Volatility as a Tradeable Asset Class

The Options Institute SM
Kevin Davitt | Jermal Chandler | Matt Moran

Cboe Global Markets

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VIX® Index Fundamentals

- **The VIX Index Methodology**
  - Established in 1993
  - Acts as a market barometer
- **Cboe Volatility Index® (VIX Index®)– What is it?**
  - A forward-looking indicator
- **Why is a forward-looking indicator important?**
  - Allows investors to potentially predict future impacts on equity portfolios
  - Reduce or hedge risk of their portfolios
- **How is the Cboe Volatility Index calculated?**
- **How is the Cboe Volatility Index used?**
  - Inverse relationship to the S&P 500 Index
  - From Index to tradable product
  - Ways to use VIX futures & options
- **Adoption continues to grow**

The VIX Index Methodology

www.cboe.com/VIX

- In 1993 Cboe introduced the VIX methodology, a formula used to measure market risk and investor sentiment.
- The formula uses option prices rather than stock prices in its calculation.
  - The option prices investors are willing to pay are a direct reflection of how quickly they think the underlying index level will move.
- The formula calculates the expected (or implied) volatility of an index – i.e. how much a security or index will move over a future period of time.
- The VIX methodology can be applied to a wide range of indices and stocks that have actively traded underlying options markets.

• Cboe S&P 500 Volatility Index (VIX)	• Cboe Nasdaq 100 Volatility Index (VXN)
• Cboe S&P 100 Volatility Index (VXO)	• Cboe Russell 2000 Volatility Index (RVX)
• Cboe DJIA Volatitilty Index (VXD)	

The VIX Index Market Barometer

www.cboe.com/VIX

The Cboe Volatility Index (VIX) is an important financial barometer that is frequently quoted in the financial press.

"The VIX, which is widely considered to be the best volatility gauge in the market, also hit its lowest level since July on Friday, around 12." Published by CNBC on Nov. 11, 2019

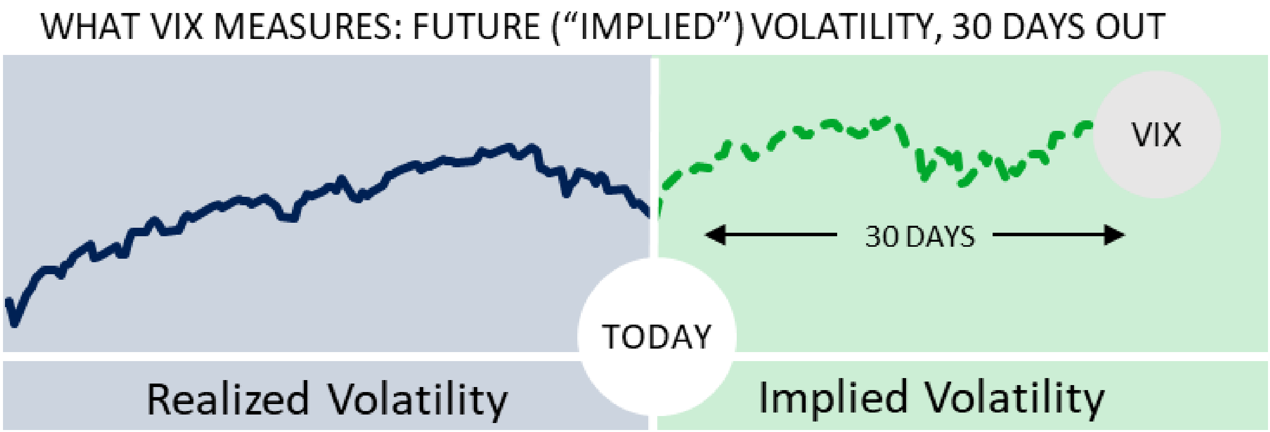
"Commonly known by its ticker, the VIX highlights intense stock market fear or complacency" Published by Investor's Business Daily on Nov. 18, 2019

"While the Major stock indices continue to press higher, the compression of the previous valuation gap combined with investment advisors complacency and the low VIX suggest some degree of caution is warranted." Published by Real Money on Nov 15, 2019

What is the Cboe Volatility Index® (The VIX® Index)?

www.cboe.com/VIX

The Cboe Volatility Index® (VIX® Index), projects the probable range of movement in the U.S. equity markets. Specifically, the VIX® Index measures the implied volatility of the S&P 500® Index (SPX℠) over the next 30 days.

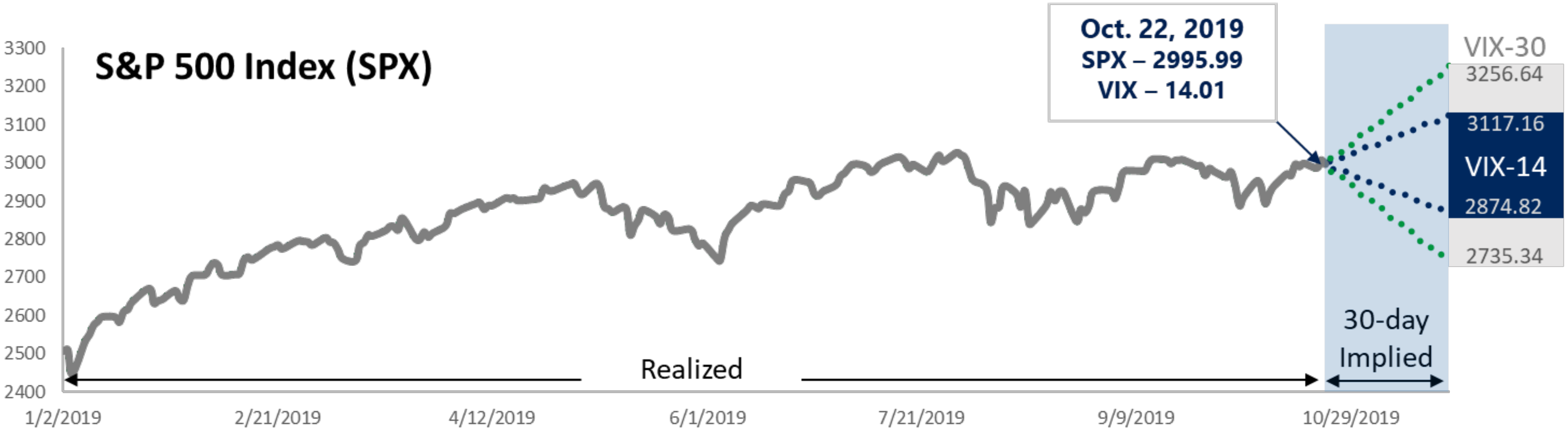


The VIX provides a glimpse into the market's expectations for the future which can be an extremely important tool for investors.

Investors can then use this information to better understand the magnitude of potential movements and how those movements may impact their portfolios- driving more informed investment decisions.

A Forward-Looking Indicator

www.cboe.com/VIX



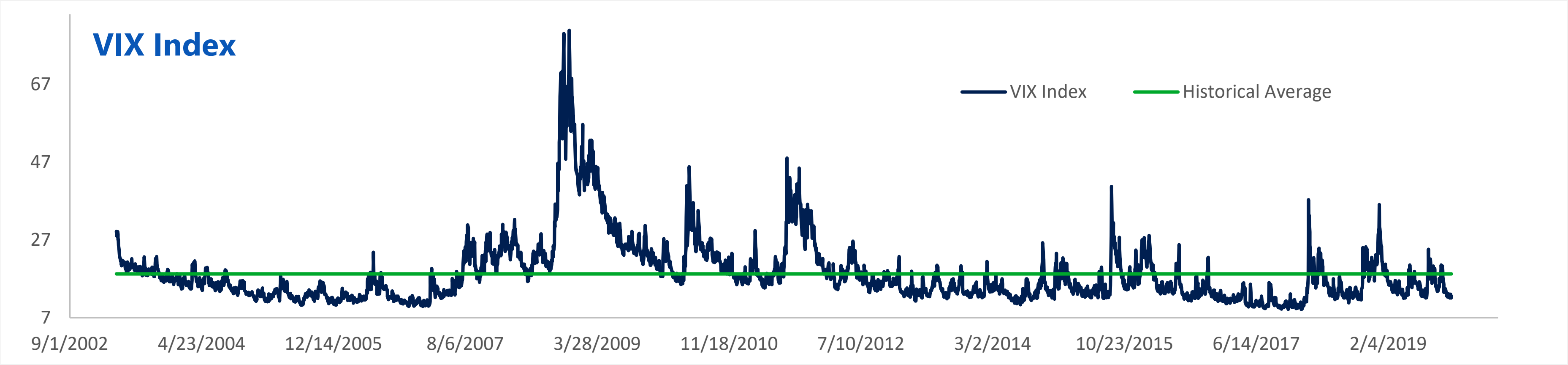
- Volatility measures the frequency and magnitude of price movements, both up & down. The more dramatic the price swings, the higher the level of volatility.
- The VIX Index provides a constant, **30-day forward** look into expected (or implied) volatility of the U.S. stock market.
- Implied volatility is a statistical measure of how much a security or index is expected to move over a future period of time.
  It does **NOT** predict direction, i.e. whether the index will go up or down.

A VIX level of 14 = +/- 4.04% move in the S&P 500 Index

A VIX level of 30 = +/- 8.66% move in the S&P 500 Index

Why is a Forward-Looking Indicator Important?

The VIX Index (or implied volatility) tends to be **“mean reverting”**, which means that over time it will move back or return to its historical average.



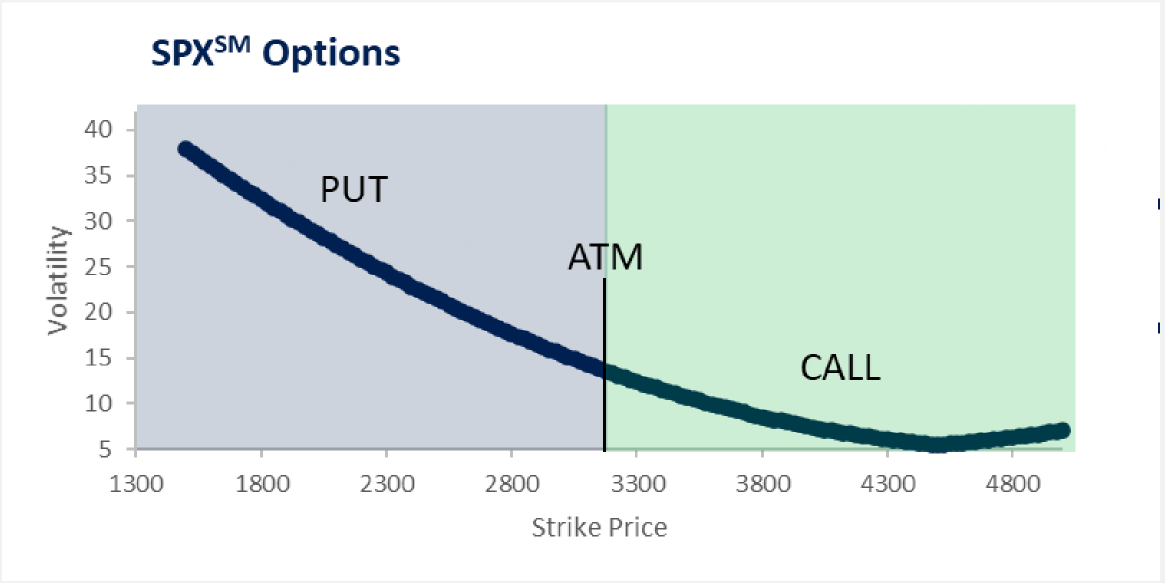
Source: Cboe Global Markets

The VIX Index helps investors read trends in the market, i.e. how current levels of volatility compart to historical highs and lows. This is particularly helpful when preparing for shifts in trends but also when investors are determining which hedging strategy is best for their portfolio.

