

Cboe S&P 500 Dispersion Index *Methodology*

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Introduction

Index Objective

The Cboe S&P 500 Dispersion Index, also called the Dispersion Index or just DSPXSM, measures the expected dispersion in the S&P 500[®] over the next 30 calendar days, as derived from the prices of options on the S&P 500 index and selected S&P 500 constituents using a modified VIX[®] methodology.

Data Source

Equity options data are sourced from the Options Price Reporting Authority (OPRA). The level of VIX is sourced from Cboe, Exchange, Inc. ("Cboe").

Collaboration

The Cboe S&P 500 Dispersion Index is generated and published under agreements between Cboe and S&P Dow Jones Indices. Eligible constituents are selected, and index level is calculated by Cboe according to the rules in this methodology. S&P Dow Jones Indices thanks Cboe for its contributions to the development and the calculation of the Cboe S&P 500 Dispersion Index.

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' Equity Indices Policies & Practices Methodology	Equity Indices Policies & Practices
S&P Dow Jones Indices' Index Mathematics Methodology	Index Mathematics Methodology
S&P Dow Jones Indices' Float Adjustment Methodology	Float Adjustment Methodology

This methodology was created by S&P Dow Jones Indices and Cboe 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.

Eligibility Criteria

The Cboe S&P 500 Dispersion Basket Index

The Cboe S&P 500 Dispersion Basket Index, also called the Dispersion Basket Index or DSPBX, represents a subset of S&P 500 constituents of the S&P 500 that have had a wide range of quoted call and put options with expiry dates between 10 and 120 calendar days. The Basket Index provides the underlying stock universe for the calculation of the Dispersion Index.

For more details, see the Cboe S&P 500 Dispersion Basket Index Methodology, available at [\[link\]](#).

Index Universe

The index universe consists of listed options on the S&P 500 (in particular, those used to calculate the VIX index levels) and listed options on all constituents of the Basket Index, subject to further eligibility criteria as described in the following sections and as adjusted for any composition changes due to the current rebalancing.

Multiple Share Classes and Dual Listed Companies

Options on all publicly listed multiple share class lines are eligible for index inclusion, subject to meeting the eligibility criteria. For more information regarding the treatment of multiple share classes, please refer to Approach A within the Multiple Share Classes section of the S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Index Construction

Outline of the Dispersion Index Methodology

The Dispersion Index is calculated as the square root of the difference between (i) the weighted average expected variance of constituents of the Basket Index—ranging among all such constituents whose expected variance can be calculated at that point in time – and (ii) the expected variance of the S&P 500, as represented by the square of the current level of the Cboe Volatility Index (“VIX”). If that difference is negative, the Dispersion Index will equal zero.

The formula below summarizes the calculation:

$$DSPX = 100 * \sqrt{\max\left(\sum_{i=1}^L w_i \hat{\sigma}_{i,30}^2 - VIX^2, 0\right)}$$

where, among other conditions detailed in the subsequent sections,

- $\hat{\sigma}_{i,30}^2$ represents a current or recent estimate of 30-day variance for each constituent i of the Basket Index, based on a version of the VIX methodology, *provided* such a variance calculation is available (see sections “Valid Variance Condition” and “Pulled-Forward Variance”)
- w_i represents the FMC weight for of each constituent as a proportion of the total weight of constituents from the Basket Index included in the calculation at that point in time.
- VIX represents the Cboe Volatility Index (VIX) index value.

Further conditions and details of the calculation are provided in the following sections and are integrated finally in the section: “Calculating the Dispersion Index”.

End of Day, Intraday and Back-Tested End of Day Index Levels

An “Intraday” level for the Dispersion Index is updated regularly during each U.S. equity market trading day from 9:45am until 4:00pm New York time.

A distinct “End of Day” level for the Dispersion Index is published after the market close.

A time series of “Back-Tested End of Day” levels is also available, corresponding to a calculation of the Index level for a selected range of dates prior to the Index launch date. Back-Tested End of Day Index levels are available for the period 19 Jun 2014 to 15 Sep 2023

The methodology for the Back-Tested End of Day index level differs in an important respect from the live Index levels. In particular, the Intraday and End of Day Index levels may have inputs representing 30-day variance estimates for Basket Index constituents that are “pulled forward” from a recent point in time (see sections “Valid Variance Condition”, “Pulled-Forward Variance” and “Calculating the Dispersion Index”). The Back-Tested End of Day Index level contains no inputs that are “pulled forward”.

