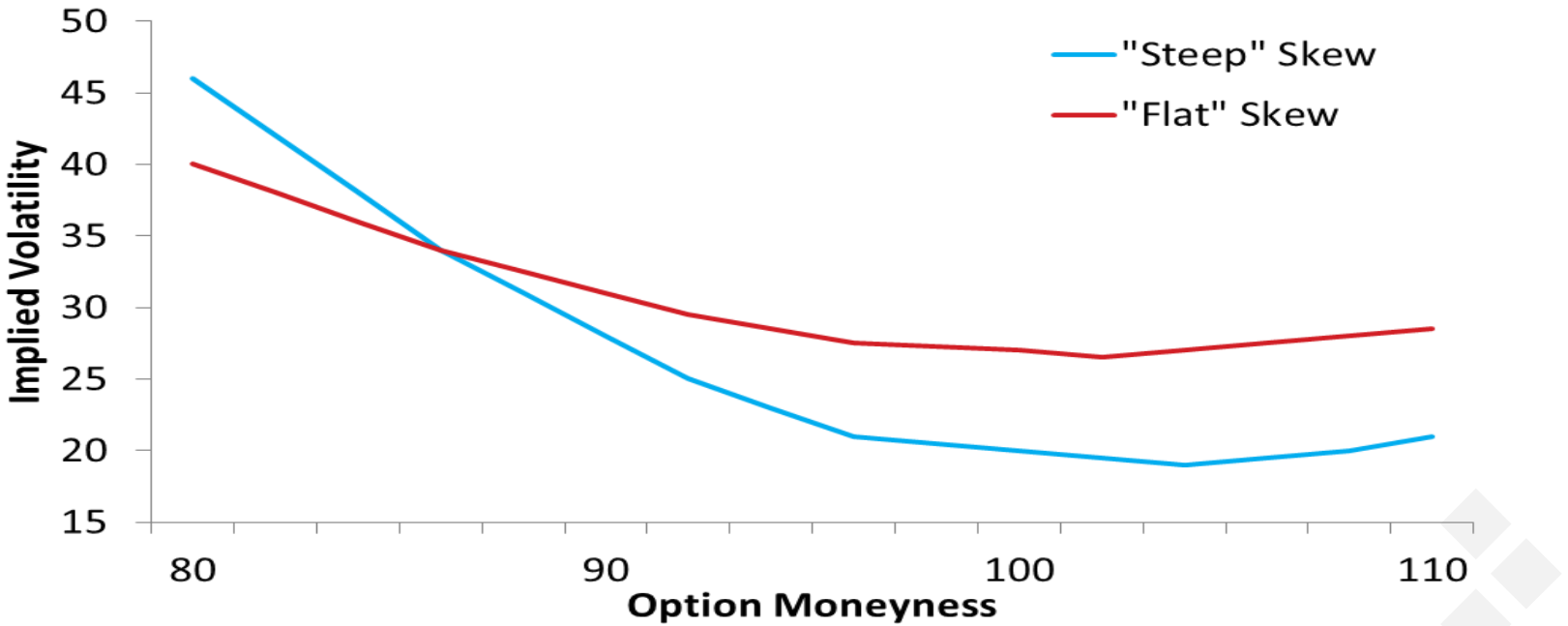




Trading Signals from Option Skew

Object of Prediction: The skewed shape of the SPX option implied volatility curve – often referred to as the “smile” or “smirk”– tends to flatten when expected volatility is already high, which signals a possible rally in stock prices.

“Flat” / “Steep” skew defined by ratio of 1M 25-delta put / 1M 25-delta call prices