EXAMPLES

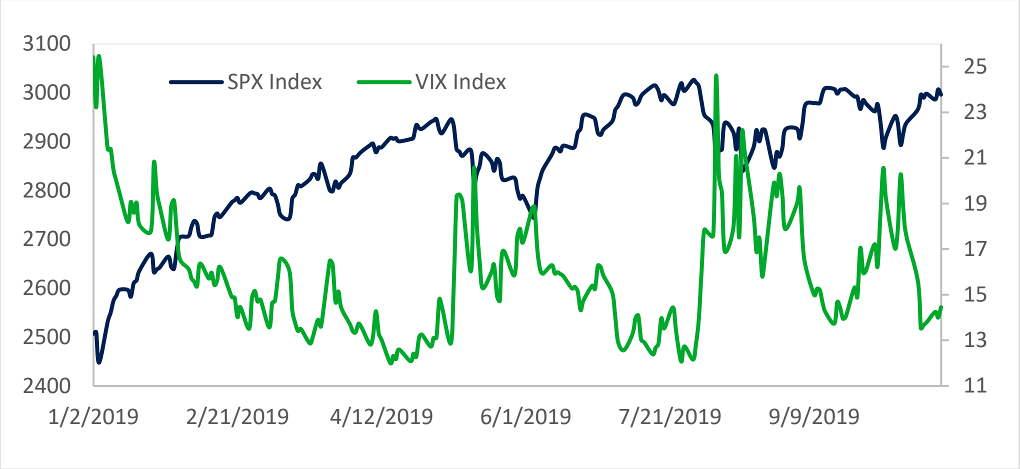
- VIX Index low to historical average – complacency in the market: Insurance company may look to buy “cheap” downside protection in the form of SPX put options
- VIX Index high to historical average – raised uncertainty in the market: Hedge fund my look to sell a VIX future to capture the higher than average risk premium being priced into the market.

How is the VIX Index Calculated?

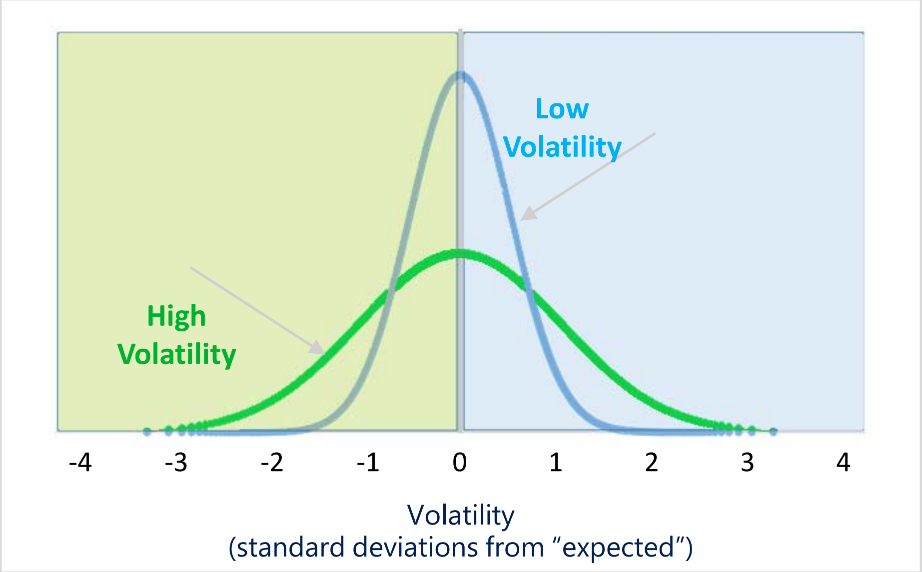


- The index is derived from real-time prices of the S&P 500 Index (SPX) options.
  - S&P 500® Index represents approximately 80% of the total market value of U.S. equities.
  - One of the most liquid options markets in the world.
  - SPX options trade on Cboe electronically and in open outcry.
- The VIX Index measures implied volatility by averaging the weighted prices of a wide range of SPX put and call options.
- The VIX Index uses option prices rather than stock prices in its calculation because the prices investors are willing to pay is a direct reflection of how quickly they think the underlying index level will move (i.e. option prices reflect the volatility buyers and sellers expect).
- Underlying option liquidity is extremely important.
  - Contributes to investors' ability to execute trades at fair and equitable prices
  - The SPX options market is supported by 19 professional liquidity providing firms (i.e. market makers)

How the VIX Index Moves



Source: Cboe Global Markets



Inverse Relationship

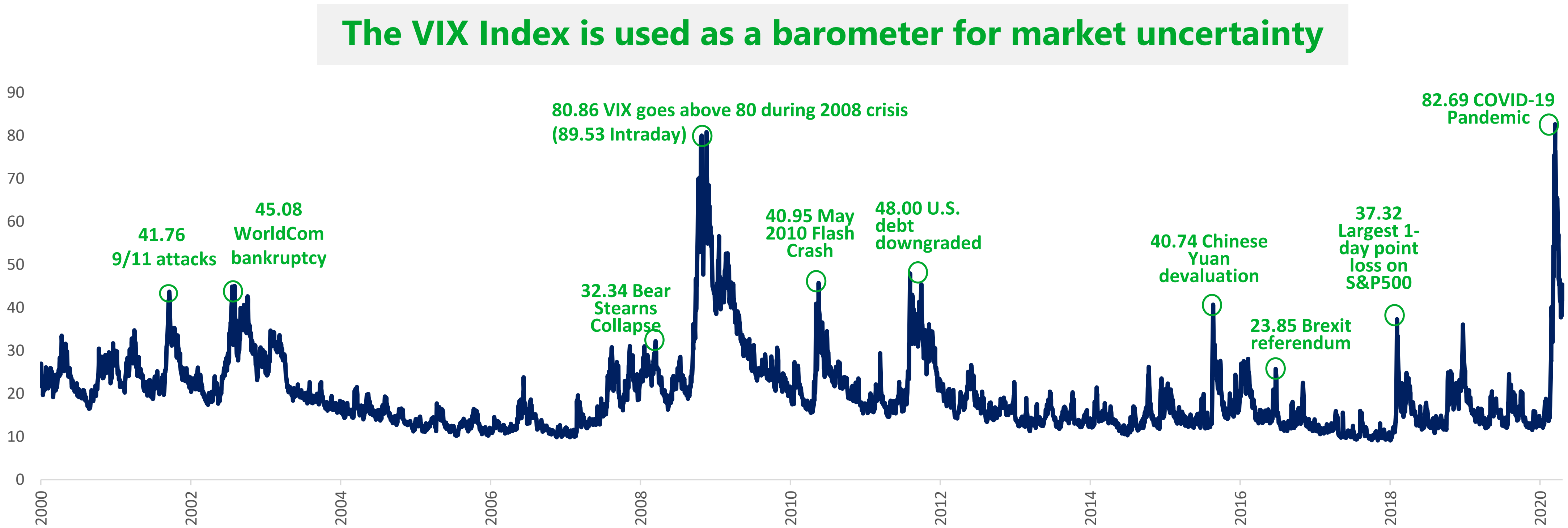
Implied volatility typically increases when markets are turbulent or the economy is faltering. In contrast, if stock prices are rising the VIX Index tends to fall or remain steady at the low end of the scale.

Volatility and Risk

As the volatility of a security or index increases, so does the risk.

- High volatility results in a higher probability of outcomes far from the mean (fat tails)
- Low volatility results in a higher probability of outcomes near the mean

The Global Benchmark for Investor Sentiment



On a global basis, the VIX Index is one of the most recognized measures of volatility -- widely reported by financial media and closely followed by a variety of market participants as a daily market indicator.

The VIX Index hit an all-time record high of 89.53 on October 24th, 2008 during the financial crisis.

The VIX Index all-time closing high of 82.69 occurred on March 16th, 2020 during the COVID-19 selloff.

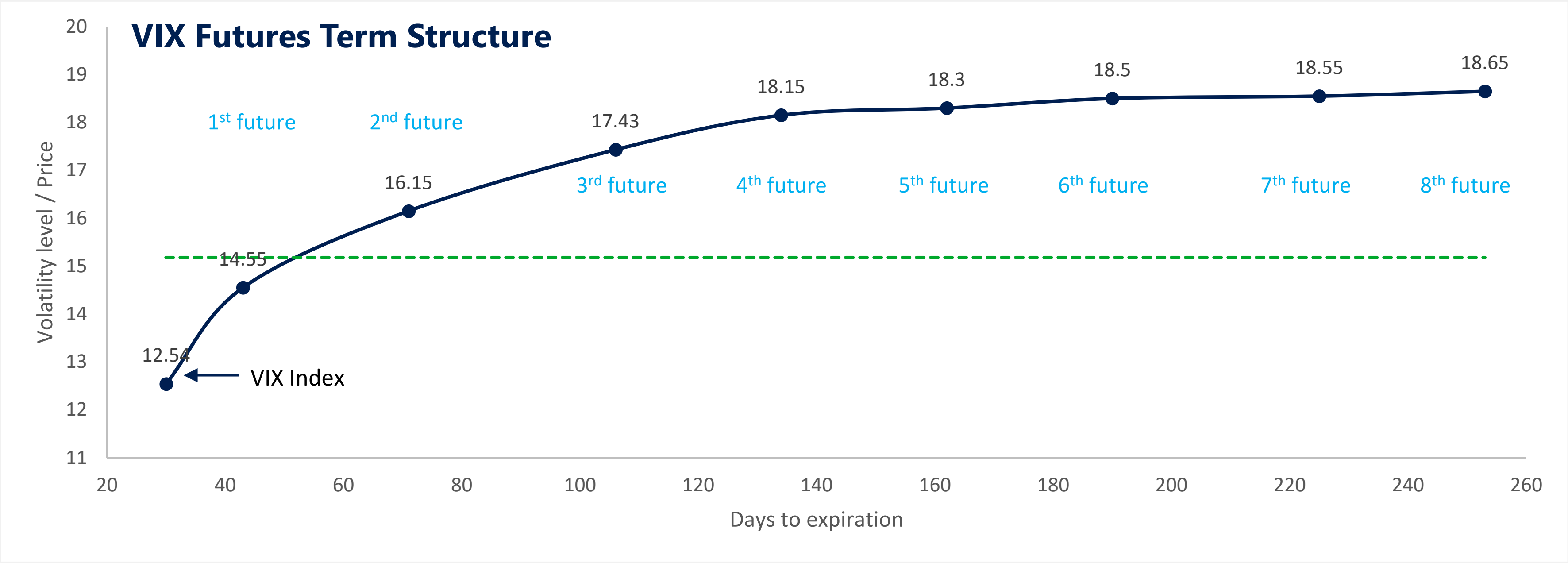
From Index to Tradeable Product

The VIX Index provides important visibility into market sentiment but it is not a tradable product.