Terminology: Options, Classes, Strips, Valid Quotes and Valid Option Strips.

Only standard monthly, standard quarterly, and Friday weekly call and put options linked to members of the Basket Index that are listed on U.S. exchanges are eligible for consideration.

For any member of the index universe on any trading day, the “option class” associated to that constituent is the set of all options sharing that underlying.

Within a specific option class, an “option strip” refers to all the options in that class sharing a particular expiry date.

Within a specific option strip, a “valid quote” is defined as a two-sided quote in which the ask price is non-zero, and the ask price is greater than or equal to the bid price.

At any point in time, a strip of options will be said to be a “valid strip” if there is at least one strike in that strip for which there is a valid quote for both the put and call.

Note: these definitions may be compared with the definition of a “valid option” as described in the section “Valid Options for the Valid Variance Condition”.

Selection of Option Expiration Dates

At each point in time and for each constituent of the Basket Index, if possible, two valid option strips with standard third Friday expiration are selected as the “Near Term” and “Next Term” maturities, respectively. The Near Term expiration must have 10 or more days to expiry and 30 or fewer days to expiry, and the Next Term expiration must have more than 30 days to expiry and 120 or fewer days to expiry. If there are no standard expirations satisfying these conditions, the closest eligible weekly Friday expiration to 30 days that satisfies the condition is used. Finally, if there are no possible Near Term or no possible Next Term expirations including weeklies that satisfy the condition, the constituent is dropped from the calculation.

The Implied Forward

For any valid option strip, an implied forward for the underlying stock is calculated using put-call parity on the strike where the absolute difference between the call and put mid-price is minimized, provided that option has a valid quote. If there are multiple strikes with the same difference between the call and put mid-price, the lowest strike is selected. The implied forward for an option strip j is equal to:

$$F_j = K_j + e^{rT} * (C_j - P_j)$$

where:

- F_j represents the implied forward
- K_j represents the strike price at which the absolute difference between the call and put option mid-price is minimized
- C_j represents the call midprice at strike K_j
- P_j represents the put midprice at strike K_j
- r is the same interest rate associated to the time horizon T used in the VIX calculation¹
- T represents the annualized time to expiry given by:

$$T = \frac{\text{Minutes in Current Day} + \text{Minutes in Settlement Day} + \text{Minutes in Other Days}}{\text{Minutes in a Year}}$$

ATM Options and OTM Options

For each valid option strip, the ATM (at-the-money) option and associated strike K_{zero} is identified by taking the strike at or directly below the implied forward.

¹ For more details, please refer to the Cboe Volatility Index Mathematics Methodology.

OTM (out-of-the-money) options for that strip are identified by selecting all calls with strikes greater than K_{zero} and put strikes less than K_{zero} .

Valid Options for the Valid Variance Condition

At any point in time, for each valid option strip on a particular equity constituent, the options are filtered in sequence by the following rules:

- Any options with strikes further away from K_{zero} than two consecutive options with zero bids are filtered out, even if they have non-zero bids.
- Any remaining options without valid quotes are filtered out.
- Any remaining options with zero bids are also filtered out.

The remaining OTM call and put options, as well as the ATM option, are “valid options” for the purposes of calculating the Valid Variance Condition on that constituent at that point in time.

Valid Variance Condition

At any point that the Dispersion Index is calculated, for a given constituent in the Basket Index, that constituent will be said to have a “valid variance” at that time if there is a Near Term options strip and a Next Term options strip which are both valid options strips, *and* both strips have at least three OTM call options and at least three OTM put options that are valid options.

