S&P Dow Jones Indices

A Division of S&P Global

S&P Defined Volatility Indices
Methodology

September 2024

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Introduction

Index Objective and Highlights

The S&P Defined Volatility Indices measure the performance of leveraged strategies applied to the S&P 500 Futures (3-Day Roll) Index (the underlying index) which seek to target specified levels of volatility. The indices reset leverage every week to the ratio of target volatility to weekly implied volatility on the S&P 500. The indices floor at 25% of the prior week's rebalancing level and a leverage cap applies. The indices rebalance weekly on Fridays, using a time-weighted average price (TWAP).

For information on the underlying index and the S&P 500, please refer to the S&P Futures Indices Methodology and S&P U.S. Indices Methodology documents, available at www.spglobal.com/spdji.

For information on the historical data used for calculating the indices, please refer to Appendix A.

Index Family

The index family includes the following:

Index	Target Volatility	Leverage Cap	Decrement Factor
S&P 500 Futures 25% Defined Volatility Index	25%	4	0%
S&P 500 Futures 30% Defined Volatility Index	30%	5	0%
S&P 500 Futures 35% Defined Volatility Index	35%	5	0%
S&P 500 Futures 25% Defined Volatility 3% Decrement Index (USD) ER	25%	4	3%
S&P 500 Futures 30% Defined Volatility 3% Decrement Index (USD) ER	30%	5	3%
S&P 500 Futures 35% Defined Volatility 3% Decrement Index (USD) ER	35%	5	3%
S&P 500 Futures 35% Defined Volatility 5% Decrement Index (USD) ER	35%	5	5%
S&P 500 Futures 35% Defined Volatility 6% Decrement Index (USD) ER	35%	5	6%

Note that the target volatilities used to determine index leverage are based on the one-week implied volatilities. The actual index realized volatility may deviate from the target volatilities.

Supporting Documents

This methodology is meant to be read in conjunction with supporting documents providing greater detail with respect to the policies, procedures and calculations described herein. References throughout the methodology direct the reader to the relevant supporting document for further information on a specific topic. The list of the main supplemental documents for this methodology and the hyperlinks to those documents is as follows:

Supporting Document	URL
S&P Dow Jones Indices' Commodities Indices Policies & Practices Methodology	Commodities Indices Policies & Practices
S&P Dow Jones Indices' Options Indices Policies and Practices Methodology	Options Indices Policies & Practices Methodology
S&P Dow Jones Indices' Index Mathematics Methodology	Index Mathematics Methodology

This methodology was created by S&P Dow Jones Indices to achieve the aforementioned objective of measuring the underlying interest of each index governed by this methodology document. Any changes to or deviations from this methodology are made in the sole judgment and discretion of S&P Dow Jones Indices so that the index continues to achieve its objective.

Index Construction

For each day that is not a rebalancing day, the index level is calculated as the leveraged change from the prior rebalancing day's TWAP level. The index value is floored at 25% of the index value as of the last rebalancing day, with the decrement included:

$$Index_t = max\left\{25\% \times Index_{rb-1}^{twap}, Index_{rb-1}^{twap} \times \left(1 + Leverage_{rb-1} \times \left(\frac{Underlying_t}{Underlying_{rb-1}^{twap}} - 1\right) - DF \times \frac{Days_{rb-1,t}}{360}\right)\right\}$$

For each rebalancing day, the index level is calculated in a two-step process.

First, the new rebalancing TWAP level is calculated based on the change from the prior rebalancing day's TWAP level, with the same 25% post-decrement floor in effect:

$$Index_t^{twap} = max\left\{25\% \times Index_{rb-1}^{twap}, Index_{rb-1}^{twap} \times \left(1 + Leverage_{rb-1} \times \left(\frac{Underlying_t^{twap}}{Underlying_{rb-1}^{twap}} - 1\right) - DF \times \frac{Days_{rb-1,t}}{360}\right)\right\}$$

Next, the leverage level for the next week is calculated and applied to the index as follows:

$$Leverage_t = \min\left(maxL, \frac{TV}{IV_t}\right)$$

For more information on the implied volatility calculation, please refer to Appendix B.

