VolS

Volatility Strategies

VolX®

Home of RealVol® Indices

Advances in Forecasting Risk

Issue #

7

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$$\sqrt{\frac{252}{n}\sum_{t=1}^{n} R_t^2}$$

Strategy Article #7 describes two cutting-edge models that have shown to forecast volatility better than the market itself can. VolX decided to create indices of these forecasts, over six time frames, backfilled typically for decades, and based on 40 key global assets. Having such an extensive dataset allows investors and traders to acquire a deep understanding of the performance of these models over many business cycles. We are proud to introduce Rough Vol (symbol RVOL) and HARK Vol (symbol HVOL) indices. Before they are explained, some background information will prove useful.

Realized Volatility

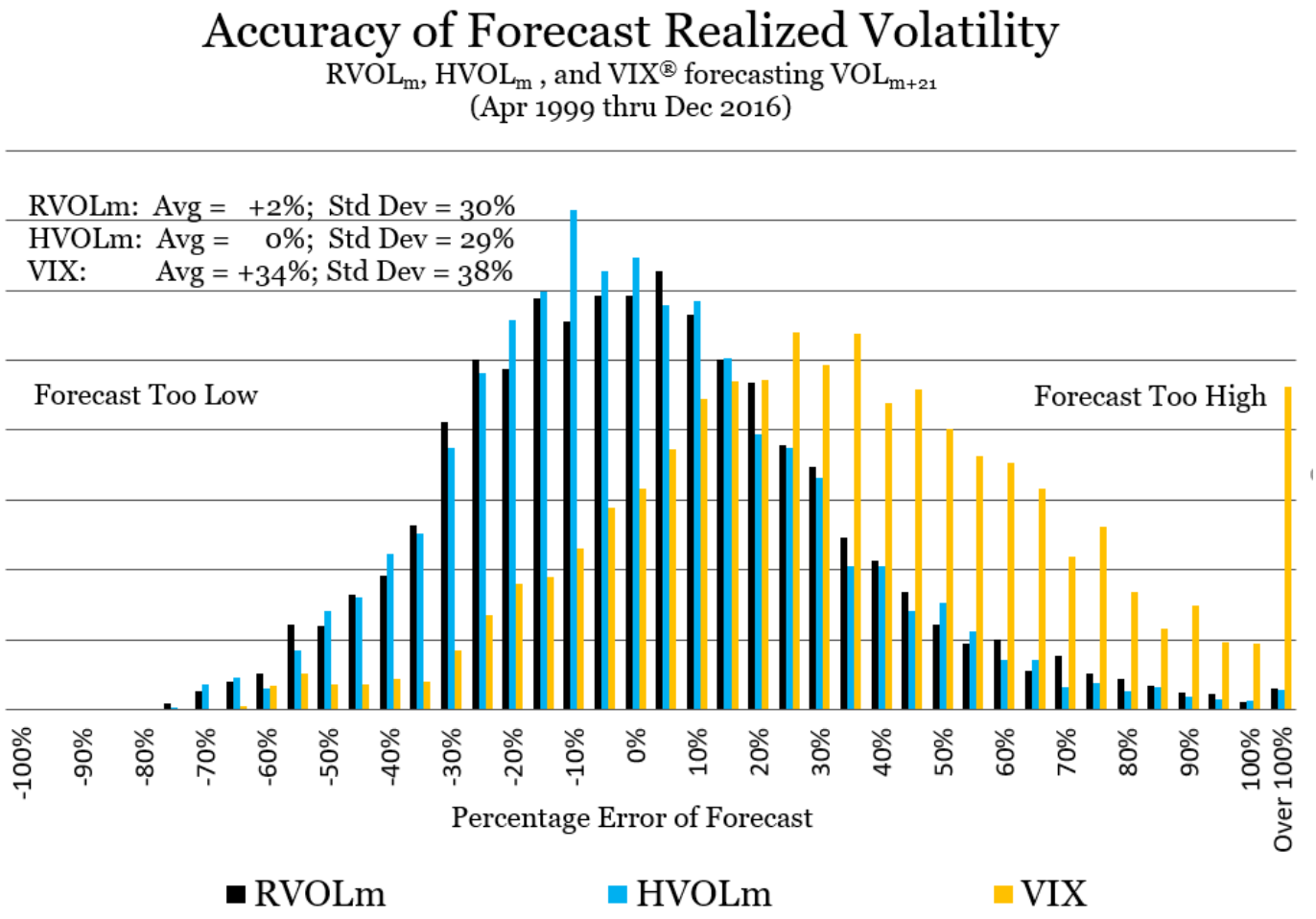
There are various ways to measure risk. Realized volatility attempts to measure the actual risk of some underlying asset over a certain time frame, typically using daily closing values only. The RealVol Indices of realized volatility are labeled VOL.

