

# DB Commodity WTI Short Volatility II Index

## Summary

The DB Commodity WTI Short Volatility index is based on a systematic short volatility strategy. The Index comprises of 3 equally weighted sub-indices reweighted on an annual basis. Each sub-index replicates a strategy to sell straddles on 3 month futures on WTI. The delta of the straddles in each sub-index is calculated on a daily basis and hedged at the market close. The straddle position is held to option expiry and then rolled for further 3 months. The index return is based on the return from straddle position and the delta hedged position.

## Index Suite

The index is calculated and published to Bloomberg in the following versions;

Index Name	Return Type	Currency	Bloomberg Ticker
DB Commodity WTI Short Volatility II Index	ER	USD	DBCMWSV2
DB Commodity WTI Short Volatility II Sub index I	ER	USD	DBCMWS12
DB Commodity WTI Short Volatility II Sub index II	ER	USD	DBCMWS22
DB Commodity WTI Short Volatility II Sub index III	ER	USD	DBCMWS32

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### Key Index Information

Index Inception Date

14- Dec-2006

Index Live Date

11-Jul-2014

Index Calculation Holiday Calendar

NYM

Index Rebalancing Date

Business day corresponding to the relevant December Option Expiry Date

Sub Index Rebalancing Date

Business Day corresponding to the relevant Option Expiry Date of option based on every third month future

### Index Rules and Calculations

Market Data Sources

Commodity future and option prices are based on exchange close settlement prices for the relevant contract and exchange.

Sub index Calculation

Each of the three sub-indices will have an identical construction with the exception of the Rebalance Date.

Each of the sub indices sells an equal number of call options and put options on the rebalance date (Straddle position). Every day the delta position implied by these options is hedged by buying the delta amount of underlying future. At the expiry date of the option, the index rolls into the next future contract in the index.

The 3 sub indices roll their position based on following month's futures on rebalance dates

Index Name	Future Contract Roll schedule
DB Commodity WTI Short Volatility II Sub Index 1	H-M-U-Z
DB Commodity WTI Short Volatility II Sub Index 2	G-K-Q-X
DB Commodity WTI Short Volatility II Sub Index 3	F-J-N-V

The index Level for each of the sub index on a day t is sum of 1)the index level on previous day, 2) the sum product of a)number of options sold on previous rebalance date and b) the change in option price from previous day, for each of the call and put, 3) product of a) Number of options sold, b) The implied delta position on previous day, c) The change in underlying future price from previous day

We calculate each of the sub Index ER level on all valid London City business days as follows.

$$IL(t) = IL(t-1) + U_{S,r,t} \times [(S_t - S_{t-1})] + U_{O,r,t} \times [C(t-1, T_{r+1}, S_t, K_r, \sigma_t^{AC}) - C(t, T_{r+1}, S_t, K_r, \sigma_t^{AC}) + P(t-1, T_{r+1}, S_t, K_r, \sigma_t^{AC}) - P(t, T_{r+1}, S_t, K_r, \sigma_t^{AC})]$$

Where:

IL(t) = Index level on day t

r = Rebalancing Date immediately preceding t. In case t is a rebalancing day, r will be the previous rebalancing date.

S<sub>t</sub> = The respective future price for the WTI future on day t

U<sub>S,r,t</sub> = Unit holdings for the underlying future for the respective sub index.

On any day t, the new unit holdings for the underlying future are adjusted by the delta of the options on previous day. This amount is calculated as,

$$U_{S,r,t} = \sqrt{\frac{\pi}{2 * T}} \times \frac{IL(r)}{S_r} \times (\Delta_{t-1}^{call} + \Delta_{t-1}^{put})$$

$$\Delta_t^{call} = \Phi(d_1)$$

$$\Delta_t^{put} = \Phi(d_1) - 1$$

$\Phi$  is the standard normal cumulative distribution function and  $d_1$  is defined in section Option Price Calculation.

$U_{O,r,t}$  = Unit holdings for the call and put options for the respective sub index.