Finally, the index level is calculated as the change from the new TWAP level to the end of day, utilizing the newly applied leverage, with a newly recalculated 25% floor in effect:

$$Index_t = max\left\{25\% \times Index_t^{twap}, Index_t^{twap} \times \left(1 + Leverage_t \times \left(\frac{Underlying_t}{Underlying_t^{twap}} - 1\right)\right)\right\}$$

where:

$Index_t$	= The closing level of the S&P Defined Volatility Index for day *t*
$Index_t^{twap}$	= TWAP of the S&P Defined Volatility Index for day *t*
$Index_{rb-1}^{twap}$	= TWAP of the S&P Defined Volatility Index on the prior rebalancing day
$Underlying_t$	= The closing level of the underlying index for day *t*
$Underlying_t^{twap}$	= TWAP of the underlying index for day *t*
$Underlying_{rb-1}^{twap}$	= TWAP of the underlying index on the previous rebalancing day
$Days_{rb-1,t}$	= The number of actual days between the previous rebalancing day and day *t*
DF	= Decrement factor
TV	= Target volatility
IV_t	= Weekly implied volatility as calculated on day *t*
$maxL$	= Leverage cap

Index Maintenance

Rebalancing

The index rebalances weekly, using a standard TWAP period of 3:20 – 3:30 PM ET every Friday. Due to certain market events the timing of the rebalancing can change, as defined below:

- For any regularly scheduled full market closure on a Friday, the index rebalances on the prior trading day, using the standard TWAP period.
- For any regularly scheduled early market closure (1:00PM ET) on a Friday, the index rebalances using an early TWAP period of 12:20 – 12:30 PM ET.
- For any unscheduled full-day market closure on a Friday, an intraday closure prior to the TWAP period, or other disruption event affecting the calculation of the implied volatility, the rebalancing occurs on the next business day when all necessary data is available and can be calculated during either the standard or early TWAP periods.

Any rebalancing postponed to a different trading day uses the recalculated implied volatility level as of the new rebalancing date.

For more information on TWAP, please refer to the Pricing Types section in S&P Dow Jones Indices' Options Indices Policies & Practices Methodology.

Currency of Calculation and Additional Index Return Series

The indices calculate in U.S. dollars.

In addition to the indices detailed in this methodology, additional return series versions of the indices may be available, including, but not limited to the following: currency, currency hedged, decrement, fair value, inverse, leveraged, and risk control versions. For a list of available indices, please refer to the *S&P DJI Methodology & Regulatory Status Database*.

For information on index calculation, please refer to S&P Dow Jones Indices' Index Mathematics Methodology.

For the inputs necessary to calculate certain types of indices, including decrement, dynamic hedged, fair value, and risk control indices, please refer to the Parameters documents available at www.spglobal.com/spdji.

Base Date and History Availability

The index history availability, base dates, and base values are shown in the table below.

Index	Launch Date	First Value Date	Base Date	Base Value
S&P 500 Futures 25% Defined Volatility Index	06/24/2022	10/28/2005	12/31/2014	1000
S&P 500 Futures 30% Defined Volatility Index	06/24/2022	10/28/2005	12/31/2014	1000
S&P 500 Futures 35% Defined Volatility Index	06/24/2022	10/28/2005	12/31/2014	1000
S&P 500 Futures 25% Defined Volatility 3% Decrement Index (USD) ER	06/24/2022	10/28/2005	12/31/2014	1000
S&P 500 Futures 30% Defined Volatility 3% Decrement Index (USD) ER	06/24/2022	10/28/2005	12/31/2014	1000
S&P 500 Futures 35% Defined Volatility 3% Decrement Index (USD) ER	06/24/2022	10/28/2005	12/31/2014	1000

