OptionMetrics

VIX – Fear of What?

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The widely touted "fear gauge" is less about what *might* happen, and more about what already *has* happened.

Summary

- The VIX, while promoted as an indicator of future market volatility, has more to do with present and past market returns than future volatility
- Most (98.8%) of the daily variation in the VIX can be explained by current SPX returns and lagged VIX values
- Unexplained changes in the VIX are more likely due to contemporaneous market reactions rather than fear of future events
- Despite its lack of predictive ability, the VIX could be useful as a hedge against bidirectional jump risk

Introduction

The CBOE Volatility Index, or VIX, is described by the CBOE as "a measure of market expectation of short-term volatility conveyed by SPX option prices." The VIX is calculated by constructing a set of synthetic variance swaps using the prices of S&P 500 index options traded on the CBOE. The values of these variance swaps are then used to derive a 30-day (annualized) volatility. By construction, the VIX closely tracks the Black-Scholes implied volatility of at-the-money SPX options with expirations closest to 30 calendar days.

In recent years, the VIX has become more popular in the financial press as a barometer of market risk. Often referred to as the "fear gauge", an increase in the VIX is generally regarded as a forward-looking indicator of higher turmoil in the stock market. If the VIX is to be

considered a reliable and useful indicator, it should possess at a minimum the following two characteristics:

1. Day-to-day changes in the value of the VIX should reflect the market's changing expectations of future volatility, and

2. The VIX should contain information about future volatility beyond that which is already available from current and past SPX returns.

To see whether these characteristics are actually present in the VIX, we regress the VIX against a set of lagged values of the VIX itself as well as contemporaneous and lagged values of the SPX and its second and fourth power.

We find that 98.8% of the variation in the VIX can be explained by a small set of explanatory variables. This means that no more than 1.2% of the VIX's daily variance can be explained by changes in market sentiment which are not already reflected in the SPX index. We additionally find that of this remaining variation in the VIX, most of it appears to be correlated with extreme stock market events happening contemporaneously, rather than predicting future volatility shocks.

These results suggest that the VIX's value is less that of a predictor of future volatility shocks, and more as a measure of contemporaneous SPX jump risk. In fact, we envision that traded instruments based on the VIX, such as VIX futures, could be used to effectively hedge jump risk, and thus have a useful risk-management role.

Data

We use the daily closing VIX and SPX values from the OptionMetrics IvyDB US database for dates from January 2, 1996 to August 5, 2016. These series are depicted in Figure 1. The most evident characteristic is the strong negative correlation between the VIX and the SPX, with downward moves in the SPX tending to correspond with increases in the VIX and vice-versa.

The SPX index which underlies the VIX has significant heteroscedasticity, with short term shocks in variance tending to persist over several days. Since the VIX represents 30-day (averaged) volatility on the SPX index, we might expect to see the VIX generally reverting to a long term mean value, with short-term jumps in volatility tending to decay over time. In fact, the VIX data does exhibit negative autocorrelation, or "reversion to the mean", as is also apparent in the chart of VIX in Figure 1 and the histogram in Figure 2.

