Demand Derivatives

RealVol® Indices

Historical and Forecast Realized Volatility Risk Measures

"What's past is prologue."

— William Shakespeare

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

The Concept

Each RealVol Index has its own unique formula, but all are, at their core, based on the realized volatility of an underlying asset.

The Problem

Academics and market practitioners agree that risk cannot be accurately reflected in one number.

The Solution

In order to get a complete picture of risk, the team at Demand Derivatives settled on a set of 40 different indices — looking at risk from 40 different angles. The entire group consists of standard formulas and cutting-edge models, each over six time frames.

Realized Volatility Defined

Realized volatility is a measure of the magnitude of daily price movements, regardless of direction, of some underlying, over a specific period.

Realized vs. Implied

Realized volatility is functionally very different from implied volatility. Realized volatility is based on the actual movement of an underlying, while implied volatility is based on a value derived from associated options prices. In essence, realized volatility measures real risk.

Analogy

The difference between realized and implied volatility is similar to trying to forecast the actual weather (realized) versus attempting to forecast the weather report (implied).

RealVol Daily Indices

RealVol daily indices are based on only daily data of the underlying asset (i.e., open, high, low, and close). Note that the 1-day and 1-week correlations will not be calculated.

Six Time Frames

1. 1 day
2. 1 week (5 trading days)
3. 1 month (21 trading days)
4. 1 quarter (63 trading days)
5. 1 half year (126 trading days)
6. 1 year (252 trading days)

Seven Types

1. Realized volatility (vol)
2. Realized vol of vol
3. Overnight/intraday vol
4. Correlation (underlying vs. vol)
5. Realized variance
6. Rough forecast vol
7. HARK forecast vol

RealVol Real-Time Index

The RealVol real-time index will use the real-time underlying price to estimate the RealVol daily index throughout the current trading day. At the close of the underlying market, the RealVol daily and real-time indices are equal.

Flagship Index

The flagship index is the 1-month RealVol index (VOLm or just VOL for short). This index will be used to settle both RealVol futures and RealVol options.

Types of RealVol Indices

RealVol Real-Time Index

The flagship RealVol real-time index (VOL) uses time-weighted, intraday underlying prices to provide real-time, 1-month (21-day), realized volatility.

RealVol Daily Indices

All other RealVol indices are daily. This means that they are updated only once each trading day and are based only on daily observations of the underlying. In addition, all RealVol daily indices come in six time frames: 1 day, 1 week (5 trading days), 1 month (21 trading days), 1 quarter (63 trading days), 1 half year (126 trading days), and 1 year (252 trading days). The six time frames correspond to the investment horizon of most traders. For periods longer than one year, realized volatility deviates little from its very long-term average so is generally estimated to be a constant.

VOL Indices

The realized volatility indices (VOL) measure the interday (close-to-close) realized volatility of an underlying using the RealVol daily and real-time formula. As discussed, there are six time frames for all indices including VOL. The special flagship VOL Index is based on the 1-month time frame only. The reason for flagship status is that the 1-month version is the only one that will be used for tradable instruments.

VOV Indices

Realized volatility of realized volatility indices (VOV) measure the realized volatility of VOL using the RealVol daily formula a second time on the same data. Trading instruments on realized volatility compels one to discover the risk of those instruments. To do so, one needs to calculate the vol of vol. (Note: The second iteration through the data is always performed on a 1-month (21-day) basis, regardless of the time frame of VOL.)

DVOL Indices

The full day, overnight/intraday realized volatility indices (DVOL) measure the realized volatility based on the previous day's close and today's open, high, and low data of an underlying using the RealVol overnight/intraday formula. One can think of DVOL as another measure of 24-hour price risk of an underlying using additional data points for greater accuracy.

VCOR Indices

Correlation indices (VCOR) measure the correlation between the underlying and its VOL. They are calculated by using the RealVol correlation formula. Use VCOR for insight into the linear relationship between the underlying and its realized volatility. (Note: Two time frames, the 1-day and 1-week correlations, will not be calculated.)

VAR Indices

Realized variance indices (VAR) measure the interday realized variance of an underlying using the RealVar daily formula. VAR Indices are simply the square of VOL. One can think of VAR as another measure of interday price risk of an underlying. Variances are easier to sum, average, and combine because the result is linear as opposed to that of volatility, which is a curve function.

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. The Rough Vol model is used to create the RVOL indices, which forecast realized volatility over six standardized time frames.

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 the University of Pisa and City University of London . It is a dynamic extension of the asymmetric (i.e., with leverage effects) HAR model where the parameters are continuously and optimally updated by the Kalman filter according to the statistical properties of an intraday realized volatility input. This allows flexibility and fast adaptation to the original HAR model. The HARK model is used to create the HVOL indices, which forecast realized volatility over six standardized time frames.

Our preliminary research has shown that the HARK Vol and Rough Vol models approximate future realized volatility more accurately than the market (based on implied volatility).