Index	Launch Date	First Value Date	Base Date	Base Value
S&P 500 Futures 35% Defined Volatility 5% Decrement Index (USD) ER	03/28/2024	10/28/2005	12/31/2014	1000
S&P 500 Futures 35% Defined Volatility 6% Decrement Index (USD) ER	04/26/2024	10/28/2005	12/31/2014	1000

Index Governance

Index Committee

An Index Committee maintains the indices. All committee members are full-time professional members of S&P Dow Jones Indices' staff. The Index Committee meets regularly. At each meeting, the Committee reviews pending corporate actions that may affect index constituents, statistics comparing the composition of the indices to the market, companies that are being considered as candidates for addition to the indices, and any significant market events. In addition, the Index Committee may revise index policy covering rules for selecting companies, treatment of dividends, share counts or other matters.

S&P Dow Jones Indices considers information about changes to its indices and related matters to be potentially market moving and material. Therefore, all Index Committee discussions are confidential.

S&P Dow Jones Indices' Index Committees reserve the right to make exceptions when applying the methodology if the need arises. In any scenario where the treatment differs from the general rules stated in this document or supplemental documents, clients will receive sufficient notice, whenever possible.

In addition to the daily governance of indices and maintenance of index methodologies, at least once within any 12-month period, the Index Committee reviews the methodology to ensure the indices continue to achieve the stated objectives, and that the data and methodology remain effective. In certain instances, S&P Dow Jones Indices may publish a consultation inviting comments from external parties.

For information on Quality Assurance and Internal Reviews of Methodology, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Index Policy

Holiday Schedule

The index is calculated daily, throughout the calendar year, when the U.S. equity markets are open.

A complete holiday schedule for the year is available on S&P Dow Jones Indices' Web site at www.spglobal.com/spdji.

Rebalancing

The Index Committee may change the date of a given rebalancing for reasons including market holidays occurring on or around the scheduled rebalancing date. Any such change will be announced with proper advance notice where possible.

Unexpected Exchange Closures

For information on Unexpected Exchange Closures, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Recalculation Policy

For information on the recalculation policy, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Real-Time Calculation

Real-time, intraday, index calculations are executed for some versions of the index, whenever the index's primary exchanges are open. Real-time indices are not restated.

For information on Calculations and Pricing Disruptions, Expert Judgment and Data Hierarchy, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Contact Information

For questions regarding an index, please contact: index_services@spglobal.com.

Index Dissemination

Index levels are available through S&P Dow Jones Indices' Web site at *www.spglobal.com/spdji,* major quote vendors (see codes below), numerous investment-oriented Web sites, and various print and electronic media.

Tickers

The table below lists headline indices covered by this document. All versions of the below indices that may exist are also covered by this document. Please refer to the *S&P DJI Methodology & Regulatory Status Database* for a complete list of indices covered by this document.

Index	BBG	RIC
S&P 500 Futures 25% Defined Volatility Index (USD) ER	SPXFV25E	.SPXFV25E
S&P 500 Futures 30% Defined Volatility Index (USD) ER	SPXFV30E	.SPXFV30E
S&P 500 Futures 35% Defined Volatility Index (USD) ER	SPXFV35E	.SPXFV35E
S&P 500 Futures 25% Defined Volatility 3% Decrement Index (USD) ER	SPXFD25E	.SPXFD25E
S&P 500 Futures 30% Defined Volatility 3% Decrement Index (USD) ER	SPXFD30E	.SPXFD30E
S&P 500 Futures 35% Defined Volatility 3% Decrement Index (USD) ER	SPXFD35E	.SPXFD35E
S&P 500 Futures 35% Defined Volatility 5% Decrement Index (USD) ER	SPXFD355	.SPXFD355
S&P 500 Futures 35% Defined Volatility 6% Decrement Index (USD) ER	SPXFD356	.SPXFD356

Index Data

Daily constituent and index level data are available via subscription.