Implied Volatility

Implied volatility is derived from options prices using an options model and working backwards to find a volatility input that would generate the premium being traded in the market. In other words, the premium charged implies a certain expected risk level.

Meaning of the Two Volatilities

While no measurement is perfect, the formula for assessing realized volatility on a close-to-close basis has been shown to be a fairly accurate gauge of actual price risk (as long as there are enough observations). Implied volatility is the level at which buyers and sellers are willing to transact. While this traded premium is, theoretically, a forecast of the risk to come, in actuality it is simply the price at which market participants are willing to execute an options transaction. Academics measure the difference between the forecast of risk and the price at which participants are willing to transact as the "risk premium." The risk premium can vary. Researchers have shown it to be, on average, a significant positive value. Essentially, buyers of options are willing to pay a price above theoretical value for the protection that an option offers. In other words, "peace of mind" has a quantifiable value.



RVOL and HVOL Histogram

The histogram above attempts to display graphically the accuracy of the RealVol models RVOL and HVOL. In this example, the *1-month* forecasts are shown (hence the symbols RVOLm and HVOLm). To begin the collection of the data, forecasts of RVOLm and HVOLm are observed for a specific day. Those forecasts are then compared to the actual realized volatility over the next 21 trading days (VOL_{m+21}). If this process is repeated for each day in the sample of historical data, with the percentage errors plotted on a histogram, one can discern the relative precision of the forecasts.

For example, suppose that the HVOL model forecasts that the coming month's realized volatility (VOL) will be 20%. Looking forward in time 21 days later, the VOL index (VOL_{m+21}) turns out to be 30%. In this hypothetical example, the 20% forecast was about 33% too low (20%/30% – 1).

VIX Histogram

To highlight the relative accuracy of these models, a third plot was performed using the VIX® index (source CBOE). Some would argue that implied volatility levels are not a good predictor of future realized volatility. Others would say that VIX ought to be the best predictor available (after adjusting for the risk premium) because the index is the result of trader interactions and should incorporate all known information. Regardless of one's view, it is evident that implied volatility, as represented by VIX, is typically too high. This phenomenon corresponds to the academic literature describing how, normally, options prices, especially out-of-the-money puts, often contain a substantial risk premium. During the period studied, using VIX to forecast realized volatility levels produced values that were, on average, 34% too high. For example, if VIX were currently at 20%, the resulting realized volatility one month later would be, on average, 14.93% (20%/1.34).

Accuracy

In addition to measuring the means of the various forecasts, the second statistic to observe is the dispersion of those predictions (the standard deviation, or s.d.) around their means. If, for example, VIX were perfect at predicting future realized volatilities but consistently guessed 34% too high, it would be trivial to ascertain the "correct" future realized volatility simply by reducing the VIX forecast by the amount of the upward bias. Of course, it is difficult to predict the future; hence the s.d. around the average. It is important to note that not only do the HVOL and RVOL models have little or no bias in their average forecast values (0% and 2% means, respectively), but their standard deviations are also smaller than that of VIX, indicating more accurate forecasts by roughly 21% (1 – 30%/38%) to 24% (1 – 29%/38%).

RVOL Indices

The Rough Vol model (Rough Fractional Stochastic Volatility or "RFSV") forecasts realized volatility. According to the model, created by Professor James Gatheral of Baruch College, the log of daily high/low realized volatilities is well approximated by fractional Brownian motion with a Hurst parameter H close to zero.

