Tradable Volatility Estimates

Bruno Dupire
Head of Quantitative Research
Bloomberg L.P.

Conference in Honor of Steve Shreve
Carnegie Mellon, June 3, 2015
Outline

I. Trading Volatility Estimates

II. Tradable Estimates

III. A New Hi-Lo Based Tradable Estimate
I. Trading Volatility Estimates
Historical volatility tends to depend on the sampling frequency.

SPX 2006 to 2011 Data
Historical volatility tends to depend on the sampling frequency.

SPX 2006 Data

Selected Time Interval From 04/04/2006 To 01/04/2007

Frequencygram
Historical volatility tends to depend on the sampling frequency.
Historical volatility tends to depend on the sampling frequency.
Historical volatility tends to depend on the sampling frequency

SPX 2009 Data
Historical volatility tends to depend on the sampling frequency.

SPX 2010 Data
Historical volatility tends to depend on the sampling frequency

SPX 2011 Data
If weekly historical vol < daily historical vol:
buy strip of T options, Δ-hedge daily
sell strip of T options, Δ-hedge weekly

Adding up:
do not buy or sell any option;
play intra-week mean reversion until T;
final P&L:
Daily / Weekly Vol Arbitrage
Intra week mean reversion strategy

Short

Long

Long

Short
1 day/1 week volatility trade
More profitable when vol is high
500 stocks cross section
Daily – Weekly Vol Spread for S&P 500 constituents

Jan 2008 to Apr 2015
Daily – Weekly Vol Spread for S&P 500 constituents

Jan 2008 to Apr 2015
Covariation Trading
Historical Cov / Historical Cov Arbitrage
II. Tradable Estimates
Some Definitions
(Normal as opposed to Lognormal convention)

Tradable
Unbiased
Discretized Quadratic Variation

\[ \Delta \text{ hedge of a parabola} \]

Tradable unbiased estimate

Costless stock trading
Classical Estimator

SPX Index 30 Day Rolling Window Historical Volatility Estimate

Historical Volatility
For option pricing, a volatility estimate should reflect the cost of hedging.

Hedge according to spot moves (move based) better than hedge at fixed times (time based).
Move-Based Estimator

noise is smoothed out by phase averaging
OHLC
Hi-Lo Estimates
The Uncertainty of the Night

SPX Index

GS US Equity
But…

- Hi-Lo Estimators are less useful than the classical one because they cannot be traded.

- Highs and Lows are always observed after the fact.

- However… we introduce a tradable Hi-Lo based estimator.
III. A New Hi-Lo Based Tradable Estimate
Averaging Down
A Side Note
A New Estimator
Trading Strategy

(Mid – Close)/Range
Comparison of Estimators

SPX Index 30 Day Rolling Window Historical Volatility Estimate

- Historical Volatility
- Parkinson High-Low
- Garman-Klass Estimator
- Rogers-Satchell Estimator
- Yang-Zhang Estimator
- Tradable Estimator
- Tradable Estimator with Night
Conclusion

- Most common volatility trade is historical vs implied

- With tradable estimates: can trade historical vs historical, without any option market

- Hi-Lo estimates are usually not tradable…
Thank You