To answer customer demand for a tradable product, Cboe listed both futures and options on the VIX Index.

- 2004 Cboe launched VIX futures
- 2006 Cboe launched VIX options

Retail and institutional investors use VIX futures and options contracts much as they use futures and options contracts on other financial indices: to hedge their portfolios or to express a market view.



Worth Noting

Standard VIX futures have a contract multiplier of $1000 USD/point
Mini VIX futures will have a contract multiplier of $100 USD/point

There's an established appetite for futures with a smaller contract size

Ways to Use the VIX Index, VIX Futures, & VIX Options

- **Comparing price movement of the VIX Index against price movement of the S&P 500 Index (SPX) can signal trends in investor sentiment**
  - **Rising VIX Index + rising SPX** = bearish sentiment, shrinking risk appetite, increased chance for a downside reversal.
  - **Rising VIX Index + declining SPX** = bearish sentiment, higher odds for a downside trend.
  - **Declining VIX Index + declining SPX** = bullish sentiment, growing risk appetite and high potential for an upside reversal
  - **Declining VIX Index + rising SPX** = bullish sentiment, higher odds for an upside trend.

- **Common strategies using VIX futures and options**
  - **Downside protection:** during a market selloff VIX futures tend to increase in value, owning VIX futures can help hedge against losses of a long equity portfolio.
  - **Mean reversion:** unlike many equity index products volatility tends to mean revert. Therefore, when volatility diverges from the historical mean, investors may use both VIX futures and options to position themselves to benefit if/when it mean reverts.
  - **Contango vs. Backwardation roll:** depending on the market environment, investors may buy/sell VIX future spreads to take advantage of changes in the VIX term structure.

Strategies

VIX futures and options have unique characteristics and behave differently than other financial-based commodity or equity products. Understanding these traits and their implications is important. VIX futures and options may provide market participants with flexibility to hedge a portfolio, employ strategies in an effort to generate returns from relative pricing differences, or express a bullish, bearish or neutral outlook for broad market implied volatility.

Portfolio Hedging
One of the biggest risks to an equity portfolio is a broad market decline. The VIX Index has had a historically strong inverse relationship with the S&P 500® Index (see the Correlations and Convexity charts on the previous page). Consequently, a long exposure to volatility may offset an adverse impact of falling stock prices. Market participants should consider the time frame and characteristics associated with VIX futures and options to determine the utility of such a hedge.

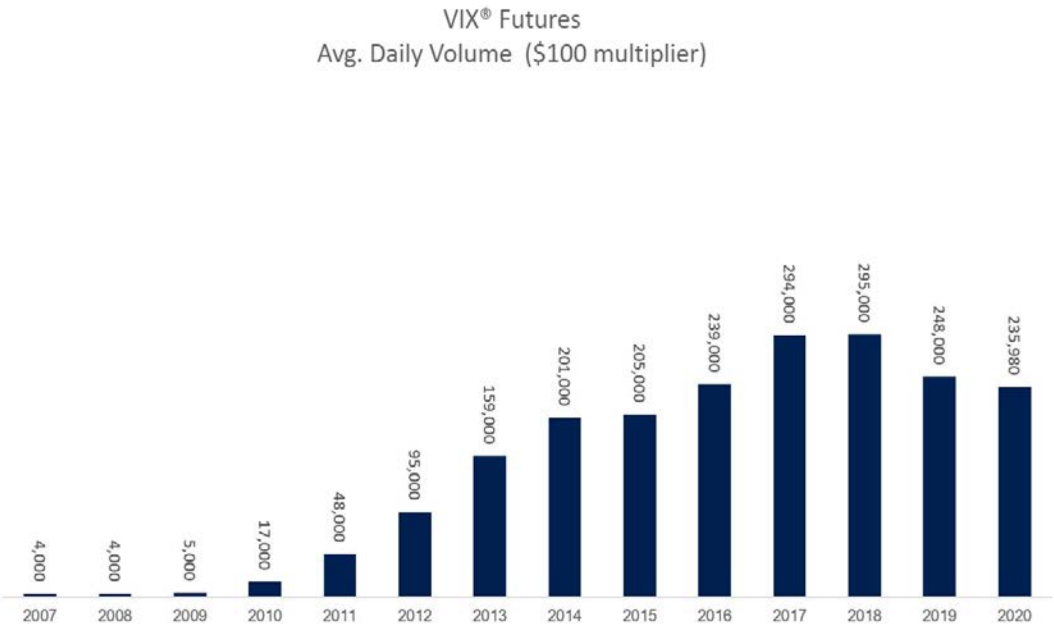
Long/Short Volatility
VIX futures provide a pure play on the level of expected volatility. Expressing a long or short sentiment may involve buying or selling VIX futures. Alternatively, VIX options may provide similar means to position a portfolio for potential increases or decreases in anticipated volatility.

Risk Premium Yield
Over long periods, index options have tended to price in slightly more uncertainty than the market ultimately realizes. Specifically, the expected volatility implied by SPX option prices tends to trade at a premium relative to subsequent realized volatility in the S&P 500 Index. Market participants have used VIX futures and options to capitalize on this general difference between expected (implied) and realized (actual) volatility, and other types of volatility arbitrage strategies.

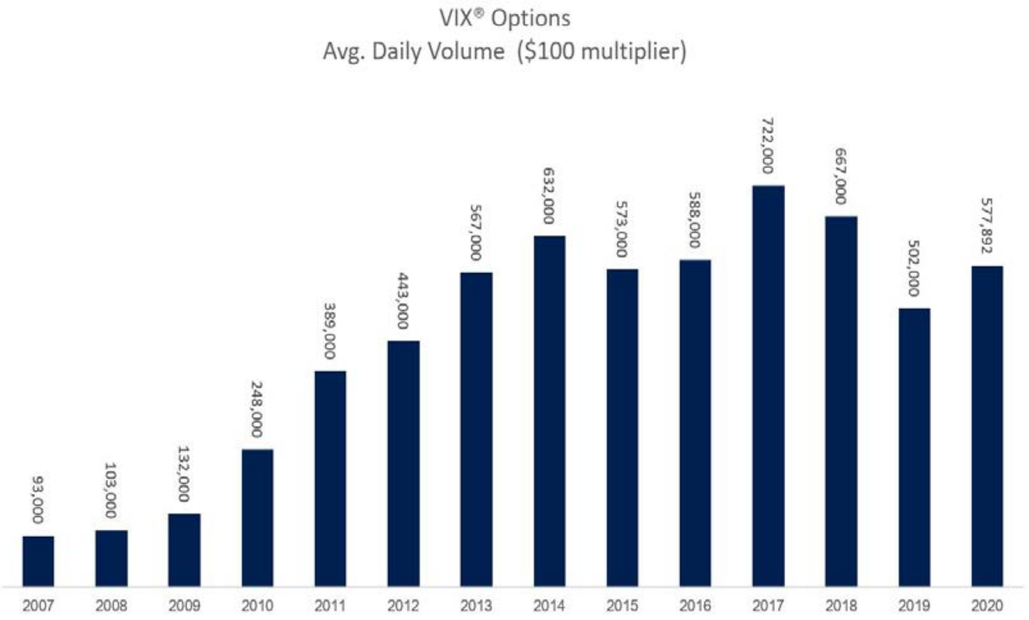
Term Structure Trading
One of the unique properties of volatility – and the VIX Index – is that its level is expected to trend toward a long-term average over time, a property commonly known as “mean-reversion.” The mean reverting nature of volatility is a key driver of the shape of the VIX futures term structure and the way it can move in response to changes in perceived risk. CFE lists nine standard (monthly) VIX futures contracts, and six weekly expirations in VIX futures. As such, there is a wide variety of potential calendar spreading opportunities depending on expectations for implied volatility.

Adoption Continues to Grow

- For the past 15 years, VIX Index products have provided the marketplace with opportunities to hedge portfolios against market downturns, manage portfolio risk and smooth out volatility.
- During this time, Cboe has worked with market participants to enhance VIX futures and options trading and provide education to help grow the market.



Source: Cboe Global Markets



Source: Cboe Global Markets

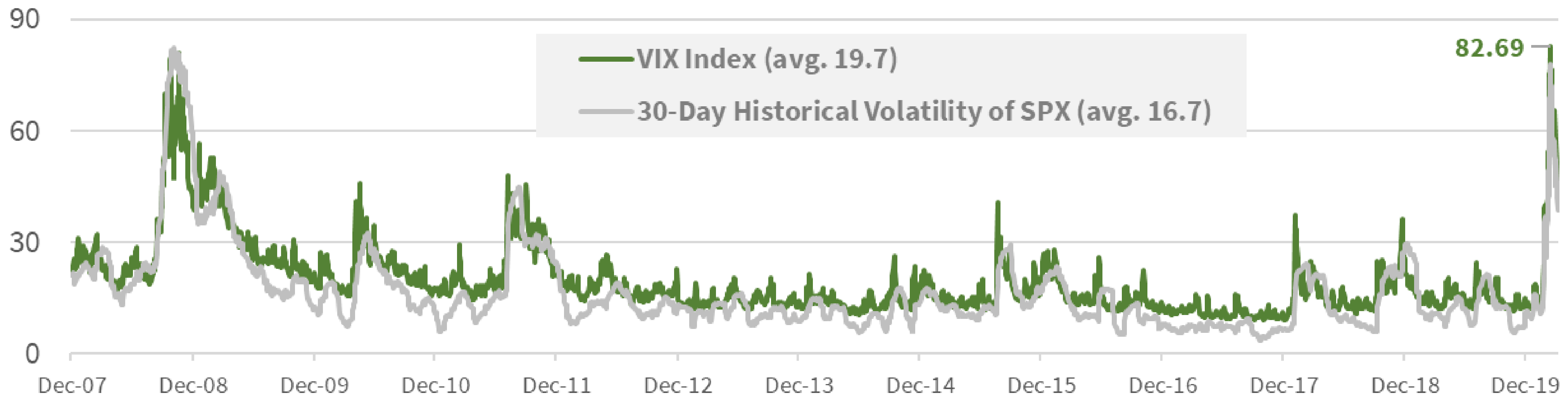
Key Points

- Cboe invented the VIX methodology and applied it to the S&P 500 Index to create the VIX Index
- The VIX Index measures the implied volatility of the S&P 500 Index over the next 30 days using real-time prices of SPX options.
  - The VIX Index is a forward indicator that allows investors to predict future impacts on equity portfolios
  - It does **NOT** predict direction, i.e. whether the S&P 500 Index will go up or down.
  - The VIX Index typically has an inverse relationship to price movements in the SPX
  - As the volatility of a security or index increases, so does the risk.
- The VIX Index is one of the most recognized measures of volatility -- widely reported by financial media
- To answer customer demand, Cboe listed both futures (2004) and options (2006) on the VIX Index.
- Comparing price movement of the VIX Index against price movement of the SPX can signal trends in investor sentiment.
- Investors use VIX futures and options in multiple ways to express a market view or hedge portfolio risk.