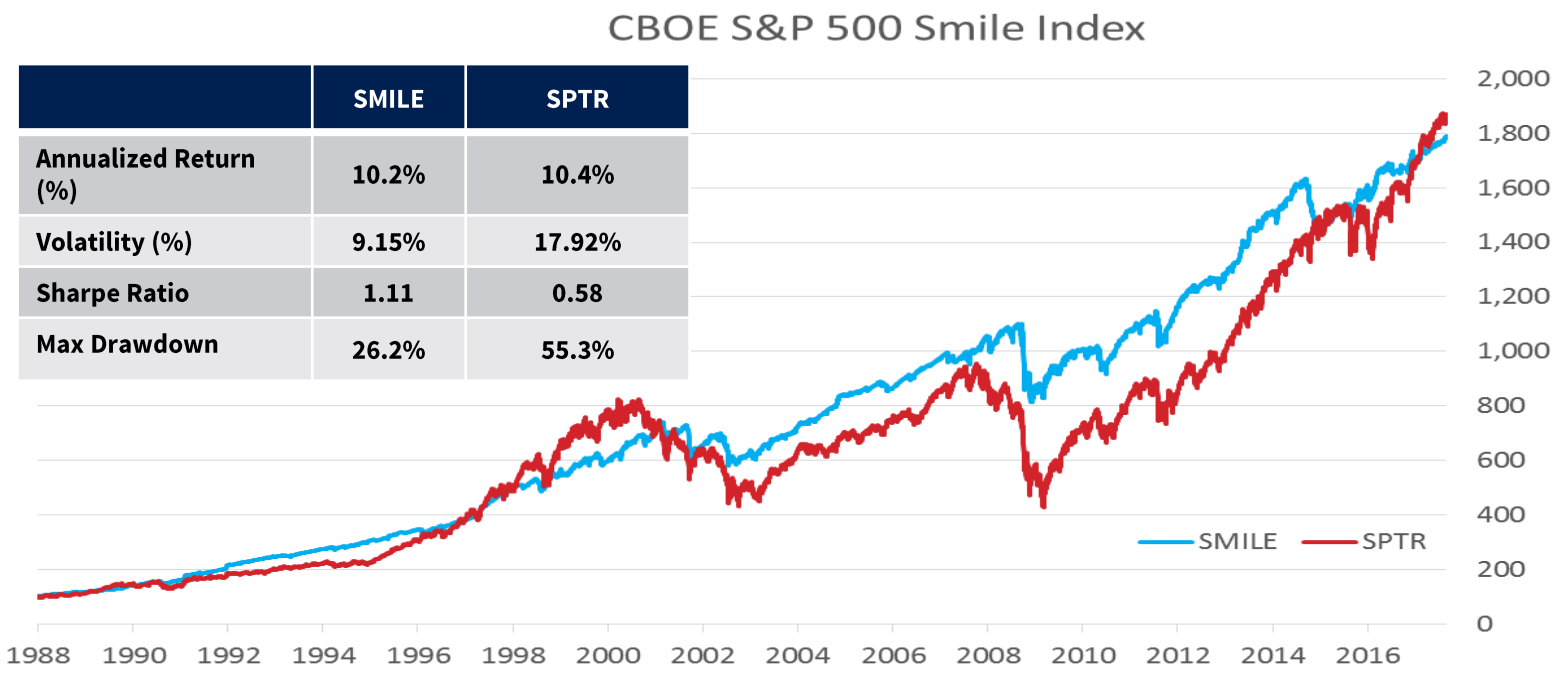


CBOE S&P 500 “SMILE” Index

The SMILE Index tracks a premium capture strategy that alternates between:

- Risk reversal (short 1M 25-delta put and long 1M 25-delta call) when the SPX option skew is “flat” (put price/call price < 1.5)
- Short strangle (short 1M 25-delta put and short 1M 25-delta call) when option skew is “steep” (put price/call price > 1.5)

	SMILE	SPTR
Annualized Return (%)	10.2%	10.4%
Volatility (%)	9.15%	17.92%
Sharpe Ratio	1.11	0.58
Max Drawdown	26.2%	55.3%



Implied Volatility as a Trading Signal

"Market Timing with Implied Volatility Indices"