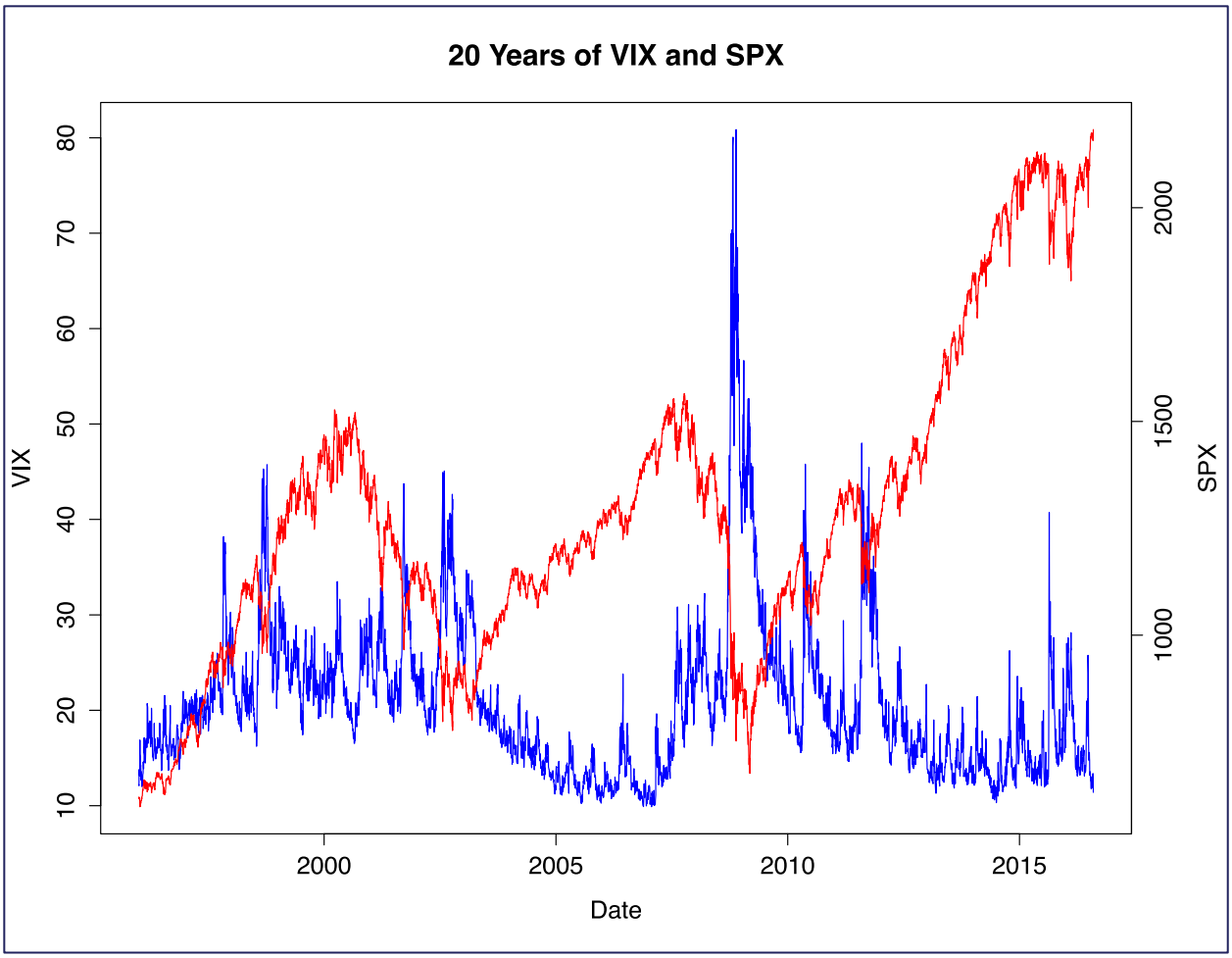

Figure 1 – VIX and SPX

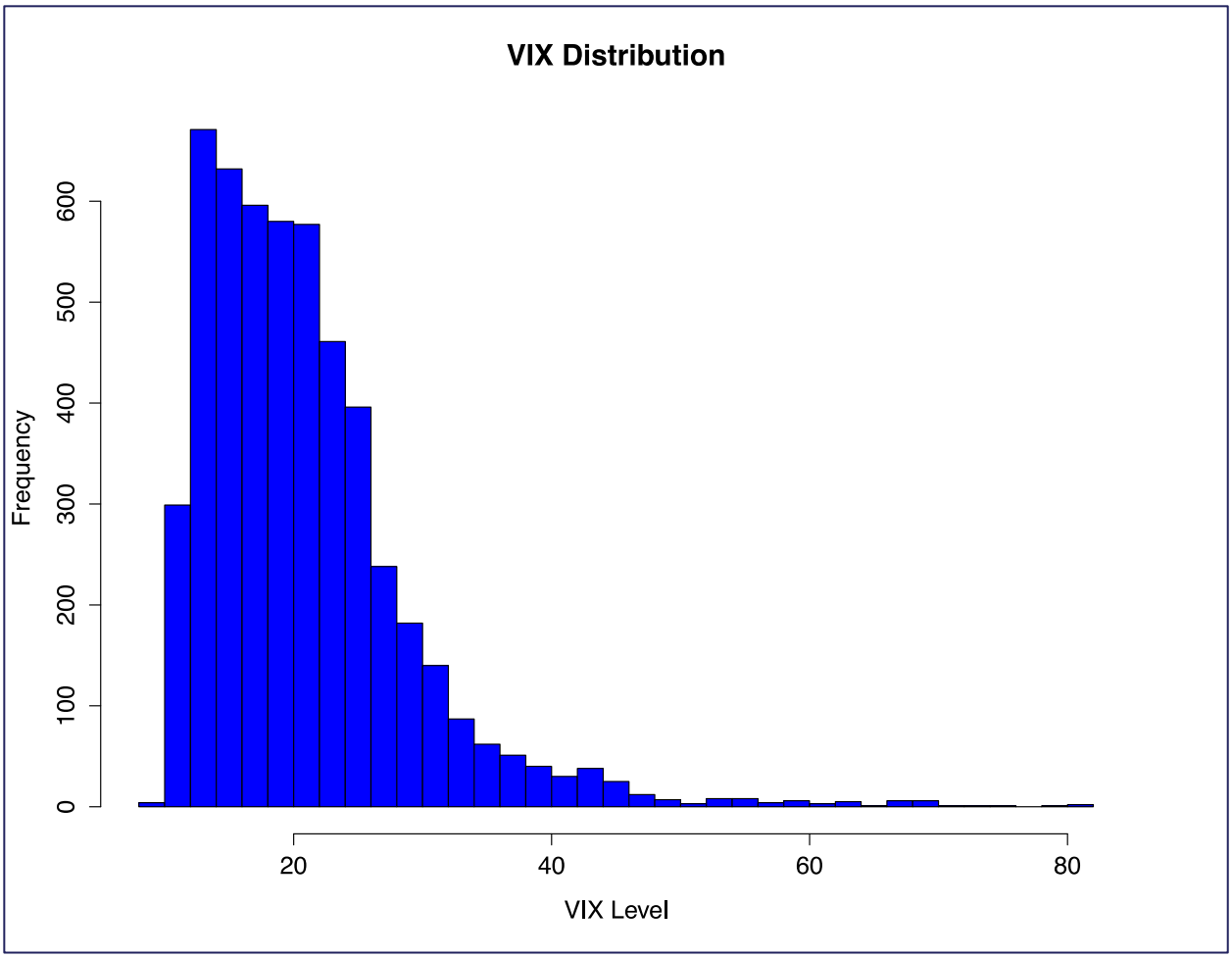

Figure 2 – VIX Histogram

Model and Estimation

We estimate a regression equation using the current level of VIX as the dependent variable, and the following independent variables:

VIXT1, VIXT5, and VIXT10 – the VIX index lagged by 1 day, 5 days, and 10 days, respectively. The choice of lags attempt to capture dependency of the level of the VIX from one day, one week, and two weeks prior.

SPXR, SPXR2, SPXR4 – The return on the SPX index, return-squared, and return to the fourth power, respectively. The SPXR variable are intended to capture the negative correlation between changes in the SPX and the VIX; while the SPXR2 and SPXR4 variables will capture any direction-independent jump effects of the SPX on the VIX.

The results of the regression are given in Table 1. All of the regression variables are significant to p <= 0.001. The R^2 of the regression, signifying the proportion of VIX variance explained by the regression variables, is approximately 0.988. The standard error of the residuals is approximately 0.907.

Table 1 – Regression Results

	Estimate	*Std. Error*	*t value*
Constant	0.449	0.037	12.157
VIXT1	0.911	0.005	190.718
VIXT5	0.039	0.005	7.09
VIXT10	0.025	0.004	5.802
SPXR	-106.205	1.041	-102.008
SPXR2	964.305	51.9	18.58
SPXR4	-70511.237	6122.303	-11.517

R^2 = 0.988. F-stat (6,5161) = 70627.092. Resid. S.E. = 0.907

Other than the linear dependence of the VIX on SPX and the lagged VIX values, there is a significant dependence on SPXR2 and SPXR4.

A scatter plot of the residuals is shown in Figure 3. Ninety-five percent (95%) of the residuals fall in the interval (-1.63, 1.84), which indicates that our model is accurate to within better than 2 VIX points on any given day.

We have indicated residuals that have a large magnitude than ±3 with a red dot. Several of these extreme values have been identified with a notable event that occurred on that day. In particular, we can see that most of the extreme deviations from our regression model occurred during a large move in the VIX corresponding to a large SPX shock (or a large reversion back to the mean on the next day, as a correction). This suggests that while SPXR2 and SPXR4 capture a large portion of the variation in the VIX due to jumps, there is still room for further explanation of large VIX movements as a result of information surprises. However, this effect is contemporaneous, not predictive, contrary to the assumed role of a VIX as having predictive ability for large volatility movements.