RealVol Index Symbols

Base Symbol	Description	Day	Week (5-day)	Month (21-day)	Quarter (63-day)	Half Year (126-day)	Year (252-day)
VOL	Realized Volatility	VOLd	VOLw	VOLm	VOLq	VOLh	VOLy
VOV	Realized Volatility of Realized Volatility	VOVd	VOVw	VOVm	VOVq	VOVh	VOVy
DVOL	Overnight/Intraday "Daily" Realized Volatility	DVOLd	DVOLw	DVOLm	DVOLq	DVOLh	DVOLy
VCOR	Correlation of Underlying vs. VOL	N/A	N/A	VCORm	VCORq	VCORh	VCORy
VAR	Realized Variance	VARd	VARw	VARm	VARq	VARh	VARy
RVOL	RFSV "Rough" Model Forecast of VOL	RVOLd	RVOLw	RVOLm	RVOLq	RVOLh	RVOLy
HVOL	HARK Model Forecast of VOL	HVOLd	HVOLw	HVOLm	HVOLq	HVOLh	HVOLy

Note: The highlighted index (VOLm) is the flagship index. The *real-time* version of the flagship index may be used to settle tradable RealVol instruments. The *daily* indices could be used to guide investment decisions.

Table of Assets and Symbols

Asset Class	Symbol	Index Name	Underlying Asset	Start
Equities				
	VOLSPY	RealVol SPY Indices	SPDR® S&P 500® ETF	1993
Equity Indices				
	VOLES	RealVol US 500 Indices	E-mini® S&P 500® Futures – CME	1997
	VOLYM	RealVol Indu 30 Indices	E-mini Dow® ($5) Futures – CBT	1997
	VOLNQ	RealVol Tech 100 Indices	E-mini NASDAQ 100® Futures – CME	1999
	VOLMD	RealVol Mid 400 Indices	E-mini S&P® MidCap 400® Futures – CME	1992
	VOLNK	RealVol Japan 225 Indices	Nikkei®/USD Futures – CME	1990
Commodities				
	VOLCC	RealVol Cocoa Indices	Cocoa Futures – ICE	1970
	VOLKC	RealVol Coffee Indices	Coffee Futures – ICE	1973
	VOLC	RealVol Corn Indices	Corn Futures – CBT	1962
	VOLCT	RealVol Cotton Indices	Cotton Futures – ICE	1972
	VOLFC	RealVol Feeder Cattle Indices	Feeder Cattle Futures – CME	1974
	VOLLC	RealVol Live Cattle Indices	Live Cattle Futures – CME	1966
	VOLLN	RealVol Lean Hogs Indices	Lean Hog Futures – CME	1970
	VOLOJ	RealVol Orange Juice Indices	Orange Juice Futures – ICE	1967
	VOLS	RealVol Soybean Indices	Soybean Futures – CBT	1970
	VOLSBM	RealVol Soybean Meal Indices	Soybean Meal Futures – CBT	1964
	VOLBO	RealVol Soybean Oil Indices	Soybean Oil Futures – CBT	1962
	VOLSB	RealVol Sugar Indices	Sugar Futures – ICE	1964
	VOLWHT	RealVol Wheat Indices	Wheat Futures – CBT	1962
Currencies				
	VOLSF	RealVol CHF/USD Indices	Swiss Franc Futures – CME	1975
	VOLEC	RealVol EUR/USD Indices	Euro FX Futures – CME	1999
	VOLBP	RealVol GBP/USD Indices	British Pound Futures – CME	1976
	VOLJY	RealVol USD/JPY Indices	Japanese Yen Futures – CME	1977
Interest Rates				
	VOLTU	RealVol 2 Yr Note Indices	2 Yr Note Futures – CBT	1990
	VOLFV	RealVol 5 Yr Note Indices	5 Yr Note Futures – CBT	1988
	VOLTY	RealVol 10 Yr Note Indices	10 Yr Note Futures – CBT	1982
	VOLUS	RealVol U.S. Treasury Bond Indices	U.S. Treasury Bond Futures – CBT	1977
	VOLBS	RealVol Euro-Schatz Indices	Euro-Schatz – EUREX	1997
	VOLBM	RealVol Euro-Bobl Indices	Euro-Bobl – EUREX	1995
	VOLBL	RealVol Euro-Bund Indices	Euro-Bund – EUREX	1990
	VOLLG	RealVol Long Gilt Indices	Long Gilt – LIFFE	1990
Energy				
	VOLBC	RealVol Brent Crude Oil Indices	Brent Crude Oil Futures – ICE	1994
	VOLCL	RealVol Crude Oil Indices	Crude Oil Futures – NYMEX	1983
	VOLG	RealVol Gasoil Indices	Gasoil Futures – ICE	1990
	VOLHO	RealVol Heating Oil Indices	NY Harbor ULSD Futures – NYMEX	1980
	VOLNG	RealVol Natural Gas Indices	Natural Gas (Henry Hub) Physical Futures – NYMEX	1990
	VOLRB	RealVol NYH RBOB Gas Indices	RBOB Gasoline Physical Futures – NYMEX	1996
Metals				
	VOLHG	RealVol Copper Indices	Copper Futures – CEC	1962
	VOLGC	RealVol Gold Indices	Gold Futures – CEC	1975
	VOLSLV	RealVol Silver Indices	Silver Futures – CEC	1965

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