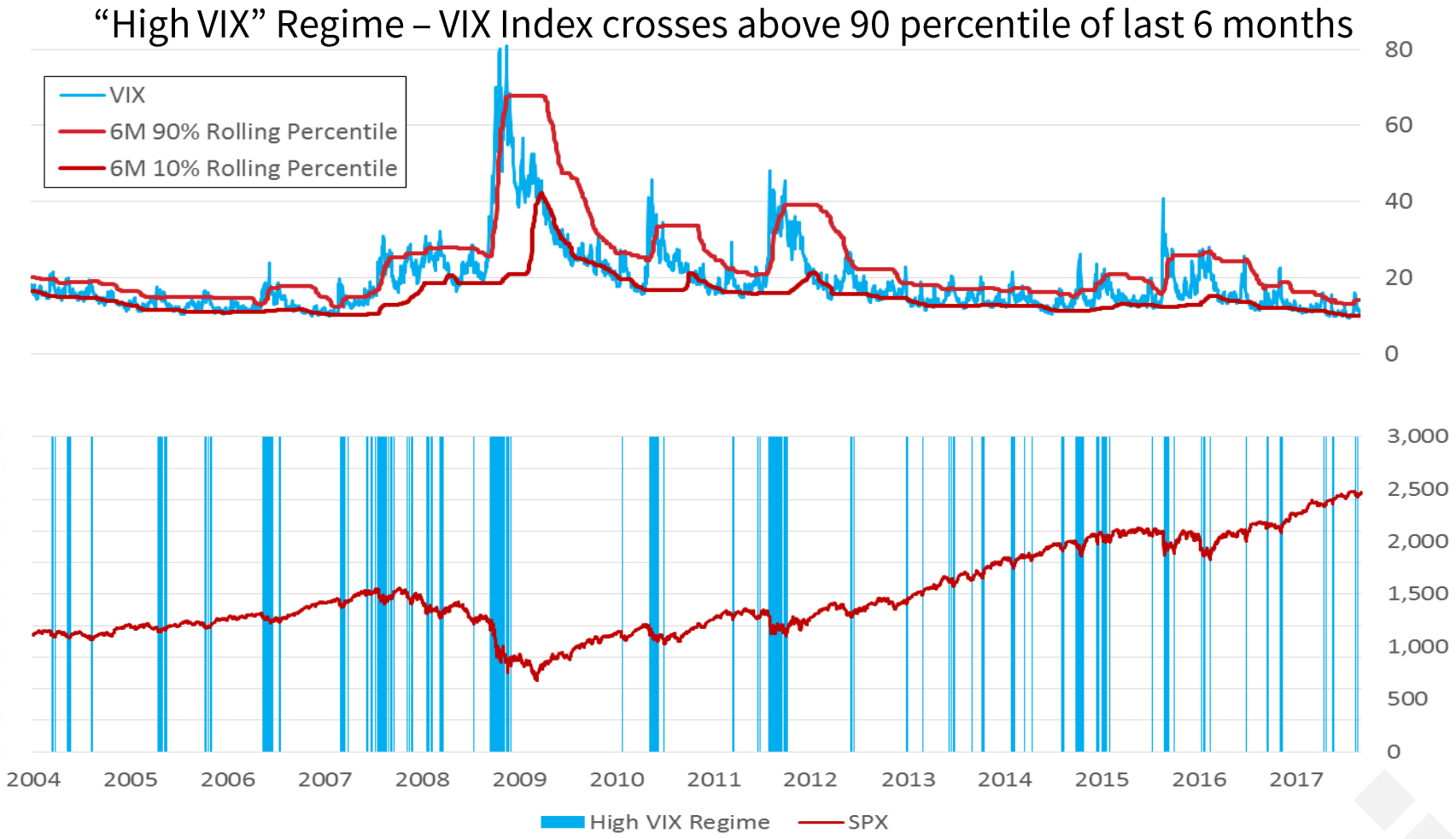
Yoshiki Obayashi, Antonio Mele and Kshitij Dhingra

S&P Dow Jones Indices Research / Strategy Note

Summary

- Drawdowns tend to coincide with periods of high realized volatility
- Implied volatility indexes tend to lead future realized volatility
- Simple volatility "regime" framework produces robust market timing signals
- Practical application: Stabilis US Index
- Asset rotation strategy based on CBOE Volatility Index (VIX) and CBOE/CBOT 10-year U.S. Treasury Note Volatility Index (TYVIX®)