For product information, please contact S&P Dow Jones Indices, www.spglobal.com/spdji/en/contact-us.

Web Site

For further information, please refer to S&P Dow Jones Indices' Web site at www.spglobal.com/spdji.

Appendix A

Historical Data Used for Calculating Index Levels

Start Date	End Date	Underlying Index	Rebalancing Timing	Implied Volatility Calculation
10/28/2005	12/31/2014	S&P 500 Futures Excess Return Index	End of Day (EOD)	2:00 - 2:30 PM ET TWAP
01/02/2015	05/20/2022	S&P 500 Futures Excess Return Index	3:20 – 3:30 PM ET TWAP	2:00 - 2:30 PM ET TWAP
05/20/2022	Present	S&P 500 Futures Index (3-Day Roll)	3:20 – 3:30 PM ET TWAP	2:00 - 2:30 PM ET TWAP

On 09/30/2016, due to data availability, the EOD level of the S&P 500 Future Excess Return Index was used as the 3:20-3:30 PM ET TWAP in the index calculation.

Appendix B

Definitions

This section defines the pricing methodology (alongside the implied volatility computation methodology[1]) for a European-style OTC vanilla option (the "Option") on the "Reference Instrument" (SPX Index), at any given Calculation Time *t*. The methodology is based on Listed Options on the corresponding Reference Instrument.

Determination of Maturity and Strike Price

The methodology is based on the Prices of the Listed Options as published by the Cboe Exchange at Calculation Time *t*. At any given Calculation Time *t*, the Listed Options market is made up of several maturities. Select the listed maturity corresponding to the following Friday and note such Maturity *T*. Should the Friday fall on an exchange holiday, the Maturity *T* is the preceding business day. The Maturity *T* is comprised of n strikes $K_k, j \in \{1,2,\dots,n\}$. The Strike Price *K* is at which the absolute difference between the $call_k$ and put_k is smallest.

The Mid Prices for the available Listed Options will be noted as $call_k$ and put_k.

The table below shows the specific options contract used for the calculation:

From	To	Listed Options Used
12/31/2014	Present	PM-settled SPX Weekly Options, PM-settled 3rd Friday SPX options

Calculation of Future Value and Forward Price

The Future Value and Forward Price for Maturity Date *T* shall be calculated in accordance with the following methodology:

The risk-free interest rate, R, is the yield based on U.S. Treasury yield curve rates[2] (commonly referred to as "Constant Maturity Treasury" rates), to which a cubic spline is applied to derive yield on Maturity Date *T*. The following method is used to calculate the continuous compound interest rate $R_T(t)$ and the Future Value $FV_T(t)$ on Calculation Time *t* for Maturity Date *T*:

$$\mathrm{R_T(t)} = \log\left(1 + \frac{\mathrm{R}}{2}\right)^2$$

$$FV_T(t) = e^{(R_T(t) \times T)}$$

The Black model shall be used to calculate the "call-put parity" relation and the following methodology is used in order to compute $F_T(t)$ at Calculation Time *t* for Maturity Date *T*:

$$F_T(t) = K_T(t) + FV_T(t) \times (Call_{T,K}(t) - Put_{T,K}(t))$$

where:

T = the listed maturity, as defined in accordance with *Determination of Maturity & Strike Price* above

t = the relevant Calculation Time *t*

[1] Cboe is the source of the implied volatility calculation.

[2] Source: Treasury Government Website: Resource Center | U.S. Department of the Treasury. The rates were captured around 18:02 New York time every Thursday and used for the following business day. Should Thursday fall on an exchange holiday, the rates were captured the preceding business day.

