Interpreting Volatility-Related Indicators & Benchmarks

William Speth, Head of Research
Cboe Multi-Asset Solutions Team

March 7, 2018
Options reflect expected risk in the future, and the market price of protecting against that risk.

The Cboe Volatility Index® (VIX®) combines prices of hundreds of SPX℠ options to provide a single, standardized benchmark for 30-day expected volatility of S&P 500®.

Other volatility-related indicators and benchmarks provide a more nuanced and complete view of expected risk:

- **Volatility of Volatility** – Cboe VVIX Index
- **Skew** – Cboe SKEW Index, 90%-110% IV & CS Fear Barometer
- **Term Structure** – VIX, VVIX & SKEW
- **Correlation** – Cboe S&P 500 Implied Correlation Indices (ICJ, JCJ, KCJ)

Can be tradable or generate trading signals
The VIX® Index
What is the VIX Index?

- The VIX Index is an up-to-the-minute market estimate of 30-day expected volatility of the S&P 500® Index that is calculated by using the midpoint of real-time SPX option bid/ask quotes.
- The VIX Index methodology isolates pure volatility exposure directly from option prices.
- The VIX Index was designed as an underlying for tradable products. The VIX Index reflects what investors are actually paying for protection rather than how they are feeling about risks generally.

- Long term negative correlation with SPX returns (-.70); with short term variability
- VIX Index moves are convex to SPX; some of the largest VIX % moves have taken place during low volatility
- The VIX Index tends to spike in response to sharp down moves; falls more slowly in rising markets

Source: Cboe
Other things you should know about the VIX Index...

- The portfolio of SPX options comprising the VIX Index changes every minute.

- The range of strikes used in the VIX calculation is dynamic and is determined by the “zero-bid” rule:
  - As implied volatility increases, more OTM puts / calls become bid and the strike range increases.
  - As implied volatility falls, more OTM puts / calls have no bids and the strike range decreases.

- The VIX Index rises when option premiums increase and/or SPX strike range is extended.
“VIX of VIX” (VVIX)
What is “VIX of VIX”? 

- The Cboe VVIX Index ("VVIX") measures the volatility of the 30-day forward price of the VIX Index. This forward price is the price of a hypothetical VIX futures contract that expires in 30 days.
- VVIX is calculated using the VIX methodology applied to near- and next-term VIX options.
- VVIX is not the same as the expected volatility of the “spot” VIX Index, but the two are related.

- Beta of 30-day forward VIX to spot VIX ≈ 0.50
- Since 2007, average VVIX value is 88 vs. spot VIX volatility of 128

Source: Cboe
Properties & Uses of VVIX

- VVIX and VIX returns are positively correlated ≈ 0.80
- Highest 10% of VVIX values associated with Avg. VIX Index value of 28; 6 of highest VVIX values occurred in February 2018 (record 180 on 2/8)
- VVIX can be used to estimate risk premium of VIX options; expected variability of VIX Index values; an input to determine VIX futures FV

Source: Cboe
Recent VVIX behavior suggests demand for VIX options is another way to measure expected risk.

- VVIX has tended to be more correlated to the VIX Index since 2010.

January 2007 through February 2018
Source: Cboe
Skew Indicators
What is Skew?

- The difference between an observed price distribution and a theoretical “normal” distribution, whether large moves are more likely on the downside or upside.
- Option prices generally reflect the price of expected risk; OTM option prices reflect “tail” risk.
Measuring Skew with Options

- Cboe S&P 500 Skew Index (SKEW\textsuperscript{SM}) - derives expected skewness ("tail risk") of the S&P 500 using a strike-independent portfolio of SPX options
  - Like the VIX Index, uses 30-day options and range of strikes can vary
  - Statistic converted to index: \( \text{SKEW} = 100 - 10 \times \text{price of skewness} \)

- Strike Skew – compares the relative volatilities of OTM puts and calls equally spaced around ATM strike price (e.g., “90%-110%”)
  - Most common reference for skew
  - Flexible & intuitive

- CS Fear Barometer (“CSFB”) – measures amount of downside put protection that can be purchased with the sale of a 10% OTM call
  - Standardized pricing of a 3M zero-cost collar
  - High level of CSFB means that investors are willing to sacrifice upside in order to buy downside protection
SKEW Index measures expected “tail risk” of SPX

- SKEW methodology reflects imbalance of downside/upside tail risk
- SKEW Index has been increasing since 2008
- Possible structural, regulatory explanations

January 2007 through February 2018
Source: Cboe
What the SKEW Index is saying about perceived tail risk...