On the rebalance day  $r$  the amount of call and put options to be sold are calculated as,

$$U_{O,r,t} = \sqrt{\frac{\pi}{2 * T}} \times \frac{IL(r)}{S_r}$$

$T$  is equal to the time to maturity (ACT/365 basis) of the option on rebalance date  $r$ . It is calculated as,

$$T = \frac{E - r}{365}$$

$T_{r+1}$  = The next rebalancing date of the sub index (also the expiry of the option)

$S_r$  = The respective future price for the WTI future on rebalance day  $r$

$C(t, T_{r+1}, S_t, K_r, \sigma_t^{AC})$  = The price on day  $t$  of a call option with expiry  $T_{r+1}$ , strike  $K_r$ , evaluated using Black's model with volatility  $\sigma_t^{AC}$ , future price  $S_t$ , and discount factor equal to 1. These are calculated as given in section Option price calculation except for the rebalance date for the old security. For the old security on rebalance date, the intrinsic value of the option is considered as its call option price, which is calculated as  $\max(0, S_r - K_r)$ . The prices for old security on the expiry date are not published by exchange.

$P(t, T_{r+1}, S_t, K_r, \sigma_t^{AC})$  = The price on day  $t$  of a put option with expiry  $T_{r+1}$ , strike  $K_r$ , evaluated using Black's model with volatility  $\sigma_t^{AC}$ , future price  $S_t$ , and discount factor equal to 1. These are calculated as given in section Option price calculation except for the rebalance date for the old security. For the old security on rebalance date, the intrinsic value of the option is considered as its put option price, which is calculated as  $\max(0, K_r - S_r)$ . The prices for old security on the expiry date are not published by exchange.

### Option Price Calculation

For each sub index the strike of the option on the rebalance date is calculated as the closest integer strike to the at the money future price on such date. The index sells a call and a put at this strike on rebalance date for the option related to respective future. The expiry of these options is the option expiry corresponding to the future.

The exchange publishes the option prices corresponding to each integer strike. The below formulae are used to calculate the price using the after cost volatility.

$$C(t, T_{R+1}, S_t, K_r, \sigma_t^{AC}) = S_t \Phi(d_1) - K_r \Phi(d_2)$$

$$P(t, T_{R+1}, S_t, K_r, \sigma_t^{AC}) = K_r \Phi(-d_2) - S_t \Phi(-d_1)$$

$$d_1 = \frac{\ln\left(\frac{S_t}{K_r}\right) + \frac{1}{2}(\sigma_t^{AC})^2(T_{R+1} - t)}{\sigma_t^{AC}\sqrt{T_{R+1} - t}}$$

$$d_2 = \frac{\ln\left(\frac{S_t}{K_r}\right) - \frac{1}{2}(\sigma_t^{AC})^2(T_{R+1} - t)}{\sigma_t^{AC}\sqrt{T_{R+1} - t}}$$

$\sigma_t^{AC}$  is the after cost implied volatility of the relevant option and it is obtained from the implied volatility of the relevant exchange traded option as

$$\sigma_t^{AC} = \sigma_t - \max(4\% * \sigma_t, 0.75\%)$$

Where,  $\sigma_t$  is the volatility of the call option which has strike  $K_r$  and is calculated using standard Black's model.

$K_r$  = Option strike. It is the integer value closest to the at the money forward future price on the rebalance date  $r$ . For avoidance of any doubt, the strike will be rounded up in case of a tie.

#### Main index Calculation

DB Commodity WTI Short Volatility II Index is calculated on each valid London city business day as follows,

$$IL(t, ER) = IL(t - 1, ER) + \sum_{i=1}^3 [I(i, t, ER) - I(i, t - 1, ER)] \times N(t - 1, i)$$

Where:

$IL(t, ER)$  = Index level of DB Commodity WTI Short Volatility II Index on day  $t$

$I(i, t, ER)$  = Index level of sub index  $i$  on day  $t$

$N(t, i)$  = Notional holdings of sub index  $i$  on day  $t$

#### Notional Holdings

The index rebalances on the option expiry date of Z contract of WTI Crude every year. On any other day the notional holdings remain constant,

$$N(t, i) = N(t - 1, i)$$

It  $t$  is the rebalancing date

$$N(t, i) = \frac{IL(t, ER)}{3 * (I(i, t, ER))}$$

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