Individual Stock Variance Calculation

At any point that the Dispersion Index is calculated, for each constituent i of the Basket Index that has a valid variance at that point in time, an expected variance $\sigma_{i,30}^2$ for that constituent will be calculated based on the prices of valid options in the Near Term and Next Term options strips according to the following two steps:

- 1) Calculate the Near Term and Next Term variance contribution for Stock i :

$$\sigma_{i,Near}^2 = \frac{2}{T_{Near}} \sum_k^M \left[\frac{\Delta K_{k,Near}}{K_{k,Near}^2} * e^{r_{Near} T_{Near}} * Q(K_{k,Near}) \right] - \frac{1}{T_{Near}} \left(\frac{F_{Near}}{K_{Zero,Near}} - 1 \right)^2$$

$$\sigma_{i,Next}^2 = \frac{2}{T_{Next}} \sum_k^M \left[\frac{\Delta K_{k,Next}}{K_{k,Next}^2} * e^{r_{Next} T_{Next}} * Q(K_{k,Next}) \right] - \frac{1}{T_{Next}} \left(\frac{F_{Next}}{K_{Zero,Next}} - 1 \right)^2$$

Where:

- $\sigma_{i,Near}^2, \sigma_{i,Next}^2$ refer to the near term and next term variance of stock i respectively.
- T_{Near}, T_{Next} refer to the annualized time to expiry for the Near Term and Next Term strips, respectively.
- r_{Near}, r_{Next} are the interest rates associated to the Near Term and Next Term maturities, respectively.²
- $K_{k,j}$ is the strike of valid option k and for maturity j
- $\Delta K_{k,j}$ is the strike increment called Delta K associated to the option with maturity j and strike $K_{k,j}$. Delta K is calculated by taking the half of the difference between the strike prices on either side of $K_{k,j}$. When a strike $K_{k,j}$ has only one strike bordering it, a simple difference is taken to calculate Delta K
- $Q(K_{k,j})$ is the option mid-price at strike $K_{k,j}$. If the strike is below the ATM option strike, then the put mid-price is used and if the strike is above the ATM option strike, then a call mid-price is used. If the strike is equal to the ATM strike, the midpoint of the call and put mid-price is taken.

² As before, the same interest rate calculation method used in VIX is used here. For more details, please refer to the Cboe Volatility Index Mathematics Methodology.

- F_{Near} , F_{Next} refer to the implied forward for the Near Term and Next Term strips, respectively
- K_{zero} is the strike of the ATM option

2) After the Near Term and Next Term variance contributions are calculated, a 30-day variance $\sigma_{i,30}^2$ is computed as a weighted average of the Near Term and Next Term variances, weighted by their time to expiration and annualized as shown in the formula below:

$$\sigma_{i,30}^2 = \left\{ T_{Near} \sigma_{i,Near}^2 \left[\frac{(N_{Next} - N_{30})}{(N_{Next} - N_{Near})} \right] + T_{Next} \sigma_{j,Next}^2 \left[\frac{(N_{30} - N_{Near})}{(N_{Next} - N_{Near})} \right] \right\} \times \frac{N_{365}}{N_{30}}$$

Where:

- N_{Near} represents the number of minutes until expiration of the Near Term options
- N_{Next} represents the number of minutes until expiration of the Next Term options
- N_{30} represents the number of minutes in the given 30-day term
- N_{365} represents the number of minutes in a calendar year (525,600)

Note: providing such calculation is completed, the value $\sigma_{i,30}^2$ is said to be the “valid variance” associated to the constituent i at that point in time.

Pulled-Forward Variance

At each point in time, for each constituent of the Basket Index, if that constituent does not have a valid variance (see section “Valid Variance Condition”), then a “pulled-forward variance” – equal to a valid variance for that constituent calculated at an earlier point in time - may be used to calculate the Dispersion Index. The conditions under which a pulled forward value may be used varies between the End of Day and Intraday index levels, and the Back-Tested End of Day index levels, as follows.

Intraday Index and End of Day Index level:

At any point that the Dispersion Index is being calculated, if there is a constituent of the Basket Index without a valid variance, then one of three calculations will be conducted.

- If a valid variance was available for that constituent *earlier in that trading day*, then the most recently available valid variance will be used.
- If no valid variance was available for that constituent earlier in that trading day, but a valid variance for that constituent was used in the calculation of the End of Day Index level *at the close on the prior trading day*, then that valid variance will be used.
- Otherwise, that constituent will be excluded from the calculation at that point in time and the weight of the remaining constituents will be reweighted in the calculation.

Additionally, if either condition (a) or (b) applies, the resulting value for that constituent’s variance used in the calculation will be called a “pulled-forward variance”. Accordingly, the maximum length of time that a Basket Index constituent can have a pulled-forward variance is from first calculation of the index on any trading day (when a value from the prior day’s close may be used), up to and including the close of the same trading day.