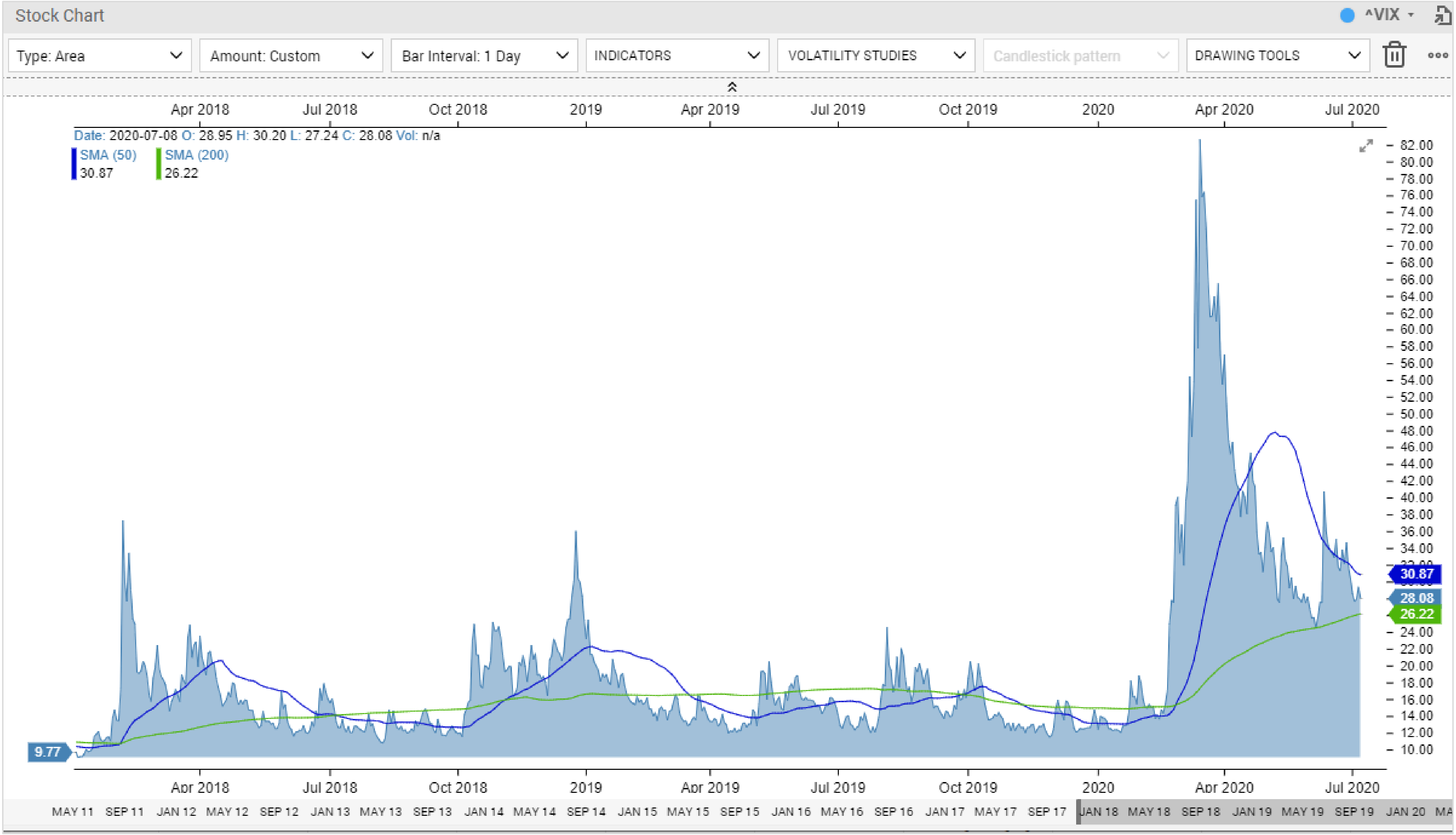
Market Insights

VIX Index and SPX Historical Volatility

30-day Historical Volatility reflects the past 30 trading days, while the VIX Index shows expected volatility over the next 30 calendar days

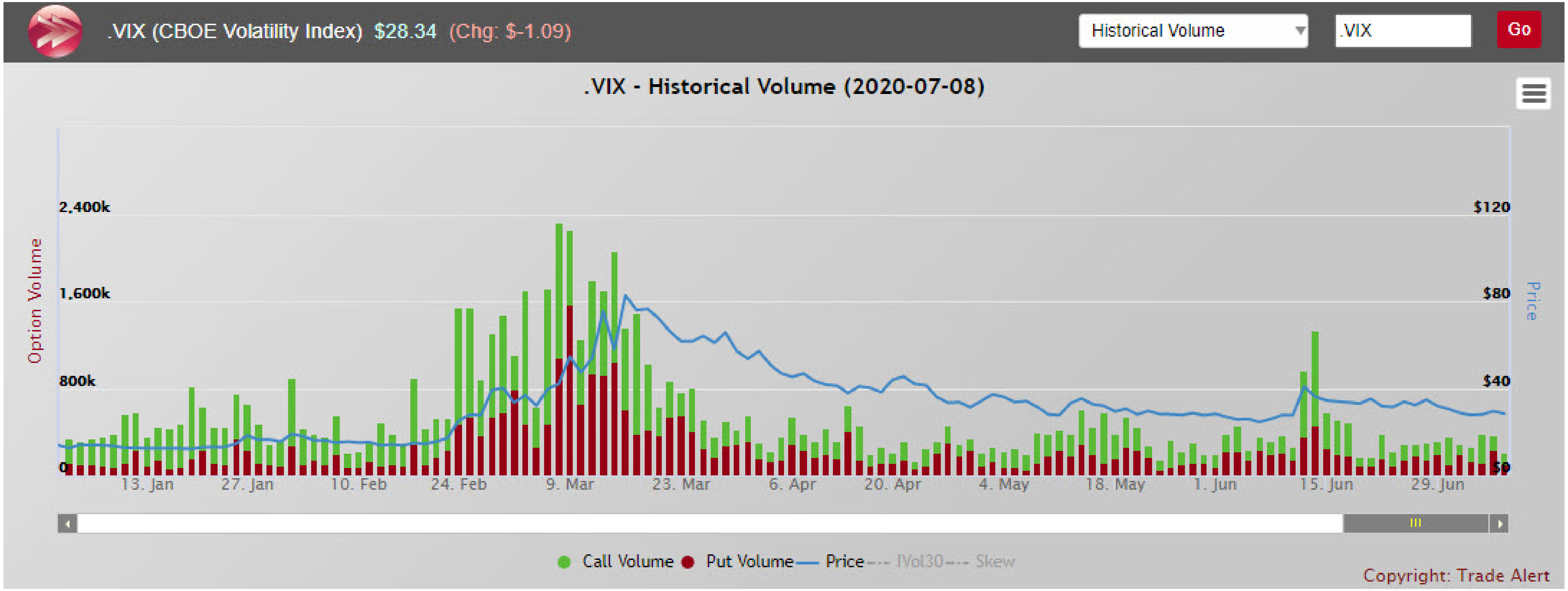


(Dec. 31, 2007 - Apr. 6, 2020) Daily closing values. Sources: Bloomberg and Cboe Exchange.
www.cboe.com/VIX