$F_T(t)$ = the Forward Price at Calculation Time t for the Maturity Date T

$K_T(t)$ = the Strike Price at Calculation Time t for the Maturity Date T as defined in accordance with *Determination of Maturity & Strike Price* above

$Call_{T,K}(t)$ = the mid price of the call option on Calculation Time t for the Maturity Date T and the Strike K

$Put_{T,K}(t)$ = the mid price of the put option on Calculation Time t for the Maturity Date T and the Strike K

$FV_T(t)$ = the Future Value on Calculation Time t for the Maturity Date T

Calculation of Implied Volatility

The Black model is used to estimate the premium of the Options:

$$premium\big(CP, F_T(t), FV_T(t), T, K_T(t), V_{T,K}(t)\big) = FV_T(t) \times CP \times [F_T(t) \times N(CP \times d_1) - K \times N(CP \times d_2)]$$

with:

$$d_1 = \frac{ln\left(\frac{F_T(t)}{K_T(t)}\right) + \frac{V_{T,K}^2(t)}{2} \times \frac{Act(t,T)}{525{,}600}}{V_{T,K}(t) \times \sqrt{\frac{Act(t,T)}{525{,}600}}}$$

$$d_2 = d_1 - V_{T,K}(t) \times \sqrt{\frac{Act(t,T)}{525{,}600}}$$

where:

CP = whether the Option is a Call ($CP = +1$) or a Put ($CP = -1$)

$V_{T,K}(t)$ = the Implied Volatility at Calculation Time *t* for the Maturity Date *T* and the Strike *K*

$Act(t,T)$ = the total minutes between Calculation Time *t* and Maturity Date *T* (minutes until 9:30 New York time for "standard" AM-settled SPX expirations, or minutes until 4:00 PM ET for "weekly" PM-settled SPX expirations, or minutes until 1:00 PM ET for "weekly" PM-settled SPX expirations if the market closes early)[3]

$N(x)$ = the cumulative distribution function of the standard normal distribution

$$N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{\frac{-u^2}{2}} du$$

The implied volatility $V_{T,K}(t)$ on Calculation Time *t* for the Maturity Date *T* and the Strike *K* is calculated by equating the Black Model Option Price to the selected option price from the listed market in accordance with *Determination of Maturity & Strike Price*:

$$\left|Premium(CP, F_T(t), TVF_T(t), T, K_T(t), V_{T,K}(t)) - Option\ Price_{T,K}(t)\right|$$

Calculation of Average Implied Volatility

The average of the implied volatility is calculated every minute during the 2:00 – 2:30 PM ET calculation window. If the market closes early at 1:00 PM ET, the calculation window is 11:00 – 11:30 AM ET. The last quote update is selected for each option prior to each minute in the TWAP period to get a snapshot of the listed option market quotes at that minute timestamp to be used in the calculation.

[3] For a given price observed in the market the use of minutes versus trading days until expiration may lead to a lower calculated implied volatility level (and thus higher leverage) when there are scheduled holidays and/or early closes in that interval.

For each minute:

Select the two listed strikes below and above the forward price

$$K_1(t) \leq F_T(t) \leq K_2(t)$$

For each of those two listed strikes, calculate bid/ask implied volatility based on call prices and bid/ask implied volatility based on put prices, and average those four implied volatilities. There are now two implied volatilities—one each for the lower strike $K_1(t)$ and the upper strike $K_2(t)$:

$$IV_{K_i}(t) = \frac{V_{T,K_i,C\_Bid}(t) + V_{T,K_i,C\_Ask}(t) + V_{T,K_i,P\_Bid}(t) + V_{T,K_i,P\_Ask}(t)}{4} \quad with\ i \in 1,2$$

Final volatility *IV(t)* is the weighted average of those volatilities weighted by the distance to the forward price:

$$IV(t) = IV_{K_1}(t) * \left(1 - \frac{F_T(t) - K_1(t)}{K_2(t) - K_1(t)}\right) + IV_{K_2}(t) * \left(1 - \frac{K_2(t) - F_T(t)}{K_2(t) - K_1(t)}\right)$$

where:

$K_1(t)$ = The highest listed strike price less than or equal to the forward price