- SKEW Index measures the market expectation of a tail risk event
- 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

### Average SKEW & VIX Index Levels Annually

<table>
<thead>
<tr>
<th>Year</th>
<th>SKEW</th>
<th>2 SD Move Prob.</th>
<th>3 SD Move Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>100</td>
<td>2.30%</td>
<td>0.15%</td>
</tr>
<tr>
<td>1993</td>
<td>105</td>
<td>3.65%</td>
<td>0.45%</td>
</tr>
<tr>
<td>1996</td>
<td>110</td>
<td>5.00%</td>
<td>0.74%</td>
</tr>
<tr>
<td>1999</td>
<td>115</td>
<td>6.35%</td>
<td>1.04%</td>
</tr>
<tr>
<td>2002</td>
<td>120</td>
<td>7.70%</td>
<td>1.33%</td>
</tr>
<tr>
<td>2005</td>
<td>125</td>
<td>9.05%</td>
<td>1.63%</td>
</tr>
<tr>
<td>2008</td>
<td>130</td>
<td><strong>10.40%</strong></td>
<td><strong>1.92%</strong></td>
</tr>
<tr>
<td>2011</td>
<td>135</td>
<td><strong>11.75%</strong></td>
<td><strong>2.22%</strong></td>
</tr>
<tr>
<td>2014</td>
<td>140</td>
<td>13.10%</td>
<td>2.51%</td>
</tr>
<tr>
<td>2017</td>
<td>145</td>
<td>14.45%</td>
<td>2.81%</td>
</tr>
<tr>
<td>2017</td>
<td>150</td>
<td>15.70%</td>
<td>3.10%</td>
</tr>
<tr>
<td>2018</td>
<td>155</td>
<td>17.05%</td>
<td>3.40%</td>
</tr>
</tbody>
</table>

**Source:** Cboe
Is SKEW Tradable?

- 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

Source: Cboe, Bloomberg

January 2006 through February 2018
90% - 110% IV is most common Skew reference point

- Variability of 90%-110% 3M IV less than 90%-110% 1M IV
- Delta skew \[\frac{(25 \text{ delta put IV} - 25 \text{ delta call IV})}{50 \text{ delta IV}}\] is a variation of strike skew that adjusts for volatility

Source: Bloomberg
CS Fear Barometer offers unique & intuitive measure of market risk

January 2007 through February 2018

Source: Bloomberg
Skew measures didn’t pick up downside risk...

Source: Cboe, Bloomberg

January 2017 through February 2018
... due to demand for OTM calls relative to ATM

- “Smirk” became more of a smile Q3/Q4 2017, January 2018 as market moved to record highs; call selling slowed, short covering
- Demand for OTM SPX calls while ATM IV continued to grind lower
- Skew indicators interpreted the inversion of ATM and OTM call IV as more balanced risk, lower skew

Source: Cboe, Bloomberg
VIX, VVIX & SKEW Term Structure
What causes the VIX term structure behavior?

- Mean reversion and long-term uncertainty drives VIX futures term structure.
- When VIX spikes, shorter dated futures are more responsive because less time for VIX Index to mean revert.
- Longer dated VIX futures less responsive because high levels of VIX Index historically unsustainable.