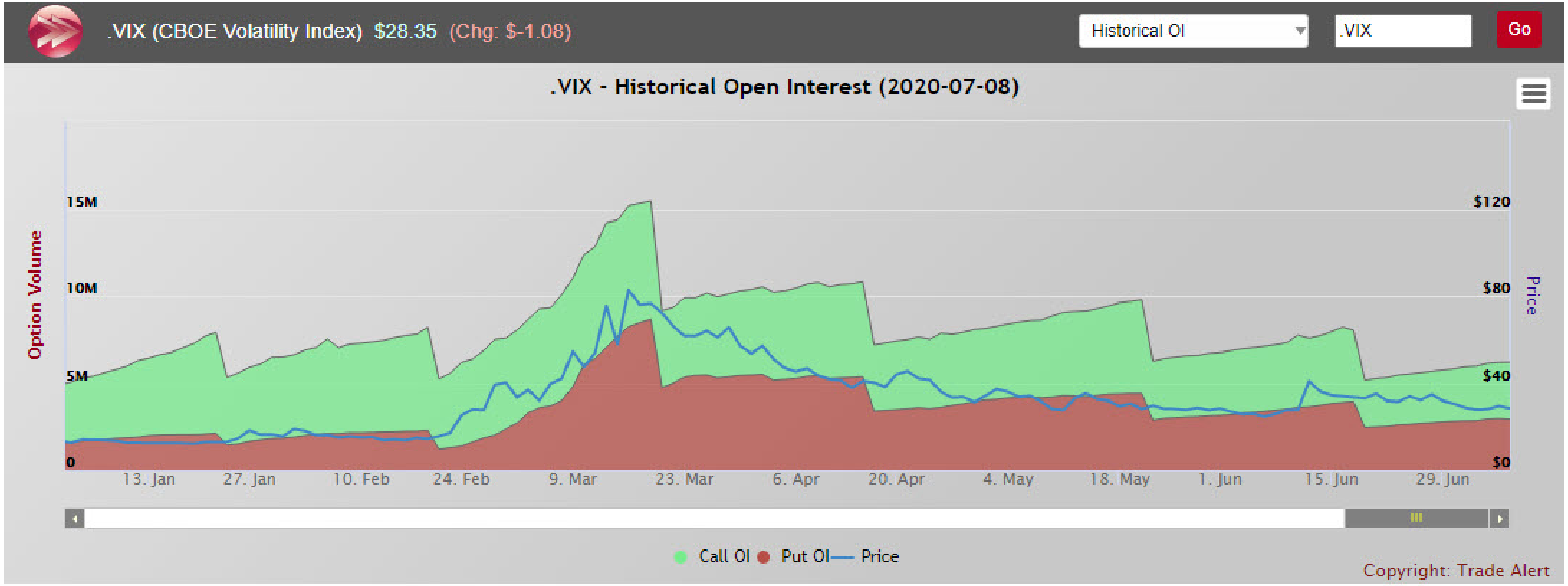


Source: Cboe LiveVol, www.livevol.com/

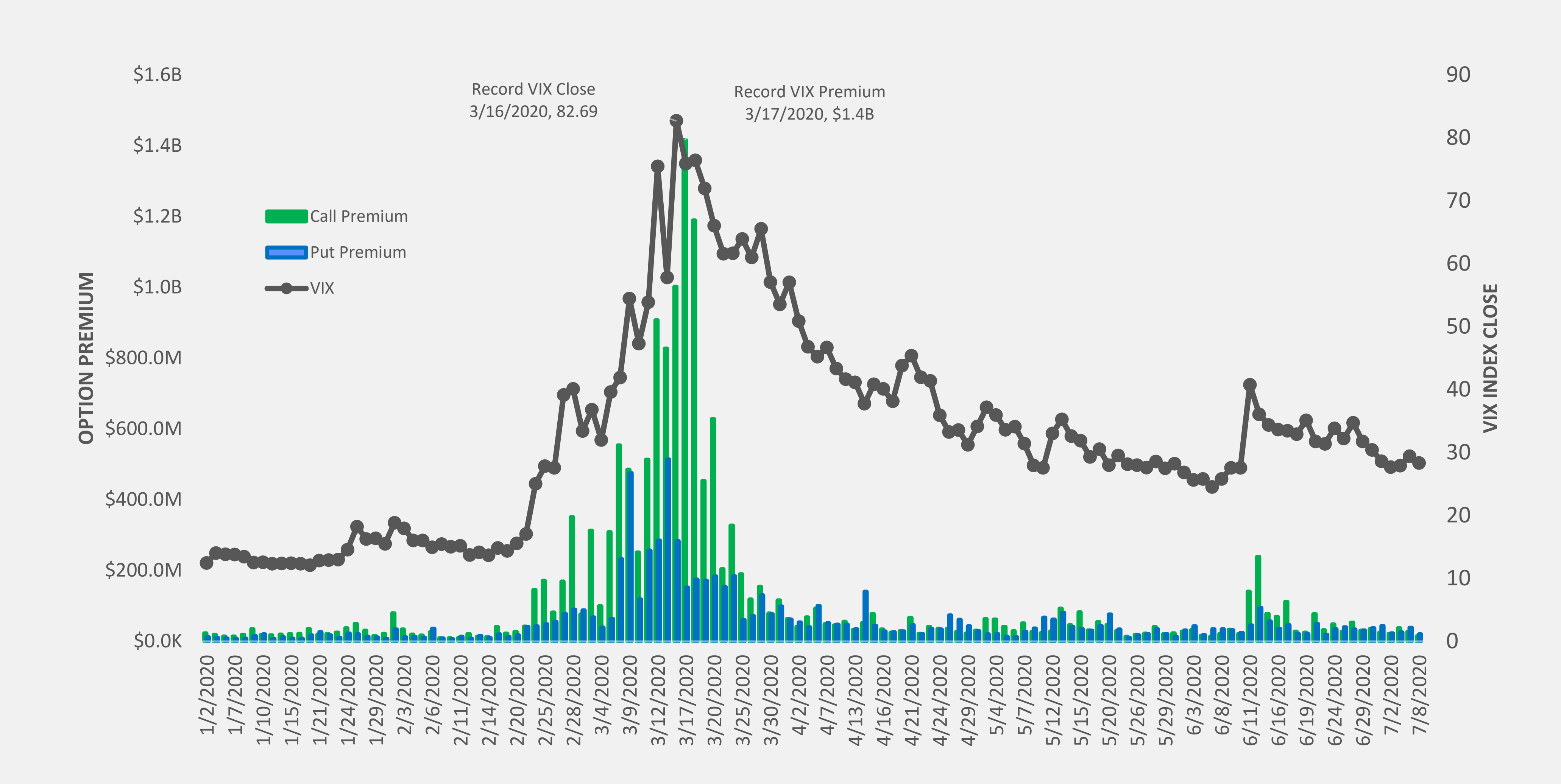
VIX Options Historical Volume (2020)



VIX Options Historical Open Interest (2020)



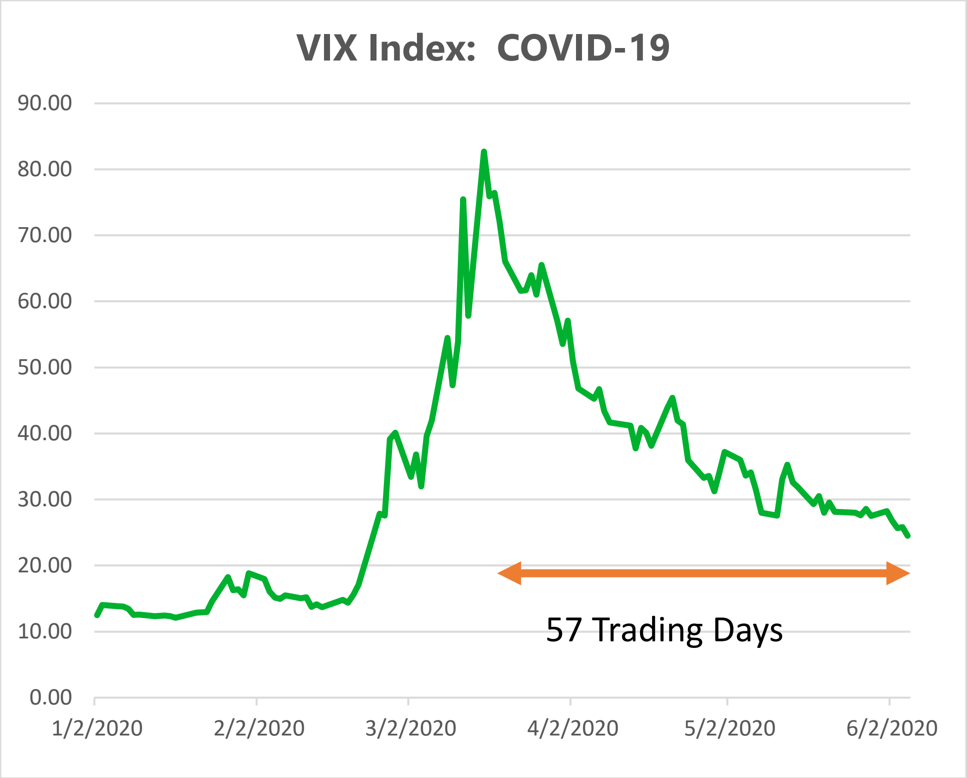
VIX Options Historical Premium (2020)



Source: Cboe TradeAlert, https://whatstrading.trade-alert.com/home/

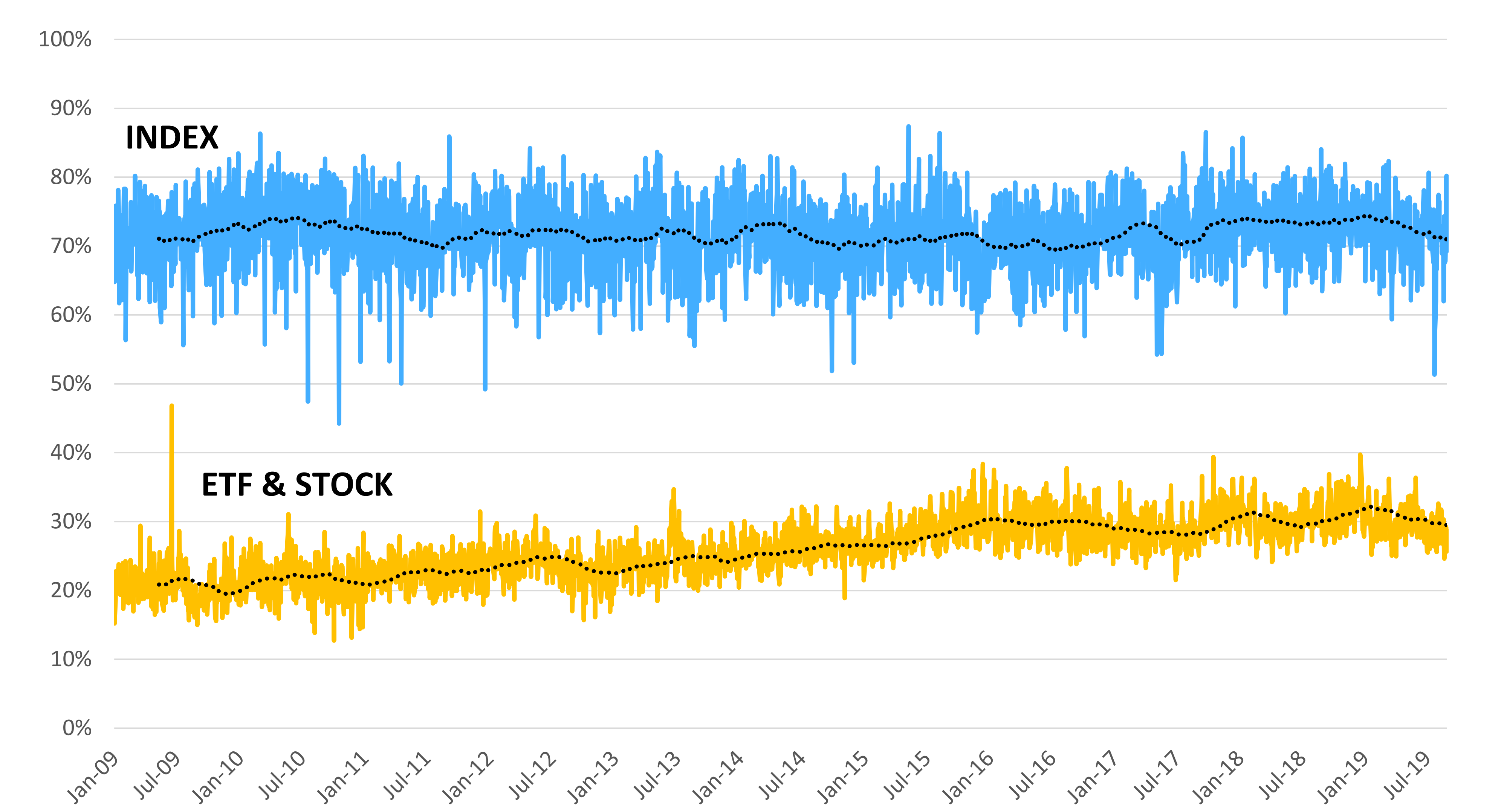
Speed of Mean Reversion

Source: Cboe Global Markets



Source: Cboe Global Markets

Complex Order Market Share by Year



Source: Cboe TradeAlert, https://whatstrading.trade-alert.com/home/

Research Studies & Whitepapers

- Global Volatility Indices
- Multi-Year Performance of Strategies that Use VIX® Futures or Options