High Volatility Linked to Drawdowns

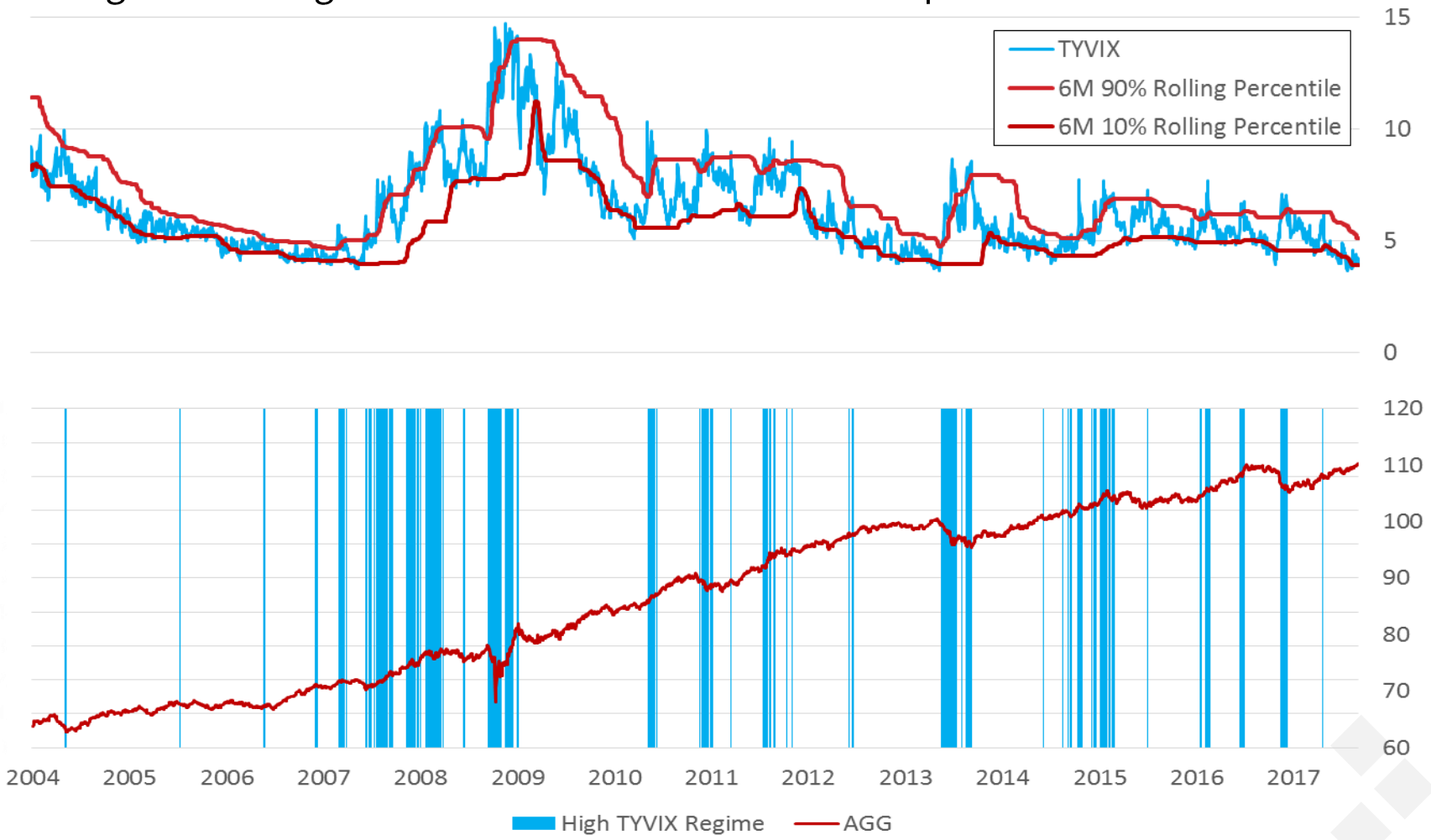


High Volatility Linked to Drawdowns

APPLIED ACADEMICS

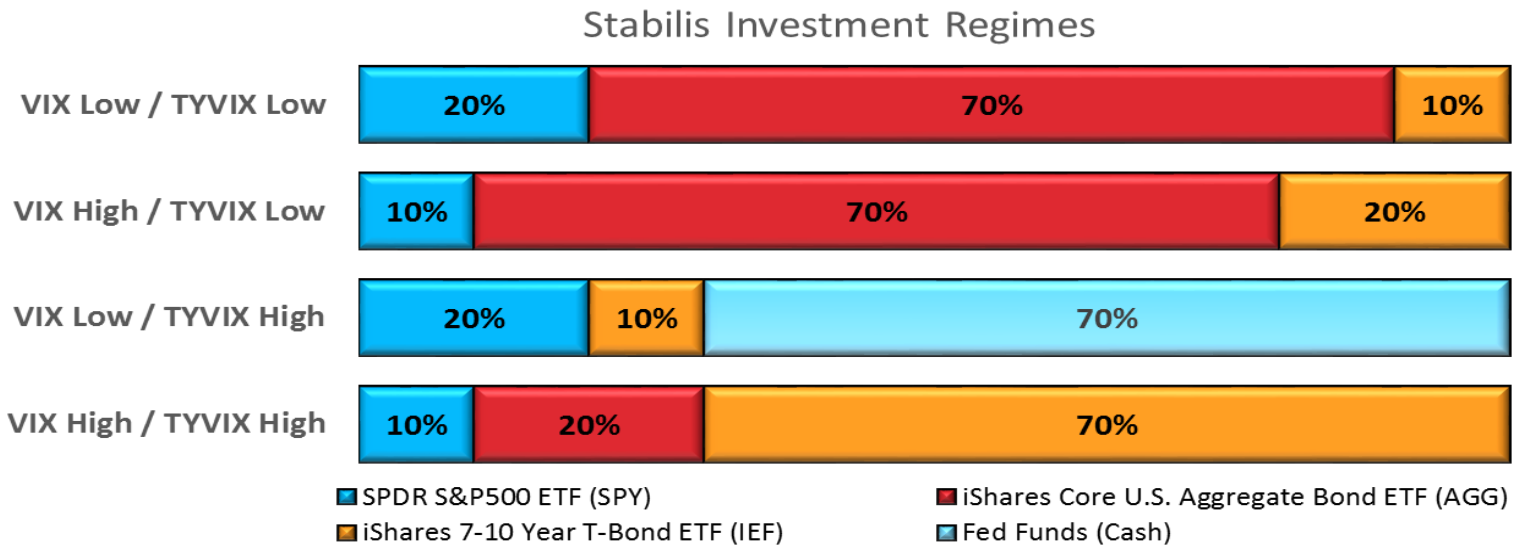
Cboe

"High TYVIX" Regime – TYVIX Index crosses above 90 percentile of last 6 months



Stabilis US Index

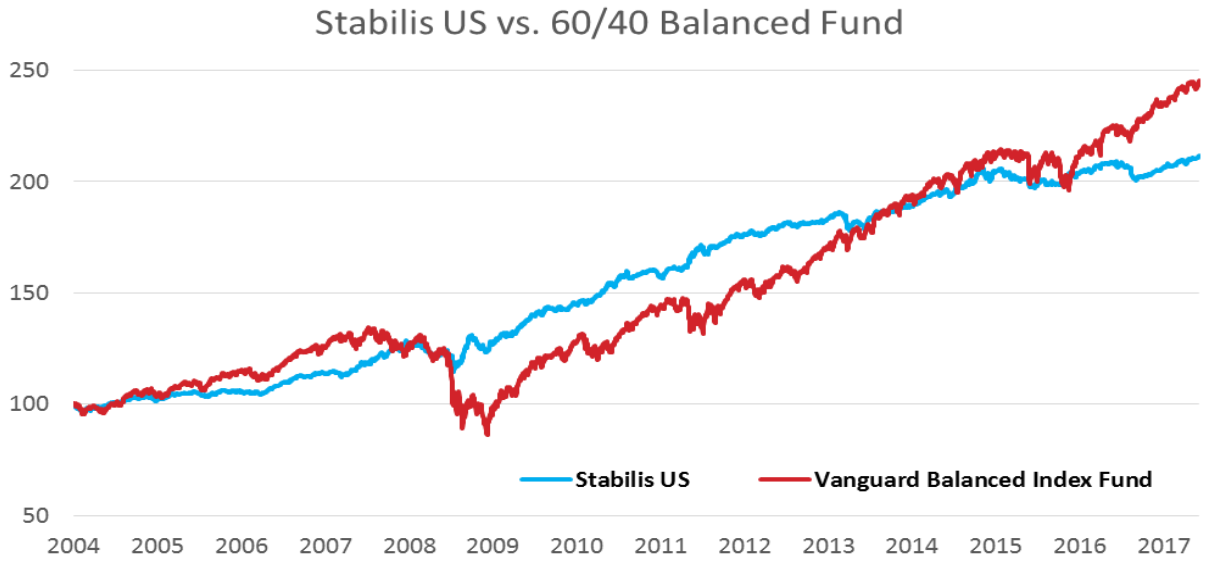
Stabilis US Index is a dynamic asset allocation strategy that derives its trading signals from regime changes in the VIX Index and the TYVIX Index. The concept underpinning Stabilis is that the interplay of the TYVIX and VIX Indexes has historically predicted the relative performance of diversified equities, bonds and cash.



TYVIX High regime: TYVIX breaks above 90 percentile of past 6 months
TYVIX Low regime: TYVIX beaks below 10 percentile of past 6 months
VIX High regime: VIX breaks above 90 percentile of past 6 months
VIX Low regime: VIX beaks below 10 percentile of past 6 months

Stabilis US Index

Stabilis US has significantly higher risk adjusted returns compared to a steady 60% stock / 40% bond allocation



	Stabilis US	60/40 Fund
Annualized Return (%)	**5.75%**	**6.91%**
Volatility (%)	**4.28%**	**10.99%**
Sharpe Ratio	**1.34**	**0.63**
Max Drawdown	**11.2%**	**36.3%**

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