![VIX Futures Term Structure during 2018 Correction](image)

**Backwardation**: downward-sloping term structure

**Contango**: upward-sloping term structure

Source: Cboe
VIX Futures Term Structure usually in contango but can be flat or in backwardation
VVIX Term Structure in backwardation, important implication for VIX options traders

VVIX Term Structure  
January 2, 2018 through January 31, 2018

Source: Cboe
SKEW Term Structure generally upward-sloping but still reflects market shocks

SKEW Term Structure
January 16, 2018 through February 15, 2018

Source: Cboe
Cboe Implied Correlation Indices
What are ICJ, JCJ & KCJ?

- The Cboe S&P 500 Implied Correlation Indexes (ICJ, KCJ, JCJ) measure changes in the relative premium between index options and single-stock options.
- Index volatility is driven by a combination of two factors: the volatilities of index components and the correlation of index component price returns.
- ICJ, JCJ & KCJ are rotating “tranches” of implied correlation, each running for overlapping 2-year periods. Two tranches are active at any one time.
- ICJ, JCJ & KCJ measure average implied correlation using SPX options and a tracking basket of the top 50 SPX components by market cap.
- Option implied volatilities are based on ATM strangles for both SPX options and options on stocks in the tracking basket.
- SPX tracking basket is re-balanced once per month.
Correlation key driver of volatility - Tale of Two Correlation Regimes

- Implied correlation ranged from 50 – 70 through 2015; began to decline in 2016, along with the VIX Index.
- After the 2016 election, ICJ, JCJ & KCJ fell to historic lows, averaging 43.
- JCJ 2018 fell below 20 in October, as 1M realized correlation fell below 10.

Source: Cboe
Options involve risk and are not suitable for all investors. Prior to buying or selling an option, a person must receive a copy of Characteristics and Risks of Standardized Options. Copies are available from your broker or from The Options Clearing Corporation at www.theocc.com. Futures trading is not suitable for all investors, and involves the risk of loss. The risk of loss in futures can be substantial. You should, therefore, carefully consider whether such trading is suitable for you in light of your circumstances and financial resources. For additional information regarding futures trading risks, see the Risk Disclosure Statement set forth in CFTC Regulation §1.55(b). The information in these materials is provided for general education and information purposes only. No statement within these materials should be construed as a recommendation to buy or sell a security or to provide investment advice. Supporting documentation for any claims, comparisons, statistics or other technical data in these materials is available by contacting Cboe at www.cboe.com/Contact. The Cboe Volatility Index, Cboe VIX Index, Cboe S&P 500 Skew Index and the Cboe S&P 500 Implied Correlation Indexes (the “Indexes”) are designed to represent proposed hypothetical options strategies. The actual performance of investment vehicles such as mutual funds or managed accounts can have significant differences from the performance of the Indexes. Investors attempting to replicate the Indexes should discuss with their advisors possible timing and liquidity issues. Like many passive benchmarks, the Indexes do not take into account significant factors such as transaction costs and taxes. Transaction costs and taxes for strategies such as the Indexes could be significantly higher than transaction costs for a passive strategy of buying-and-holding stocks. Investors should consult their tax advisor as to how taxes affect the outcome of contemplated options transactions. Past performance does not guarantee future results. These materials contain index performance data based on back-testing, i.e., calculations of how the index might have performed prior to launch. Back-tested performance information is purely hypothetical and is provided in these materials solely for informational purposes. Back-tested performance does not represent actual performance and should not be interpreted as an indication of actual performance. Index performance returns do not reflect management fees, transactions costs or expenses. No representation is being made that any investment will or is likely to achieve a performance record similar to that shown. Parameters relating to past performance of strategies discussed are not capable of being duplicated. It is not possible to invest directly in an index. CBOE®, CBOE Volatility Index®, and VIX® are registered trademarks and SKEWSM, SPXSM and VVIXSM are service marks of Cboe Exchange, Inc. S&P 500® is a registered trademark of Standard & Poor’s Financial Services, LLC and is licensed for use by Cboe Exchange, Inc. Financial products based on S&P indices are not sponsored, endorsed, sold or promoted by Standard & Poor’s, and Standard & Poor’s nor Cboe make any representation regarding the advisability of investing in such products. All other trademarks and service marks are the property of their respective owners.