VIX® Futures & Options

CFA Research Foundation. *The VIX Index and Volatility-Based Global Indexes and Trading Instruments – A Guide to Investment and Trading Features.* (2020). (17 pages) www.cboe.com/CFA-VIX

Professor Edward Szado. *The Portfolio Diversification Potential of **Long** VIX® Futures and Options Strategies.* (2020). (54 pages) www.cboe.com/Szado-Long-VIX

Professor Edward Szado. *Selling* *VIX® Futures and Options for Portfolio Return Enhancement.* (2020). (54 pages) www.cboe.com/Szado-Selling-VIX

Topics include:

- What does the VIX Index measure?
- Negative correlations and convexity
- Term structure and pricing
- Contango and backwardation
- Skew
- Benchmark indices for multi-year performance
- Responsiveness of futures and options to price moves in the VIX Index
- Strategies that buy or sell VIX futures or options

Global Volatility

TABLE 1. FIVE GLOBAL VOLATILITY INDEXES OVER 12 YEARS, 2008–2019

				Correlations of Weekly Returns		
Index	Maximum Daily Close	Minimum Daily Close	% Change in 2008	With Local Stock Index in 2008	With Local Stock Index over 12 Years	With VIX over 12 Years
VIX Index	80.86	9.14	77.8%	−0.82	−0.71	1.00
AXVI [S&P/ASX 200 VIX]	66.72	7.39	81.6%	−0.75	−0.65	0.58
VHSI [HSI Volatility Index]	104.29	11.36	51.6%	−0.66	−0.51	0.51
NVIX [India VIX]	85.13	10.45	69.8%	−0.20	−0.37	0.32
VSTOXX [EURO STOXX 50 Volatility]	87.51	10.68	142.9%	−0.83	−0.73	0.78

Note: The five local stock indexes are the S&P 500, S&P/ASX 200, Hang Seng, NIFTY 50, and EURO STOXX 50.

Sources: Bloomberg and Cboe.

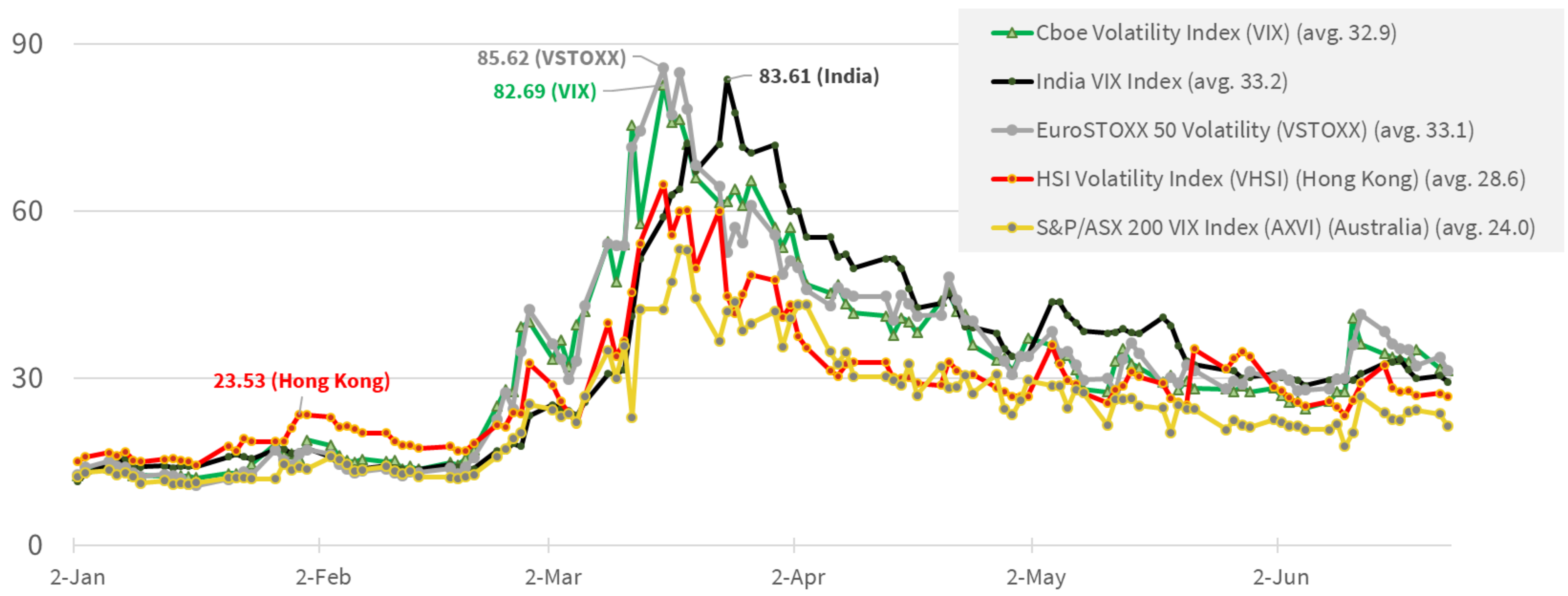
From: 2020 White Paper published by CFA Institute Research Foundation

Note that the weekly returns of volatility indices and stock indices had ***negative correlations*** *in 2008 and over the 12-year period since then.*

While the volatility indices are not investable, investors may explore the possibility of using volatility index futures and options for ***diversification*** *purposes.*

Global Volatility (2020)

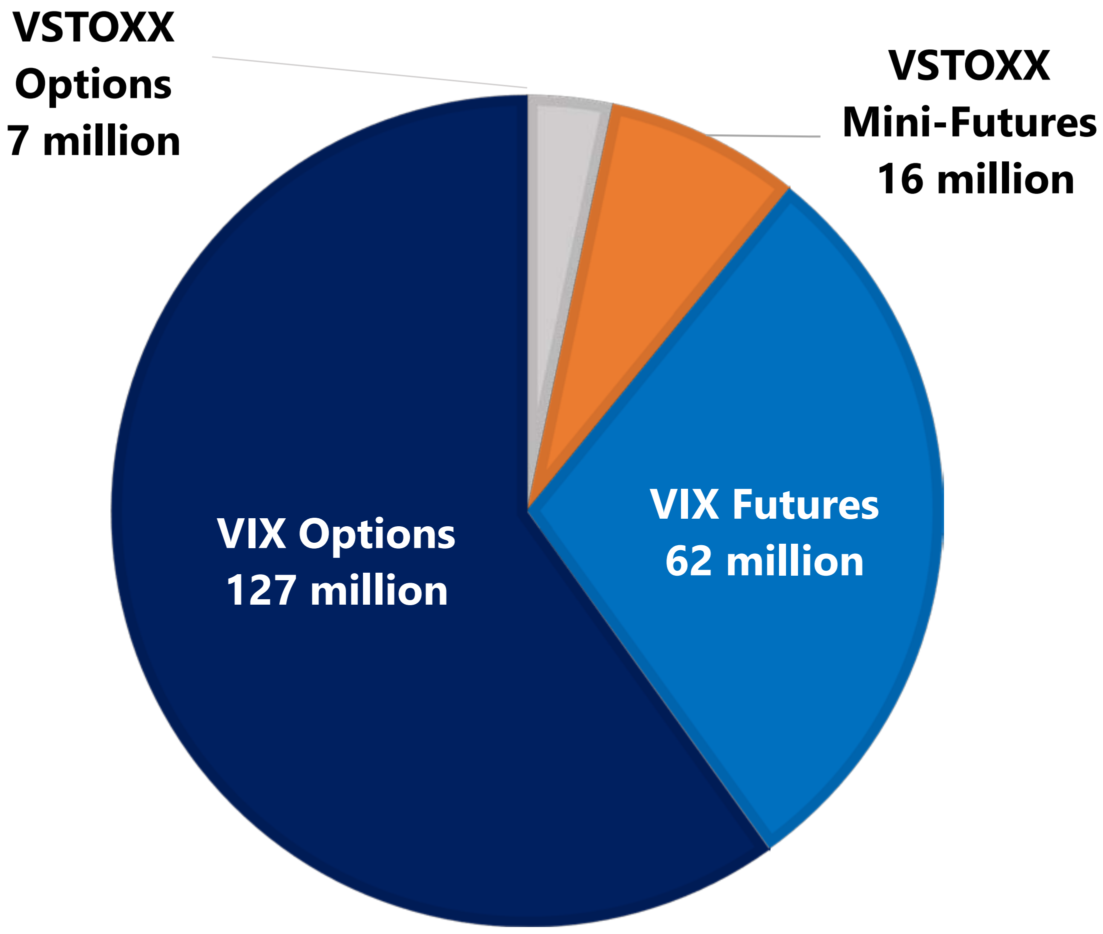
*All five volatility indices rose in the first quarter as fears spread worldwide about the impact of the **Covid-19 pandemic** on worldwide health and commerce. Note, the volatility indices are not investable.*



(Jan. 2, 2020 - Jun. 23, 2020) Daily Closing Values. Volatility indexes are not investable. Sources: Bloomberg and Cboe Exchange, Inc.
www.cboe.com/volatility

