S&P Dow Jones Indices

A Division of S&P Global

S&P 500 Futures Intraday Volatility Target Indices

Methodology

August 2024

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Introduction

Index Objective and Highlights

The S&P 500 Futures Intraday Volatility Target Indices measure the performance of a long-only, dynamically adjusted strategy that allocates to E-mini S&P 500 Futures. The indices seek to achieve a 40% volatility target using an intraday rebalance strategy based on volume-weighted average prices (VWAPs) that calculate during different time windows in the day. The indices may be levered up to four times to achieve the target.

Index Family

The index family includes the following:

Index	Volatility Target (VolTarget)	Maximum Leverage (MaxLev)	Decrement Factor (DF)
S&P 500 Futures 40% Intraday VT Index (USD) ER	40%	400%	0%
S&P 500 Futures 40% Intraday VT 4% Decrement Index (USD) ER	40%	400%	4%

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' Commodity Index Mathematics Methodology	Commodity Index Mathematics 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

Index Level Calculation

For each index calculation day t, the end of day index level calculates as:

$$Index_t = Index_{t-1} + FR_t - Decr_t \quad (1)$$

where:

$Index_t$ = The closing level of the index for day t

$Index_{t-1}$ = The closing level of the index for day $t-1$

FR_t = The cumulative return of the futures contract from day $t-1$ to day t

$Decr_t$ = The index decrement amount for day t

The cumulative futures contract return from day $t-1$ to day t calculates as:

$$FR_t = U_{t-1}^N \times (F_t^1 - F_{t-1}^N) + \sum_{i=2}^{N} U_t^{i-1} \times \left(F_t^i - F_t^{i-1}\right) \quad (2)$$

where:

U_{t-1}^N = The number of futures contract units as of the last observation window N on day $t-1$

U_t^{i-1} = The number of futures contract units as of observation window $i-1$ on day t

F_{t-1}^N = The VWAP of the futures contract calculated using the last execution window N on day $t-1$

F_t^i = The VWAP of the futures contract calculated using execution window i on day t

At the end of each execution window i on day t, the intraday index level calculates as:

$$Index_t^i = \begin{cases} Index_{t-1} + U_{t-1}^N \times (F_t^1 - F_{t-1}^N) & for\ i = 1 \\ Index_{t-1} + U_{t-1}^N \times (F_t^1 - F_{t-1}^N) + \sum_{m=2}^{i} U_t^{m-1} \times (F_t^m - F_t^{m-1}) & for\ i = 2, \dots, N-1 \\ Index_t & for\ i = N \end{cases} \quad (3)$$

For information on VWAP calculations, please refer to the Alternative Pricing section of S&P Dow Jones Indices' Index Mathematics Methodology.

For definitions of observation and execution VWAP windows, please refer to Appendix A.

Futures Units Calculation

The number of futures contract units that are held calculate at the end of each observation window i. Depending on whether day t is an index futures contract roll day or not, the number of units calculate differently.

If day t is not an index futures contract roll day, then:

$$U_t^i = \begin{cases} \frac{W_{t-1}^N \times Index_{t-1}}{F_{t-1}^N} & for\ i = 1 \\ \frac{W_t^{i-1} \times Index_{t-1}}{F_t^{i-1}} & for\ i = 2, \dots, N \end{cases} \quad (4)$$

where:

W_{t-1}^N = The weight determined on day $t-1$ at the last observation window N

W_t^{i-1} = The weight determined on day t at observation window $i-1$

If day t is an index futures contract roll day, then:

For the first $N-1$ observation windows of day t, i.e., $i = 1, \ldots, N-1$, the number of units, U_t^i, calculates as described in Equation 4. For the last observation window, $i = N$, the number of units calculates as:

$$U_{rollout,t}^N = \frac{W_t^{N-1} \times Index_{t-1}}{F_{rollout,t}^{N-1}}$$

$$U_t^N = \frac{U_{rollout,t}^N \times F_{rollout,t}^N}{F_t^N} \quad (5)$$

where:

$U_{rollout,t}^N$ = The number of units of the rolling-out futures contract as of the last observation *N* on day t

$F_{rollout,t}^{N-1}$ = The VWAP of the rolling-out futures contract calculated using execution window *N* - 1 on day t

$F_{rollout,t}^N$ = The VWAP of the rolling-out futures contract calculated using execution window *N* on day t

F_t^N = The VWAP of the rolling-in futures contract calculated using execution window *N* on day t

The weight calculates based on the target volatility level and the realized volatility of the futures contract and implements a 35% cap on weight change, compared to the prior window:

For the first observation window of each day, $i = 1$:

$$W_t^1 = \begin{cases} TW_t^1 & if\ |TW_t^1 - W_{t-1}^N| \le 35\% \\ W_{t-1}^N + 35\% & if\ TW_t^1 > W_{t-1}^N + 35\% \\ W_{t-1}^N - 35\% & if\ TW_t^1 < W_{t-1}^N - 35\% \end{cases} \quad (6)$$

For the subsequent observation windows of each day, $i = 2, \ldots, N$:

$$W_t^i = \begin{cases} TW_t^i & if\ \left|TW_t^i - W_t^{i-1}\right| \le 35\% \\ W_t^{i-1} + 35\% & if\ TW_t^i > W_t^{i-1} + 35\% \\ W_t^{i-1} - 35\% & if\ TW_t^i < W_t^{i-1} - 35\% \end{cases} \quad (7)$$

The target weight at the end of observation window i on day t calculates as:

$$TW_t^i = \min\left(MaxLev, \frac{VolTarget}{\sigma_t^i}\right) \quad (8)$$

$$\sigma_t^i = \min\left(\sigma_t^{i,21}, \sigma_t^{i,35}\right) \quad (9)$$

where:

$MaxLev$ = The maximum allowed leverage

$VolTarget$ = The target volatility level

$\sigma_t^{i,obs}$ = The volatility of the futures contract calculated as of the end of observation window i on day t, using the previous obs number of returns

The volatility of the futures contract calculates as:

$$\sigma_t^{i,obs} = \sqrt{\frac{\sum_{j=0}^{D}\sum_{k=0}^{M}\left|FutRet_{t-j}^{i-k} - \overline{FutRet_{t-j}^{i-k}}\right|^2}{obs-1}} \times 252 \times 7 \quad (10)$$

$$\overline{FutRet_{t-j}^{i-k}} = \sum_{j=0}^{D}\sum_{k=0}^{M}\frac{FutRet_{t-j}^{i-k}}{obs} \quad (11)$$

where:

$FutRet_t^i$ = The return of the futures contract as of the end of observation window i on day t

M = The number of observations included on a given day t

D = The number of days included such that the total number of observations of $FutRet_t^i$ equals obs

The return of the futures contract calculates as:

If day t is not an index futures contract roll day, then:

$$FutRet_t^i = \begin{cases} \ln\left(\frac{FO_t^1}{FO_{t-1}^N}\right) & for\ i = 1 \\ \ln\left(\frac{FO_t^i}{FO_t^{i-1}}\right)\ for\ i = 2, \dots, N \end{cases} \quad (12)$$

If day t is an index futures contract roll day, then:

For the first $N-1$ observation windows of day t, i.e., $i = 1, \dots, N-1$, the futures return, $FutRet_t^i$, calculates as described in Equation 12. For the last observation window, $i = N$, the futures return is calculated as

$$FutRet_t^N = \ln\left(\frac{FO_{rollout,t}^N}{FO_{rollout,t}^{N-1}}\right) \quad (13)$$

where:

FO_t^i = The VWAP of the futures contract calculated using observation window i on day t

FO_{t-1}^N = The VWAP of the futures contract calculated using the last observation window N on day $t-1$

$FO_{rollout,t}^N$ = The VWAP of the rolled-out futures contract calculated using observation window N on day t

$FO_{rollout,t}^{N-1}$ = The VWAP of the rolled-out futures contract calculated using observation window $N-1$ on day t

Index Decrement Calculation

The index decrement amount with decrement factor, DF, for day t calculates as

$$Decr_t = Index_{t-1} \times DF \times \frac{Act(t-1,t)}{360} \quad (14)$$

Index Futures Contract Roll Date Convention

A day t is an index futures contract roll date if it is five business days prior to the expiry date of the futures contract that is currently held. On the roll date, at the last window of the day, the index rolls the notional of the futures contract it held into the futures contract with the next quarterly expiration date.

If the index futures contract roll date coincides with a scheduled full early close day, then the roll date is moved to the following business day.

For any unscheduled full-day market closure, an intraday closure prior to the end of the last VWAP calculation window, or other disruption event affecting VWAP calculation (regardless of the window of the disruption), the roll occurs on the next business day, at the last window of the day, when all necessary data is available.

