

EXTERNAL

Cboe NASDAQ-100 Half BuyWrite V2 Index

This document details the calculation methodology of the titled index/benchmark. This document, in conjunction with the Cboe Index Rules and Governance document (available on Cboe's Governance website), provides a transparent and easily accessible view of the methodology used to calculate the Cboe NASDAQ-100 Half BuyWrite V2 Index ("BXNH Index"), ticker symbol 'BXNH'.

Description of the Market or Economic Reality Measure

The Cboe NASDAQ-100 Half BuyWrite V2 Index (BXNH) measures the total rate of return of a NASDAQ-100 covered call strategy. This strategy ("BXNH covered call strategy") consists of holding a portfolio indexed to the NASDAQ-100 and selling a succession of one-month at-the-money NASDAQ-100 (NDX) call options. The BXNH Index is similar in design to the Cboe NASDAQ-100 BuyWrite V2 Index (BXNT). However, the difference in methodology is as follows: on the Roll Day, the strategy only writes half a unit of an ATM monthly NDX Call option while the long NDX Index position remains unchanged. The BXNH index is based on the cumulative gross rate of return of this strategy since the inception of the index. The BXNH Index does not use contributed input data, and all input data is readily available via public sources. The BXNH Index is non-significant, as defined by EU Regulation 2016/1011 ("EU Benchmark Regulation" or "EU BMR").

Index Calculations

The following describes the methodology for calculating the BXNH Index, including applicable formulas and input data. Under the BXNH Index methodology, roll dates is the Thursday preceding the third Friday and the third Friday of each month. Should the third Friday fall on an exchange holiday, the roll dates are the preceding days.

BXNH is a total return index that is rebalanced monthly. Dividends paid on the component stocks underlying the NASDAQ-100 Index and the dollar value of option premium deemed received from the sold call options are functionally "re-invested" in the covered NASDAQ-100 Index portfolio.

The BXNH covered call strategy requires that each NASDAQ-100 call option be held until the day before its date of maturity, generally the Thursday prior to the third Friday of the month. Cboe introduced the Cboe NASDAQ-100 Half Buywrite V2 Index (BXNH) on June 22, 2015. The BXNH Index replicates the methodology used to calculate the BXN Index, with two exceptions. First, the written NDX call options are a half unit. Second, the written half unit call options are held until one day prior to the expiration date (i.e., generally the Thursday preceding the third Friday of the month) and is liquidated at a VWAP price determined at the close, $C_{old_option_vwap}$. $C_{old_option_vwap}$ is the volume-weighted average trading price between 3:30 p.m. and 4:00 p.m. ET.

Cboe calculates the old Call option VWAP in two steps: first, Cboe excludes trades in the old Call option between 3:30 p.m. and 4:00 p.m. ET that are identified as uppercase A – H and lowercase f – t.

This will remove all forms of late, cancel and spread orders; and second, Cboe calculates the weighted average of all remaining transaction prices of the old Call option between 3:30 p.m. and 4:00 p.m. ET, with weights equal to the fraction of total remaining volume transacted at each price during this period. Equivalently, the VWAP is the average traded price of the call. The source of the transaction prices used in the calculation of the VWAP is OPRA. If no transactions occur between 3:30 p.m. and 4:00 p.m. ET, then the existing call option position is closed at the last NBBO ask price reported before 4:00 p.m. ET.

On the standard expiration date, typically on the third Friday of each month, a new at-the-money call option expiring in the next month is then written, a transaction commonly referred to as the “roll.” The strike price of the new call is the NDX call option with the closest listed strike price greater than or equal to the last value of the NASDAQ-100 Index reported before 11:00 a.m. ET. For example, if the last NASDAQ-100 price reported before 11:00 a.m. is 1600.65 and the closest listed option strike price at or above 1600.65 is 1605, then the NASDAQ-100 1605 call is selected as the new call to sell.