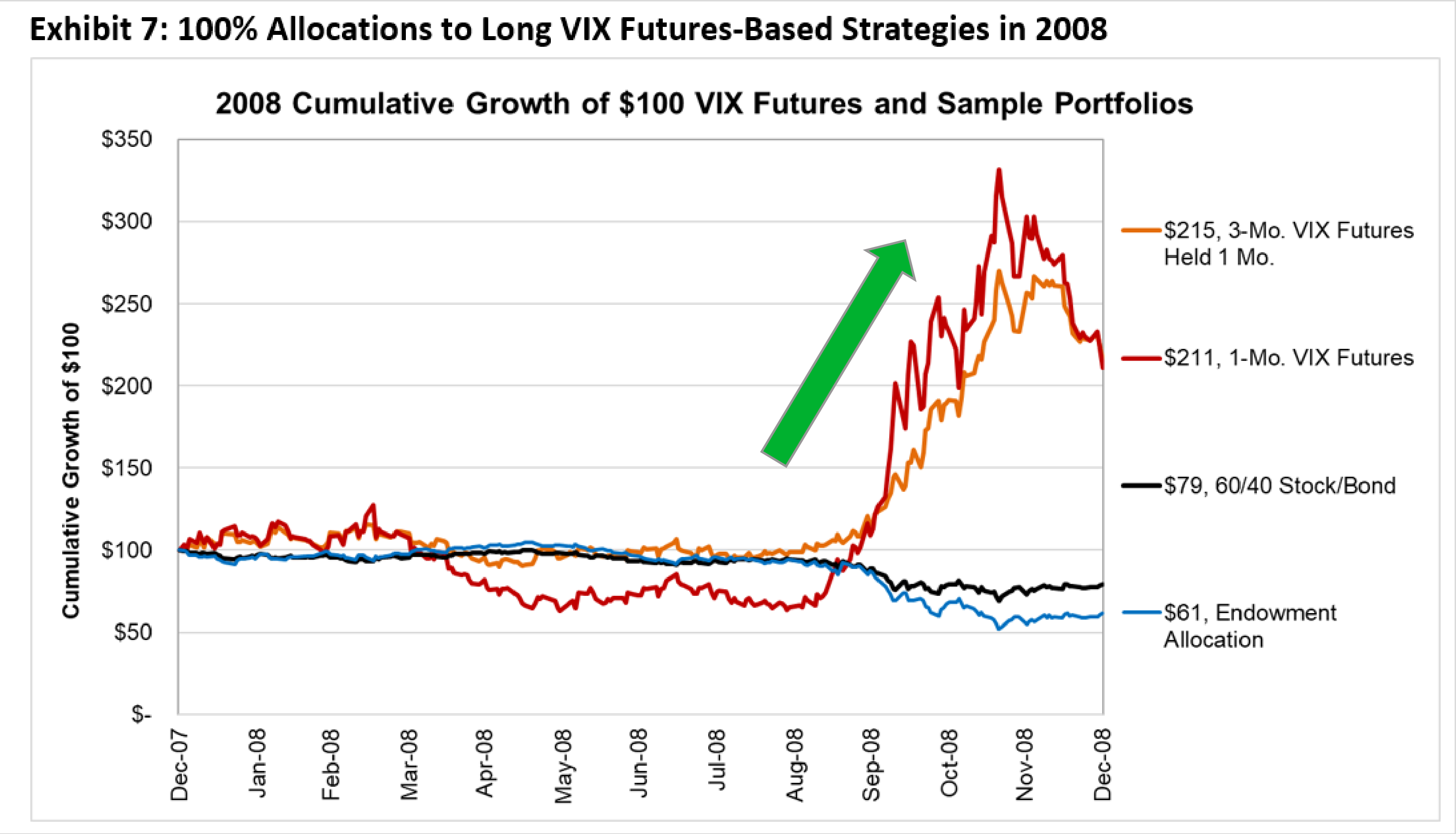
VIX Futures and Options

*Aggregate total volume in 2019 exceeded **210 million** for these 4 contracts.*



Sources: Cboe Exchange, Inc., and FIA

VIX Futures Strategies (2008)



Most VIX futures values rose in many weeks in September – October 2008

Sources: Cboe Option Exchange, CFE, Bloomberg

VIX Futures Strategies (2008)

Summary Statistics for the Year 2008	60/40 Stock/Bond Portfolio	Endowment	100% Allocation to 1-Mo. VIX Futures	100% Allocation to 3-Mo. VIX Futures Held 1 Mo.
Annualized Return	-20.9%	-38.6%	111.1%	114.9%
Annualized Standard Deviation	24.1%	31.0%	83.1%	48.2%
Sharpe Ratio	-0.87	-1.25	1.34	2.39
Maximum Drawdown	-30.9%	-50.4%	-50.8%	-22.3%
Skewness	0.16	-0.13	0.52	0.61
Kurtosis	4.14	3.21	1.30	1.03
Correlation w SPX	1.00	0.92	-0.82	-0.83
Beta	0.58	0.69	-1.66	-0.97
Alpha	1.53%	-17.63%	45.85%	51.19%
Alpha P-Value	0.501	0.158	0.338	0.061

Sources: Cboe Option Exchange, CFE, Bloomberg

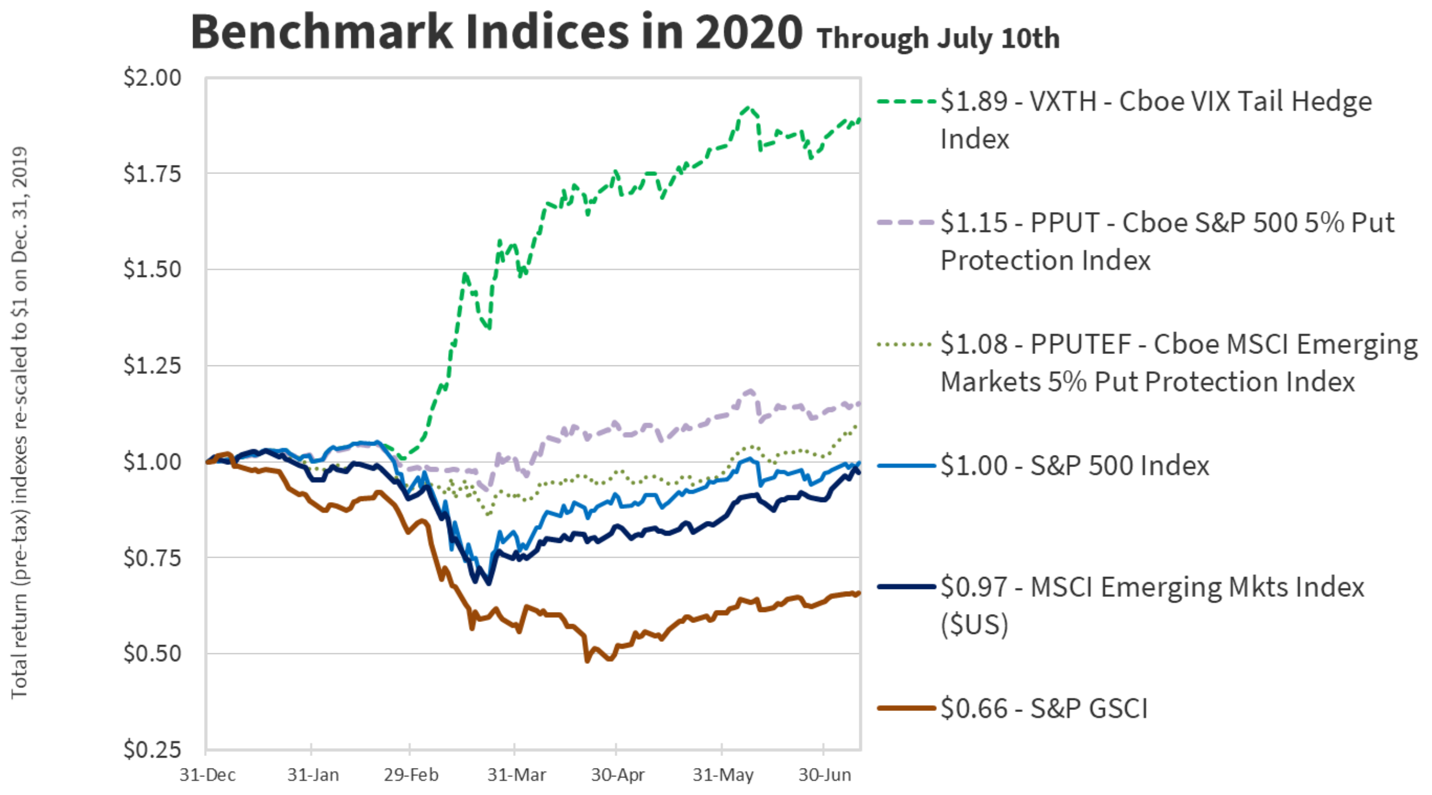
Cboe Benchmark Indices

Cboe offers dozens of benchmark indices that track the hypothetical performance of strategies that use index options and/or VIX futures. www.cboe.com/benchmarks

Strategy	Ticker	Description	Webpage
Buys SPX puts	**PPUT℠**	The Cboe S&P 500 5% Put Protection Index is designed to track the performance of a hypothetical strategy that holds a long position indexed to the S&P 500® Index and buys a monthly 5% out-of-the-money S&P 500 Index (SPX) put option as a hedge.	www.cboe.com/PPUT
Buy VIX futures	**SPVIXMTR**	Buys a combination of VIX futures positions in order to reflect the expectations of the VIX Index level in 5 months. Some of the VIX futures are rolled daily in order to maintain a constant average weighted five-month term.	
Cash-secured sale of VIX futures and Buy VIX calls	**VPN℠**	Tracks the performance of a strategy that systematically sells 1-month VIX futures, capped by the purchase of a VIX call option. The Index will be calculated once per day after the close. The short VIX futures position is capped with long VIX calls struck 25 points higher than the VIX futures price or calls at the closest strike below if this strike is not listed.	www.cboe.com/VPN
Buy VIX calls	**VXTH℠**	Buys and holds the performance of the S&P 500® index (the total return index, with dividends reinvested), and Buys one-month 30-delta call options on the Cboe Volatility Index® (VIX)® . New VIX calls are purchased monthly, a procedure known as the "roll." The weight of the VIX calls in the portfolio varies at each roll and depends on the forward value of VIX, an indicator for the perceived probability of a "swan event". The weights are determined according to the schedule below and the weights applied at a particular roll date can be seen by opening the VXTH Monthly Roll Spreadsheet (see webpage).	www.cboe.com/VXTH

Cboe Benchmark Indices (2020)

VXTH Index Bought VIX Calls and Rose 89%



(Dec. 31, 2019 - July 10, 2020) Daily re-scaled closing values. Sources: Bloomberg and Cboe Exchange, Inc. Past performance is not predictive of future returns. Read disclosures at www.cboe.com/benchmarks

VXTH, PPUT, and PPUTEF all were up in 2020 (through July 10), while none of the stock and commodity indices were up.