$K_2(t)$ = The lowest listed strike price greater than or equal to the forward price

$V_{T,K_i,C\_Bid}(t)$ = The implied volatility at calculation time *t* for the call bid and maturity date *T* and the strike K_i

$V_{T,K_i,C\_Ask}(t)$ = The implied volatility at calculation time *t* for the call ask and maturity date *T* and the strike K_i

$V_{T,K_i,P\_Bid}(t)$ = The implied volatility at calculation time *t* for the put bid and maturity date *T* and the strike K_i

$V_{T,K_i,P\_Ask}(t)$ = The implied volatility at calculation time *t* for the put ask and maturity date *T* and the strike K_i

The average of the implied volatility is calculated as follows:

$$IV_{TWAP}(t) = \frac{\sum_j^{30} IV(j)}{30}$$

where:

j = Each minute that takes place over the TWAP period

Disclaimer

Performance Disclosure/Back-Tested Data

Where applicable, S&P Dow Jones Indices and its index-related affiliates ("S&P DJI") defines various dates to assist our clients by providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the index is set to a fixed value for calculation purposes. The Launch Date designates the date when the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P DJI defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its data feed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

Please refer to the methodology for the Index for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Information presented prior to an index's launch date is hypothetical back-tested performance, not actual performance, and is based on the index methodology in effect on the launch date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. In addition, forks have not been factored into the back-test data with respect to the S&P Cryptocurrency Indices. For the S&P Cryptocurrency Top 5 & 10 Equal Weight Indices, the custody element of the methodology was not considered; the back-test history is based on the index constituents that meet the custody element as of the Launch Date. Also, the treatment of corporate actions in back-tested performance may differ from treatment for live indices due to limitations in replicating index management decisions. Back-tested performance reflects application of an index methodology and selection of index constituents with the benefit of hindsight and knowledge of factors that may have positively affected its performance, cannot account for all financial risk that may affect results and may be considered to reflect survivor/look ahead bias. Actual returns may differ significantly from, and be lower than, back-tested returns. Past performance is not an indication or guarantee of future results.

Typically, when S&P DJI creates back-tested index data, S&P DJI uses actual historical constituent-level data (e.g., historical price, market capitalization, and corporate action data) in its calculations. As ESG investing is still in early stages of development, certain datapoints used to calculate certain ESG indices may not be available for the entire desired period of back-tested history. The same data availability issue could be true for other indices as well. In cases when actual data is not available for all relevant historical periods, S&P DJI may employ a process of using "Backward Data Assumption" (or pulling back) of ESG data for the calculation of back-tested historical performance. "Backward Data Assumption" is a process that applies the earliest actual live data point available for an index constituent company to all prior historical instances in the index performance. For example, Backward Data Assumption inherently assumes that companies currently not involved in a specific business activity (also known as "product involvement") were never involved historically and similarly also assumes that companies currently involved in a specific business activity were involved historically too. The Backward Data Assumption allows the hypothetical back-test to be extended over more historical years than would be feasible using only actual data. For more information on "Backward Data Assumption" please refer to the FAQ. The methodology and factsheets of any index that employs backward assumption in the back-tested history

will explicitly state so. The methodology will include an Appendix with a table setting forth the specific data points and relevant time period for which backward projected data was used. Index returns shown do not represent the results of actual trading of investable assets/securities. S&P DJI maintains the index and calculates the index levels and performance shown or discussed but does not manage any assets.

Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. As a simple example, if an index returned 10% on a US $100,000 investment for a 12-month period (or US $10,000) and an actual asset-based fee of 1.5% was imposed at the end of the period on the investment plus accrued interest (or US $1,650), the net return would be 8.35% (or US $8,350) for the year. Over a three-year period, an annual 1.5% fee taken at year end with an assumed 10% return per year would result in a cumulative gross return of 33.10%, a total fee of US $5,375, and a cumulative net return of 27.2% (or US $27,200).

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