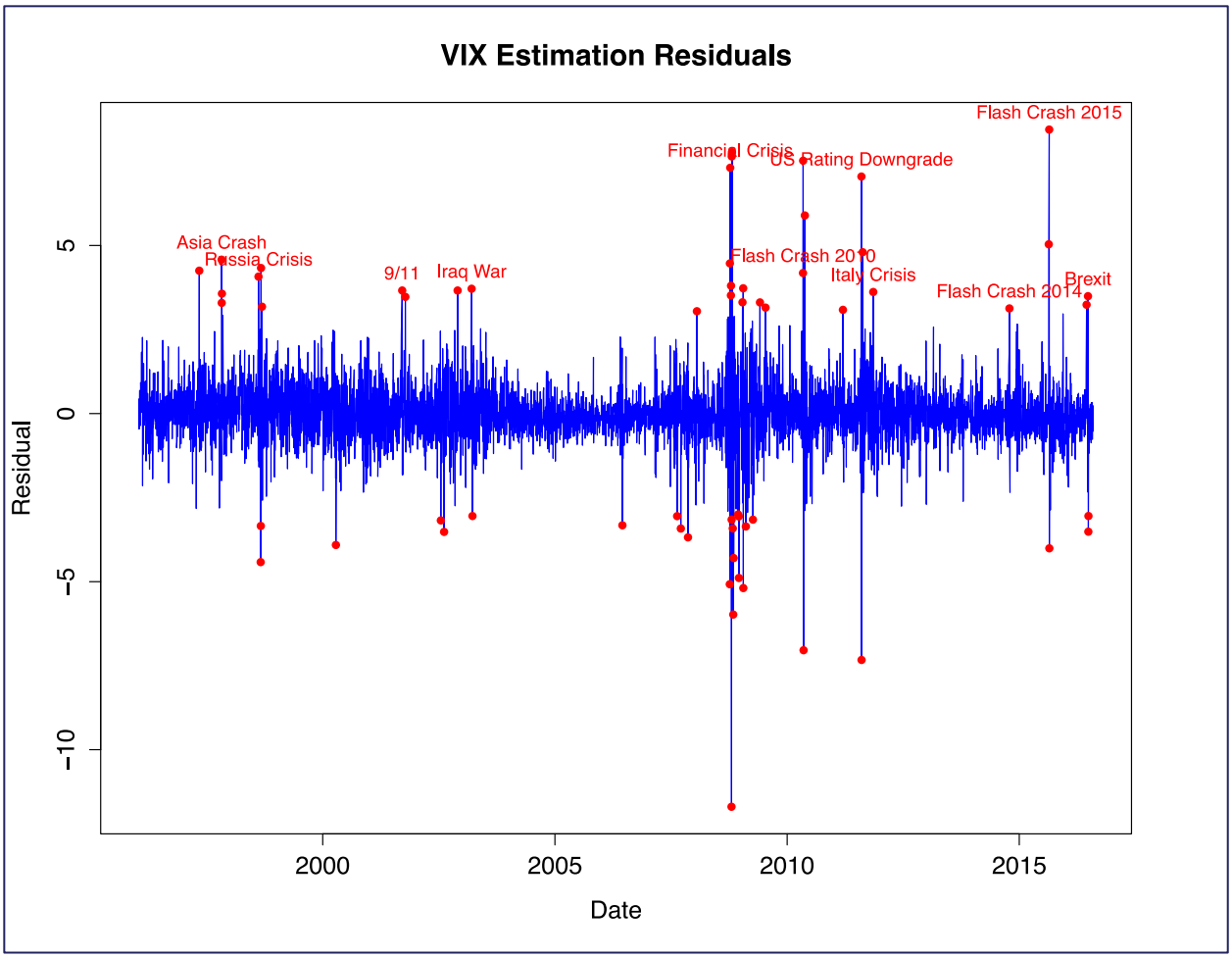

Figure 3 – Estimation Residuals by Date

Conclusion

The value of the VIX index on any given day is mostly determined by its value on the previous day and other lagged periods, and the magnitude and direction of the change in the SPX index on the same day. Since an overwhelming portion of its daily variation is explainable by contemporaneous measures, this would suggest that its value as a predictor of future volatility, or as a "fear gauge", is severely overstated.

Despite this, due to the VIX's strong correlation with jumps in the SPX (as manifested by the second and fourth power of the SPX return), futures based on the VIX index could be used as a hedge against bidirectional jump risk.