*The Cboe **VXTH Index** rose **89%** and benefited from the fact that it **bought VIX call options** which rose in value. The reported daily closing values for the VIX March 20 call options (that expired on March 18) rose from **$0.75** on February 19 to **$48.70** on March 17.*

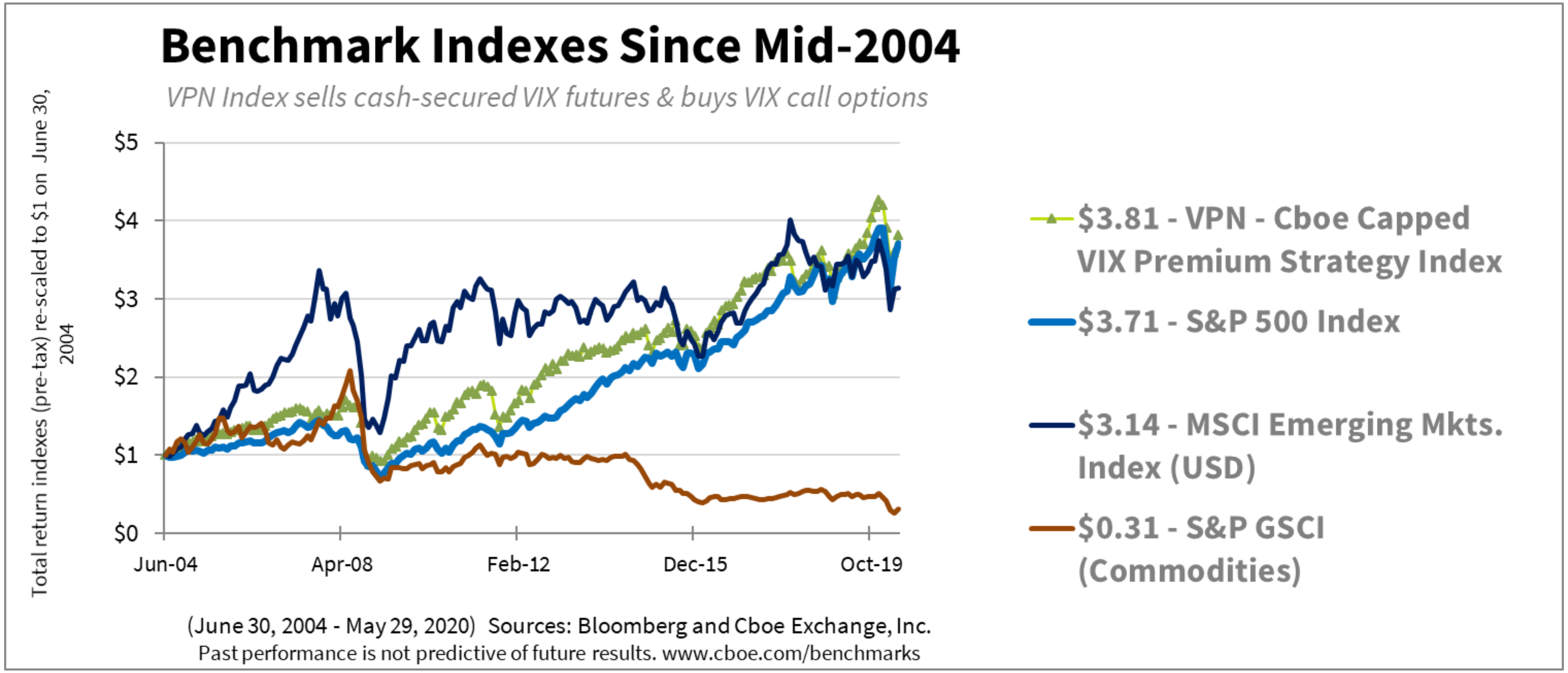
Note, on March 17 the closing value was 75.91 for the VIX Index, and the daily closing settlement value was 68.825 for the VIX March futures that expired on the following morning.

Cboe VPN Index

Sell Cash-Secured VIX Futures & Buy VIX Call Options

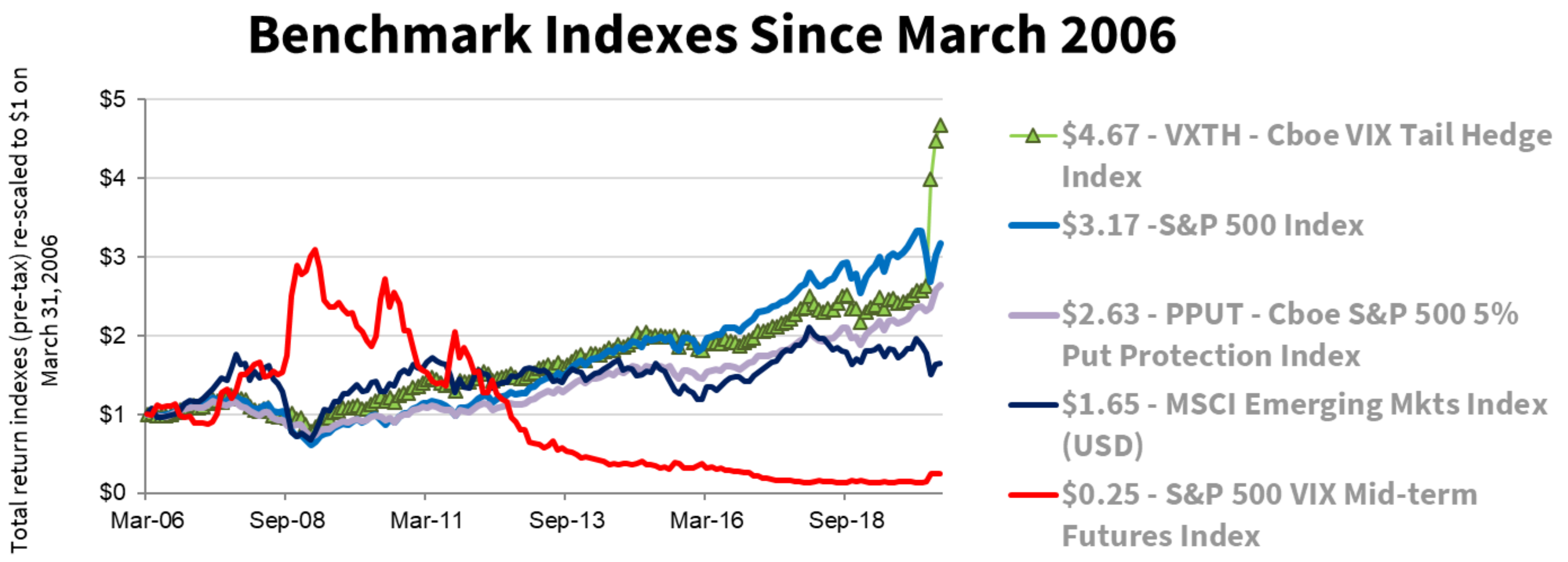
***Since mid-2004 the Cboe VPN Index rose 281%.** While the VIX futures- selling strategy is perceived to have the potential for both high return and high downside risk, the VPN Index **mitigates its downside risk** by holding cash and buying VIX calls.*

www.cboe.com/VPN



Cboe VXTH and PPUT Indices

VXTH rose more than 70% in 2007, 2008 and 2020 (through June 23)



(March 31, 2006 - May 29, 2020) Source: Cboe Exchange, Inc.
Past performance is not predictive of future results. Please read important disclosures at www.cboe.com/benchmarks.

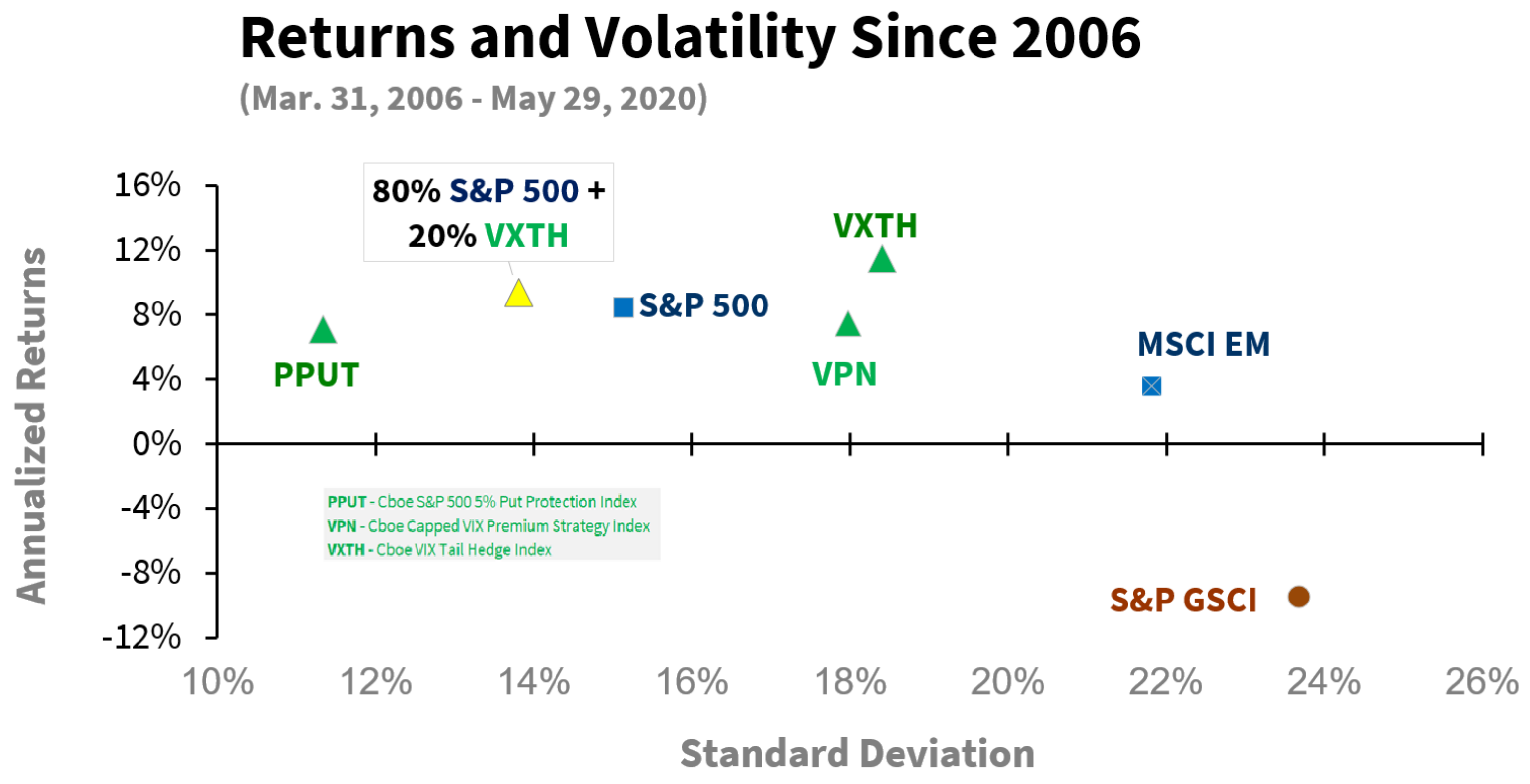
VXTH
- *Buys VIX call options*
- *www.cboe.com/VXTH*

PPUT
- *Buys SPX put options*
- *www.cboe.com/PPUT*

S&P 500 VIX Mid-Term Futures Index buys mid-term VIX futures; challenged by contango

Returns and Volatility

Diversification with VXTH Index That Buys VIX Calls Options



Sources: Cboe Exchange, Inc. and Bloomberg. Total return (pre-tax) indexes. Past performance is not predictive of future returns. www.cboe.com/benchmarks

The portfolio with **80%** allocation to S&P 500 and **20%** allocation to VXTH

- **9.4%** annualized return
- **13.8%** standard deviation

Thank you!

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