Once the strike price has been identified, the new call option is deemed sold at a price equal to the volume-weighted average price (VWAP) of the call during a two-hour period beginning at 11:30 a.m. ET. Cboe calculates the VWAP in two steps: first, Cboe excludes trades in the new Call option between 11:30 a.m. and 1:30 p.m. ET that are identified as uppercase A – H and lowercase f – t. This will remove all forms of late, cancel and spread orders; and second, Cboe calculates the weighted average of all remaining transaction prices of the new Call option between 11:30 a.m. and 1:30 p.m. ET, with weights equal to the fraction of total remaining volume transacted at each price during this period. The source of the transaction prices used in the calculation of the VWAP is OPRA. If no transactions occur between 11:30 a.m. and 1:30 p.m. ET, then the new call option is deemed sold at the last NBBO bid price reported before 1:30 p.m. ET. Similarly, if no trades occur, the Index VWAP would be the last NASDAQ-100 quote prior to 1:30 p.m. ET.

The BXNH Index is calculated every 15 seconds according to the following formula:

$$BXNH_t = BXNH_{t-1} (1 + R_t) \quad (1)$$

where:

- $BXNH_t$ is the level of the BXNH Index;
- $BXNH_{t-1}$ is the level of the BXNH Index on the previous day; and
- R_t is the return of the BXNH Index.

Non-Roll Date Calculations

The non-roll date return of the index is calculated as:

$$1 + R_t = (S_t + Div_t - 0.5 C_t) / (S_{t-1} - 0.5 C_{t-1}) \quad (2)$$

where:

- S_t is the closing value of the NASDAQ-100 Index at date t. For intraday calculations, the current reported value of the NASDAQ-100 Index is used;
- S_{t-1} is the closing value of the NASDAQ-100 Index at date t-1;

- C_t is the arithmetic average of the last NBBO quote of the call option reported before 4:00 p.m. ET at date t for the closing value. For intraday calculations, the average of the current reported NBBO quote of the call option is used;
- C_{t-1} is the arithmetic average of the last NBBO quote of the call option reported before 4:00 p.m. ET at date t-1; and
- Div_t represents the ordinary cash dividends payable on the component stocks underlying the NASDAQ-100 Index that trade “ex-dividend” at date t expressed in NASDAQ-100 Index points.

Roll Date Calculations

One day prior to the expiration date (generally the Thursday preceding the Third Friday of the month):

$$1 + R_t = (1 + R_a) \times (1 + R_b) \quad (3)$$

where:

$$1 + R_a = (S^{new_vwav} + Div_t - 0.5C_{old_option_vwav}) / (S_{t-1} - 0.5C_{t-1}); \quad (4)$$

$$1 + R_b = (S_t) / (S^{new_vwav}). \quad (5)$$

where:

- $C_{old_option_vwav}$ is the volume-weighted average price of the current call option between 3:30 p.m. and 4:00 p.m. ET.
- S^{new_vwav} is the volume-weighted average value of the NASDAQ-100 Index based on the same time and weights used to calculate the VWAP of the old call option between 3:30 p.m. and 4:00 p.m. ET.

On the expiration date:

$$1 + R_t = (1 + R_a) \times (1 + R_b) \quad (6)$$

$$1 + R_a = (S^{vwav} + Div_t) / (S_{t-1}); \quad (7)$$

$$1 + R_b = (S_t - 0.5C_t) / (S^{VWAV} - 0.5C_{VWAP}). \quad (8)$$

Where:

- S^{VWAV} is the volume-weighted average value of the NASDAQ-100 Index based on the same time and weights used to calculate the VWAP in the new call option;
- C_{VWAP} is the volume-weighted average trading price of the new call option between 11:30 a.m. and 1:30 p.m. ET; and
- C_t refers to the average NBBO quote of the new call option reported before 4:00 p.m. ET on the roll date.

Calculation and Dissemination

Cboe compiles, calculates, maintains, and disseminates all BXNH Index values. The BXNH Index is calculated and disseminated every 15 seconds during U.S. trading hours.

On standard expiration dates (generally the third Friday), as defined above, the BXNH Index will be disseminated intraday. A daily closing value will be disseminated on roll dates following the close of U.S. trading hours.

Judgement and Potential Limitations in Calculation

No expert judgement or discretion is used by Cboe in performing the calculation of the BXNH Index. Potential limitations for this index (i.e., situations where the index may not reflect the above described market or economic reality) include:

- where underlying index input data is unavailable, the BXNH Index value will not be able to be calculated, and
- where the underlying option contract data is not available, the BXNH Index value will not be able to be calculated.

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