Index Maintenance

Rebalancing

The index rebalances intraday at the end of each VWAP calculation window. Certain market events impact the calculation timing, as defined below:

- For any unscheduled full-day market closure, an intraday closure prior to the end of the last VWAP calculation window, or other disruption event affecting VWAP calculation, the rebalancing occurs on the next business day when all necessary data is available.
- **Unavailable Pricing**
    - When an index uses VWAP or TWAP pricing — and there is at least one price during the relevant VWAP or TWAP window — then the index uses those price/prices towards the VWAP or TWAP in the manner specified in *Index Construction*.
    - If the underlying futures experience a failure or interruption and there are no recorded prices during the relevant observation window, the complete observation and relative execution window are considered disrupted, meaning the index skips that rebalance and there is no change in units from the previous window.
    - While calculating the futures VWAP over the execution window, if the underlying futures experience a failure or interruption such that there is not at least one value in each minute with a valid price and volume, the window expands one minute at a time until the end of the trading day so as to have the same number of minutes with at least one valid value as the original window would have had if there were no failures or interruptions.
        - For example, if the execution window is from 09:55:00 to 10:15:00 Eastern Time, the expectation is there are 20 one-minute sub-windows with at least one valid price and volume. If, due to failure or interruption, there were fewer than 20 such sub-windows, the execution window expands one minute at a time until there are 20 valid sub-windows. At that point, the VWAP calculates over the entire period from the start time (09:55:00) to the newly set end time using all the trades that fall within the expanded execution window.

For information on Calculations and Pricing Disruptions, Expert Judgment and Data Hierarchy, please refer to S&P Dow Jones Indices' Commodities 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[1].

Index	Launch Date	First Value Date	Base Date	Base Value
S&P 500 Futures 40% Intraday VT Index (USD) ER	08/30/2024	01/03/2005	12/31/2004	100
S&P 500 Futures 40% Intraday VT 4% Decrement Index (USD) ER	08/30/2024	01/03/2005	12/31/2004	100

[1] For information regarding back-test historical rule deviations, please refer to *Appendix B*.

Index Governance

Index Committee

An index committee maintains the index. 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 Commodities Indices Policies & Practices Methodology.

Index Policy

Announcements

Announcements of the daily index values are made after the market close each day.

For more information, please refer to the Announcements section of S&P Commodities Indices Policies & Practices Methodology.

Holiday Schedule

The index calculates 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 Commodities Indices Policies & Practices Methodology.

Recalculation Policy

Intraday index calculations are executed for some index versions whenever the index's primary exchanges are open. In case an issue arises during calculation, the index is restated, based on feasibility assessment by the index committee, for every reported intraday index level period following the issue.

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 Commodities 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
S&P 500 Futures 40% Intraday VT Index (USD) ER	SPXF40D0
S&P 500 Futures 40% Intraday VT 4% Decrement Index (USD) ER	SPXF40D4

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: VWAP Observation and Execution Time Windows

For a scheduled full trading day, the VWAP observation and execution windows are defined as:

Window ID	Observation Window	Execution Window
1	10:00:00 to 10:05:00	09:55:00 to 10:15:00
2	11:00:00 to 11:05:00	10:55:00 to 11:15:00
3	12:00:00 to 12:05:00	11:55:00 to 12:15:00
4	13:00:00 to 13:05:00	12:55:00 to 13:15:00
5	14:00:00 to 14:05:00	13:55:00 to 14:15:00
6	15:00:00 to 15:05:00	14:55:00 to 15:15:00
7	15:55:00 to 16:00:00	15:55:00 to 16:00:00

For a scheduled full early close day, the VWAP observation and execution windows are defined as:

Window ID	Observation Window	Execution Window
1	12:55:00 to 13:00:00	12:55:00 to 13:00:00

All windows described above are in Eastern Time.

For VWAP calculations, the windows are treated as “left closed and right open”, i.e., trades that occurred at times equal to or after the start time and before the end time of the window.

Appendix B: Historical Back-Test Rule Deviations

For the following dates and observation windows, a VWAP was not calculated for the futures contract due to the vendor-provided historical dataset containing zero trades that occurred within the specified date and window times. For the purposes of the back test, the missing VWAPs were replaced with the last calculated observation VWAP that was available for the futures contract as of that specific date and time.

Date	Window ID	Observation Window
04/26/2005	2	11:00:00 to 11:05:00
04/26/2005	3	12:00:00 to 12:05:00
04/26/2005	4	13:00:00 to 13:05:00
05/22/2006	3	12:00:00 to 12:05:00
06/21/2007	7	15:55:00 to 16:00:00
03/18/2020	4	13:00:00 to 13:05:00

For the following dates and execution windows, a VWAP was not calculated for the futures contract due to the vendor-provided historical dataset containing zero trades that occurred within the specified date and window times. For the purposes of the back test, the missing VWAPs were replaced with the last calculated execution VWAP that was available for the futures contract as of that specific date and time.

Date	Window ID	Execution Window
04/26/2005	2	10:55:00 to 11:15:00
04/26/2005	3	11:55:00 to 12:15:00
04/26/2005	4	12:55:00 to 13:15:00
06/21/2007	7	15:55:00 to 16:00:00

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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