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Index Methodology

As of July/2015

CBOE Strategy Benchmark Indexes

The CBOE S&P 500 5% Put Protection Index (PPUT)

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Introduction:

The CBOE S&P 500 5% Put Protection Index (PPUT) is a benchmark index designed to track the performance of a hypothetical risk-management strategy that consists of a long position indexed to the S&P 500 Index (SPX Index) and a rolling long position in monthly 5% Out-of-the-Money (OTM) SPX Put options.

Index Design:

On June 20, 1986, the initial roll date of the PPUT Index, a unit of the SPX Index is purchased and a unit of a 5% OTM monthly SPX Put option is purchased simultaneously. The strike of the SPX Put option selected is the first available strike below 95% of the last disseminated value of the SPX Index before 11:00 am ET. The SPX Put option is purchased at a volume weighted average trade price between 11:30 am and 12:00 pm ET (VWAP). If there is no trade in the SPX Put option during the VWAP period, the last ask quote of the SPX Put option before 12:00 pm ET is used. CBOE calculates the VWAP in two steps: first, CBOE excludes trades in the new SPX Put option between 11:30 am and 12:00 pm ET that are identified as having been executed as part of a “spread”; and second, CBOE calculates the weighted average of all remaining transaction prices of the new SPX Put option between 11:30 am and 12:00 pm ET, with weights equal to the fraction of total non-spread volume transacted at each price during this period. As the long SPX Index position is assumed to be entered into simultaneously with the long SPX Put option position, the weighted average price of the SPX Index is calculated using disseminated values of the SPX Index based on the same time and weights used to calculate the SPX Put option VWAP. Similarly, if there is no trade of the SPX Put option during the VWAP period, the last disseminated value of the SPX Index before 12:00 pm ET is used.

Typically, on the third Friday (Roll Day) of every month since the initial roll date, the old SPX Put option settles at 9:30 am ET against the Special Opening Quotation of the S&P 500 Index (SOQ). The option settlement value is determined as $Put\_old_{settle} = Max(0, K_{old} - SOQ_t)$. A new 5% OTM monthly SPX Put option will be subsequently purchased. The new SPX Put option is determined by selecting the first available strike below 95% of the last disseminated value of the SPX Index before 11:00 am ET. The price of the new SPX Put option is determined as the VWAP. If there is no trade of the SPX Put option during the VWAP period, the last ask quote of the SPX Put option before 12:00 pm ET is used. The long SPX Index position remains unchanged.

Index Calculation:

The PPUT Index value is calculated by CBOE in real-time, every 15 seconds.

<u>On each trading day excluding roll dates, the daily return of the index is calculated as:</u>

$$R_t = (SPX_t + DIV_t + Put\_5\%_t) / (SPX_{t-1} + Put\_5\%_{t-1})$$

Where SPX_t is the SPX Index close price on day t, DIV_t is the SPX dividend, $Put\_5\%_t$ is the average of the last bid-ask quote of the 5% OTM SPX Put option before 4:00 pm ET. The terms with subscript *t-1* stand for the values on the previous day.

<u>On Roll Days, the return is calculated in three steps:</u>

First, calculate the return from the previous day market close to morning settlement of the expiring option (9:30 am ET):

$$R_1 = (SOQ_t + DIV_t + Put\_5\%\_old_{settle}) / (SPX_{t-1} + Put\_5\%\_old_{t-1})$$

Where SOQ_t is the Special Opening Quotation of the SPX Index on the Roll Day, DIV_t is the SPX dividend, $Put\_5\%\_old_{settle} = Max(0, K_{old} - SOQ_t)$ is the settlement value of the old SPX Put option, and $Put\_5\%\_old_{t-1}$ is the average of the last bid-ask quote of the old SPX Put option before 4:00 pm ET on the previous day.

Second, calculate the return from morning settlement (9:30 am ET) to the moment the new SPX option position is deemed purchased:

$$R_2 = SOQ_t / SPX_{vwap}$$

Where SOQ_t is the Special Opening Quotation of the SPX Index on the Roll Day, and SPX_{vwap} is the volume weighted average price of the SPX Index, calculated using disseminated values of the SPX Index based on the same time and weights used to calculate the new SPX Put option VWAP. Note that if there are no trades of the Put option during the VWAP period, the last SPX Index quote before 12:00 pm ET is used.

Lastly, calculate the return from the time the new SPX Put option position is deemed purchased to the market close:

$$R_3 = (SPX_t + Put\_5\%\_new_t) / (SPX_{vwap} + Put\_5\%\_new_{vwap})$$

Where $Put\_5\%\_new_{vwap}$ is the VWAP of the new SPX Put option between 11:30 am and 12:00 pm ET, $Put\_5\%\_new_t$ is the average of the last bid-ask quote of the new SPX Put option before 4:00 pm ET on the Roll Day, SPX_t is the last disseminated value of the SPX Index on the Roll Day, and SPX_{vwap} is the volume weighted average value of SPX Index, calculated using disseminated values of the SPX Index based on the same time and weights used to calculate the new SPX Put option VWAP.

The product of the three parts is the total return of the Rolling Day:

$$R_t = R_1 * R_2 * R_3$$

Once the daily return is calculated for every trading day, the daily index value is calculated as:

$$INDEX_t = INDEX_{t-1} * R_t$$

Options involve risk and are not suitable for all investors. Prior to buying or selling an option, a person must receive a copy of Characteristics and Risks of Standardized Options. Copies are available from your broker, by calling 1-888-OPTIONS, or from The Options Clearing Corporation, One North Wacker Drive, Suite 500, Chicago, Illinois 60606 or www.theocc.com. The CBOE S&P 500 5% Put Protection Index (PPUT) is designed to represent a proposed hypothetical risk management strategy. Like many passive indexes, the PPUT Index does not take into account significant factors such as transaction costs and taxes and, because of factors such as these, many or most investors should be expected to underperform passive indexes. In the construction of the hypothetical PPUT index, the PPUT options are assumed to be sold at a certain price on the third Friday of the month. However, there is no guarantee that all investors will be able to sell at this price, and investors attempting to replicate the PPUT Index should discuss with their brokers possible timing and liquidity issues. Transaction costs and taxes for a strategy such as the PPUT could be significantly higher than transaction costs for a passive strategy of buying-and-holding stocks. Investors should consult their tax advisor as to how taxes affect the outcome of contemplated options transactions. Past performance does not guarantee future results. This paper contains index performance data based on back-testing, i.e., calculations of how the index might have performed prior to launch. Back-tested performance information is purely hypothetical and is provided in this document solely for information purposes. Back-tested performance does not represent actual performance and should not be interpreted as an indication of actual performance. It is not possible to invest directly in an index. Chicago Board Options Exchange, Incorporated (CBOE) calculates and disseminates the PPUT index.

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