For avoidance of doubt: in any calculation of the Index, any then-current constituent of the Basket Index that *does* has a valid variance at that point in time will have that variance included in the calculation, even if that constituent had previously been excluded or had a pulled-forward variance.

Back-Tested End of Day Index level:

For the calculation of Back-Tested End of Day Index Levels, no variance levels were pulled forward. Accordingly, any constituent of the Basket Index without a valid variance at the close was excluded from the calculation for that day, and the weight of the remaining constituents was reweighted in the calculation.

Calculating the Dispersion Index

At any point that the Dispersion Index is calculated, it will be calculated according to the formula as introduced in the section “Outline of Methodology”:

$$DSPX = 100 * \sqrt{\max\left(\sum_{i=1}^L w_i \hat{\sigma}_{i,30}^2 - VIX^2, 0\right)}$$

where:

- $i = 1, \dots, L$ represent the constituents of the Basket Index currently included in the calculation.
- If the constituent i has a valid variance, then $\hat{\sigma}_{i,30}^2 = \sigma_{i,30}^2$ is equal to the then-current 30-day variance (see section: “Individual Stock Variance Calculation”), otherwise $\hat{\sigma}_{i,30}^2$ is a pulled-forward variance (see section, “Pulled-Forward Variance”).
- w_i represents the FMC weight for stock i , calculated as a proportion of the sum of the FMC of the L constituents of the Basket Index whose variance is included in the calculation at that point in time (including constituents with pulled-forward variance).³
- VIX represents the Cboe Volatility Index (VIX) index value.

And additionally:

- If, at any time, there is not a valid variance nor an available pulled-forward variance for *any* constituent of the Basket Index, then the Dispersion Index will not be calculated and further updates to the index level will be suspended until such time as a valid variance is available.
- If the VIX has suspended publication, the Dispersion Index will also suspend publication.

³ The weights of each constituent may fluctuate intraday due to the impact of intraday equity price changes on constituent FMC. Additions and deletions from the Basket Index effective at the close on any day will not be reflected in the Dispersion Index until the first calculation on the following trading day.

Index Maintenance

Rebalancing

The index rebalances at each calculation time.

Additions and Deletions

Constituents added or removed from the Basket Index will have their contribution to the calculation of the Dispersion Index adjusted at the open on the following trading day (see footnote 3 above).

For details on additions and deletions to the Basket Index, see the Basket Index methodology.

Corporate Actions

The equity option classes used to calculate DSPX may be changed to reflect corporate actions, including stock splits, special dividends, merger & acquisition, spin-offs, and delisting. Adjusted options classes will be used to calculate DSPX until unadjusted series with same expiration date are available for trading.

For more information on Corporate Actions, please refer to the Market Capitalization Indices section of S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Base Date and History Availability

The index history availability, base date, and base value are shown in the table below.

Index	Launch Date	First Value Date	Base Date
Cboe S&P 500 Dispersion Index	09/15/2023	06/19/2014	06/19/2014

Index Governance

Index Committee

An S&P Dow Jones Indices' Index Committee maintains the index. All committee members are full-time professional members of S&P Dow Jones Indices' staff or full-time professional members of Cboe's 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

Announcements

All index constituents are evaluated daily for data needed to calculate index levels and returns. All events affecting the daily index calculation are typically announced in advance via the Index Corporate Events report (.SDE), delivered daily to all clients. Any unusual treatment of a corporate action or short notice of an event may be communicated via email to clients.

For more information, please refer to the Announcements section of S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Pro-forma Files

In addition to the corporate events file (.SDE), S&P Dow Jones Indices provides constituent pro-forma files each time the index rebalances. The pro-forma file is typically provided daily in advance of the rebalancing date and contains all constituents and their corresponding weights and index shares effective for the upcoming rebalancing. Since index shares are assigned based on prices prior to the rebalancing, the actual weight of each stock at the rebalancing differs from these weights due to market movements.

Please visit www.spglobal/spdji.com for a complete schedule of rebalancing timelines and pro-forma delivery times.

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/spdji.com.

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, intra-day, 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/spdji.com, 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	Bloomberg	RIC
Cboe S&P 500 Dispersion Index	DSPX	.DSPX

Index Data

Daily constituent and index level data are available via subscription.

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

Web Site

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

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