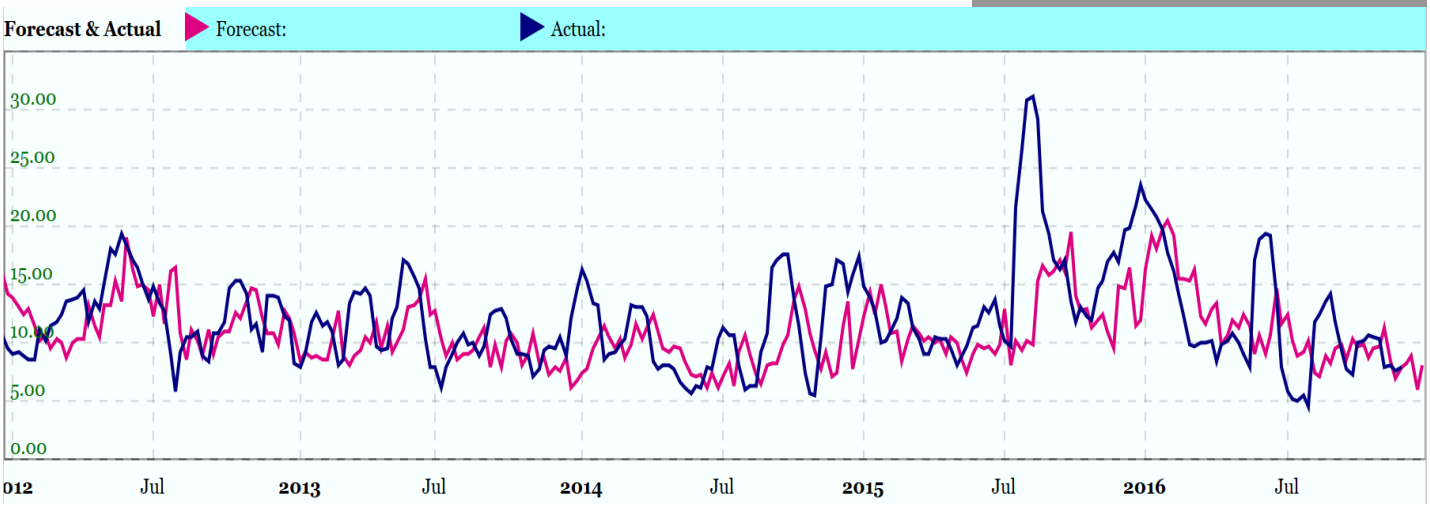
HVOL Indices

HARK (Heterogeneous Auto-Regressive model cast into a Kalman filter framework) is a forecast of realized volatility, created by Professor Fulvio Corsi of Ca' Foscari University of Venice. It is a dynamic extension of his asymmetric (i.e., with leverage effects) HAR model, but where the parameters are continuously and optimally updated by the Kalman filter according to the statistical properties of the overnight/intraday RealVol Index (DVOL). This allows flexibility and fast adaptation to the original HAR model, which was also created by Professor Corsi.

Our preliminary research has shown that both the RVOL and HVOL models approximate future realized volatility more accurately than the market (implied volatility) and standard GARCH models. Both models have similar long-run predictive accuracy, but arrive at their forecasts in quite different manners — often diverging significantly over short periods of time.

Theoretically, this should not be possible...

RVOLm vs. Lagged VOL $_{m+21}$ (2012 through 2016)



Another View

The chart on page 3 shows the RVOLm forecast (pink line) and the lagged VOL_{m+21} results (blue line) plotted together over the five-year period, 2012 through 2016. By lagging the VOL_{m+21} data, it is much easier to compare the forecast with the results, as the two are now aligned. As an example, on January 4, 2016 (corresponding to the vertical dotted line immediately above the label "2016"), the RVOLm forecast was 16.29 for the coming month. One month later, the actual realized volatility (VOL_{m+21}) turned out to be 22.23 (i.e., RVOLm underestimated the actual value by 27% on this particular day). Since the VOL data points have been moved backwards in time by 21 days, it is easier to compare the forecasts versus the results at each point. As one can see from the plots, RVOL, while not perfect, has done a very good job of forecasting future VOL. Similar results occur with HVOL, but one should collect and review the data closely to discern some key differences, especially during times of market stress.

The Efficient Market Hypothesis

As stated in Wikipedia: "In financial economics, the efficient-market hypothesis (EMH) states that asset prices fully reflect all available information. A direct implication is that it is impossible to 'beat the market' consistently on a risk-adjusted basis since market prices should only react to new information or changes in discount rates (the latter may be predictable or unpredictable).

"The EMH was developed by Professor Eugene Fama who argued that stocks always trade at their fair value, making it impossible for investors to either purchase undervalued stocks or sell stocks for inflated prices. As such, it should be impossible to outperform the overall market through expert stock selection or market timing, and that the only way an investor can possibly obtain higher returns is by chance or by purchasing riskier investments."

Theoretically, This Should Not Be Possible

Our results seem to directly refute Professor Fama's Efficient Market Hypothesis. RVOL and HVOL look only at historical data to make their predictions. Since market participants are able to incorporate both future information (such as an upcoming election, date of earnings release, or other scheduled events) and historical analysis in their forecasts, they should be able to outperform any model that looks solely at historical data. However, as has been shown, the RVOL and HVOL models have predicted future risk levels in SPY approximately 21% to 24% more accurately than the "efficient" market itself can.

Uses

Having a more accurate forecast of future risk levels could help guide risk-averse investors into constructing a more efficient portfolio. Options traders, especially, could benefit, as option premiums are directly affected by perceived risk levels. Finally, sophisticated investors who trade volatility through variance swaps, volatility swaps, or VIX instruments could benefit directly from better volatility forecasts.

Getting the Data

On the main page of the web site volx.us, there are links to free historical and forecast RealVol Index data and charts on SPY. The data and charts include the RVOL and HVOL model forecasts. Beyond SPY, other key underlying assets require a subscription. To subscribe, simply click on the orange "Subscribe" button, which is also on the main page of the web site.

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