Managing Volatility Through VIX Linked Indices

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Equity Volatility and Black Swan Risks

Source: S&P Dow Jones Indices, CBOE. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results.
Failure of the Traditional Approach to Portfolio Diversification

**Risk Contribution of 60 Equity / 40 Fixed Income Portfolio**

- Total Portfolio Variance
- Equity Risk Contribution
- Fixed Income Risk Contribution

**Asset Class Correlation with S&P 500**

- Emerging Markets Equities
- Commodities
- Credit

Source: S&P Dow Jones Indices, Barclays. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results.
Evolution of VIX-Linked Volatility Indices

- **1993-2004**
  - 1993: VIX®
  - 2003: VIX® re-launched
  - 2004: VIX Futures

- **2008-2009**
  - 2008: S&P 500 VIX Short and Mid Term Futures Index®
  - 2009: VIX ETNs
  - Inverse
  - Leveraged

- **2010-2012**
  - S&P 500 Dynamic VIX Futures®
  - S&P 500 VIX Futures Enhanced Roll®
  - S&P 500 VIX Futures Term Structure®

- **2010-**
  - S&P 500 Dynamic VEQTOR®
  - CBOE VIX Tail Risk Hedge Strategy

**Measuring**

**Trading**

**Investment**
S&P 500 VIX Futures Indices
Preserving the Tail Risk Hedge Benefits

- The S&P 500 VIX Futures indices retain the characteristics of VIX spot
  - Correlation of S&P 500 VIX Futures Short-Term vs. Spot VIX: 90%
  - Correlation of S&P 500 VIX Futures Short-Term vs. S&P 500: -80%

Source: S&P Dow Jones Indices, CBOE. Based on weekly returns from December 2005 to August 2013. Past performance is no guarantee of future results. Some of the information used in this chart reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.
S&P 500 VIX Futures Indices
Trade-off between Liquidity, Beta Exposure and Roll Cost

- The shorter dated VIX Futures indices have higher underlying liquidity, and are more sensitive to moves in the spot VIX
- However, longer dated VIX Futures indices have much lower roll costs, due to the flatter term structure

Source: S&P Dow Jones Indices, CBOE. Traded volume data as of May 2013. VIX futures index return data from December 2005 to August 2013. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results.
Dynamic Volatility Exposure
S&P 500 Dynamic VIX Futures Index

- The S&P 500 Dynamic VIX Futures index dynamically allocates between the Short-Term and Mid-Term Futures indices, depending on the steepness of the VIX futures curve.
- It aims to deliver more efficient exposure to volatility, by:
  - reducing roll costs during normal volatility environments
  - increasing beta to spot VIX with increasing market volatility

Source: Barclays Capital, S&P Dow Jones Indices.
Hedging European Equities with VIX

• Using VIX instruments to hedge European equities requires examining the trade-offs between liquidity and basis risk

• VIX linked products dominate volatility trading globally
  – E.g., average daily traded Vega volumes of $150 million in VIX futures vs. €2 million in VSTOXX futures

• Despite Europe specific risk factors, the U.S. and European volatility indices are highly correlated

Correlation Matrix of Equity Indices and Volatility Indices

<table>
<thead>
<tr>
<th></th>
<th>Euro Stoxx 50</th>
<th>Dax</th>
<th>FTSE 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSTOXX</td>
<td>-75.31%</td>
<td>-69.98%</td>
<td>-76.31%</td>
</tr>
<tr>
<td>VIX</td>
<td>-55.60%</td>
<td>-52.33%</td>
<td>-61.10%</td>
</tr>
<tr>
<td>S&amp;P VIX Short Term Futures</td>
<td>-66.05%</td>
<td>-67.00%</td>
<td>-68.02%</td>
</tr>
</tbody>
</table>

Source: S&P Dow Jones Indices, CBOE, STOXX, Deutsche Boerse. Data from December 2005 to August 2013. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results.
Cross-Asset Hedging with VIX

VIX's Correlation with European Credit Spreads: 0.63

Correlation Matrix of Commodities and Volatility Indices

<table>
<thead>
<tr>
<th></th>
<th>Oil</th>
<th>Gold</th>
<th>Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSTOXX</td>
<td>-33.72%</td>
<td>-0.44%</td>
<td>-30.74%</td>
</tr>
<tr>
<td>VIX</td>
<td>-28.16%</td>
<td>-5.53%</td>
<td>-29.36%</td>
</tr>
<tr>
<td>S&amp;P VIX Short Term Futures</td>
<td>-46.34%</td>
<td>-18.48%</td>
<td>-48.08%</td>
</tr>
</tbody>
</table>

Source: S&P Dow Jones Indices, Markit, Barclays. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results.
Volatility-Managed Equity Indices using VIX Futures

- The S&P 500 Dynamic VEQTOR Index provides investors with broad equity market exposure with an implied volatility hedge, by dynamically allocating between equity, volatility and cash.

### Performance Table

<table>
<thead>
<tr>
<th>Year</th>
<th>S&amp;P 500 Total Return</th>
<th>S&amp;P 500 Dynamic VEQTOR Index Total Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>15.79%</td>
<td>14.15%</td>
</tr>
<tr>
<td>2007</td>
<td>5.49%</td>
<td>17.20%</td>
</tr>
<tr>
<td>2008</td>
<td>-37.00%</td>
<td>21.29%</td>
</tr>
<tr>
<td>2009</td>
<td>26.46%</td>
<td>23.39%</td>
</tr>
<tr>
<td>2010</td>
<td>15.06%</td>
<td>1.65%</td>
</tr>
<tr>
<td>2011</td>
<td>2.11%</td>
<td>17.41%</td>
</tr>
<tr>
<td>2012</td>
<td>16.00%</td>
<td>3.54%</td>
</tr>
<tr>
<td>Jan-Aug 2013</td>
<td>16.15%</td>
<td>8.50%</td>
</tr>
</tbody>
</table>

### Annualized Volatility

<table>
<thead>
<tr>
<th>Year</th>
<th>S&amp;P 500 Total Return</th>
<th>S&amp;P 500 Dynamic VEQTOR Index Total Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>10.03%</td>
<td>7.50%</td>
</tr>
<tr>
<td>2007</td>
<td>16.03%</td>
<td>9.55%</td>
</tr>
<tr>
<td>2008</td>
<td>41.01%</td>
<td>16.16%</td>
</tr>
<tr>
<td>2009</td>
<td>27.25%</td>
<td>14.32%</td>
</tr>
<tr>
<td>2010</td>
<td>18.07%</td>
<td>10.28%</td>
</tr>
<tr>
<td>2011</td>
<td>23.37%</td>
<td>10.78%</td>
</tr>
<tr>
<td>2012</td>
<td>12.74%</td>
<td>8.15%</td>
</tr>
<tr>
<td>Jan-Aug 2013</td>
<td>11.62%</td>
<td>7.88%</td>
</tr>
</tbody>
</table>

Source: S&P Dow Jones Indices. Past performance is no guarantee of future results. Some of the information used in this chart reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.
Conclusions

• Demand for volatility ETPs stays strong

• VIX based instruments may serve as global and cross asset class volatility tools

• Volatility-managed investment strategies provide pre-packaged investment solutions
Performance Disclosure

The S&P 500 VIX Short Term Futures and S&P 500 Mid-Term Futures Index were launched on December 22, 2008. The S&P 500 Dynamic VEQTOR Index was launched on May 25, 2010. All information presented prior to the launch date is back-tested. Back-tested performance is not actual performance, but is hypothetical. The back-test calculations are based on the same methodology that was in effect when the index was officially launched. Complete index methodology details are available at www.spdji.com. It is not possible to invest directly in an index.

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Past performance of the Index is not an indication of future results. Prospective application of the methodology used to construct the Index may not result in performance commensurate with the back-test returns shown. The back-test period does not necessarily correspond to the entire available history of the Index. Please refer to the methodology paper for the Index, available at www.spdji.com for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Another limitation of using back-tested information is that the back-tested calculation is generally prepared with the benefit of hindsight. Back-tested information reflects the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities, fixed income, or commodities markets in general which cannot be, and have not been accounted for in the preparation of the index information set forth, all of which can affect actual performance.

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