INDEX METHODOLOGY

NASDAQ-100 CHRONOS INDEXES

INDEX DESCRIPTION

The Nasdaq-100 Chronos Indexes, each an “Index" and collectively the “Indexes”, are designed to provide exposure to the Nasdaq-100 Total Return Index® (XNDX) while targeting a specified level of volatility. The Indexes use intraday volatility control and trend-following mechanisms with the aim of capturing significant intraday swings that might not be reflected in close-to-close observations. The Indexes rebalance up to seven times per day using time-weighted average prices (TWAP).

Although the Indexes are designed to target a specific level of volatility, there is no guaranty the Indexes will achieve these results.

Unless stated otherwise, all capitalized terms used in this document are defined in Appendix A: Definitions.

INDEX CALCULATION

For each Index, the Index value is equal to the Index Base Value on the Index Base Date. Thereafter, for each Index Day, the value of an Index is calculated in accordance with the following formula:

$$I_{t,i} = I_{t-1} + \sum_{j=1}^{i}\left(U_{t,j-1} \times \left(P_{t,j}^{EXEC} - P_{t,j-1}^{EXEC}\right) - TC_{t,j}\right) - FC_t$$

where:

t = an Index Day t.

i = the i-th Intraday Window for Index Day t.

$j-1$ = the Intraday Window immediately preceding the j-th Intraday Window for Index Day t.[1]

$I_{x,y}$ = the value of the Index for Intraday Window y and Index Day x.

I_{t-1} = the closing value of the Index for the Index Day immediately prior to Index Day t.

$U_{x,y}$ = the number of units of the Component for Intraday Window y and Index Day x (see *Rebalancing process* section below for more details).

[1] If $j-1=0$, the last available value from Index Day $t-1$ is used.

$P_{x,y}^{EXEC}$ = in respect of an Execution Window that is not the last scheduled Execution Window for Index Day x, the TWAP of the Component for Execution Window y and Index Day x (as defined in *Appendix C: TWAP Calculation and Intraday Windows*), otherwise the closing price of the Component for that day.[2]

$TC_{t,i}$ = the assumed trading costs for the Component for Intraday Window i and Index Day t as determined in accordance with the following formula:

$$TC_{t,i} = \left|U_{t,i} - U_{t,i-1}\right| \times P_{t,i}^{EXEC} \times CTC$$

where:

CTC = the assigned Component trading cost as detailed in *Index parameters* below.

FC_t = the assumed funding costs for the Component for Index Day t as determined in accordance with the following formula:

$$FC_t = U_{t-1} \times P_{t-1}^{CLOSE} \times (RF_{t-1} + FS) \times \frac{Days_{t-1,t}}{360}$$

where:

U_{t-1} = the number of units of the Component as of the end of the last Intraday Window of Index Day $t-1$.

P_{t-1}^{CLOSE} = the closing price of the Component for Index Day $t-1$.

RF_{t-1} = the Effective Federal Funds Rate published by the Federal Reserve Bank of New York for Index Day $t-1$. If such rate is unavailable, then the rate shall be the most recent rate available on an Index Day preceding Index Day t−1.

FS = the assigned funding spread as detailed in *Index parameters* below.

$Days_{t-1,t}$ = the number of calendar days from Index Day $t-1$ (inclusive) to Index Day t (exclusive).

Index values are rounded to four decimal places for index publication.

If the closing price for the Component is unavailable on a given Index Day t, then such value shall be the last available closing price for that Component, as determined by the Index Administrator. In respect of an Intraday Window, if the TWAP for the Component for an Intraday Window is unavailable, then treatment will be handled in accordance with the Disruption events section of Appendix C: TWAP Calculation and Intraday Windows, subject to final determination by the Index Administrator.

[2] If the first Execution Window of an Index Day t is a Disrupted Window in its entirety, then $P_{x,y}^{EXEC}$ shall be the closing price of the Component for Index Day $t-1$.

INDEX CONSTRUCTION

Index parameters

The table below details parameters specific to the construction and calculation of each Index.

Index (Symbol)	Component (Symbol)	Target Volatility	Maximum Exposure	Minimum Exposure	Maximum Exposure Change[3]	Component Trading Cost (CTC)	Component Funding Spread (FS)
Nasdaq-100 Chronos 10% Index (XNDXCR10)	Nasdaq-100 Total Return Index (XNDX)	10%	120%	0%	50%	See below	0.006

Component Trading Cost (CTC) varies depending on the Intraday Window (i) and is determined as follows:

Index Day Type	Component Trading Cost (CTC)
Regular Trading Day	$CTC = \begin{cases} 0.0001 & if\ i = 7 \\ 0.0002 & otherwise \end{cases}$
Half Trading Day	$CTC = \begin{cases} 0.0001 & if\ i = 4 \\ 0.0002 & otherwise \end{cases}$

For information on the Component, please refer to the Nasdaq-100 Index Methodology document.

Index components and weighting

Each Index may only include the Component as detailed in the *Index parameters* section above.

For each Intraday Window, an Index's exposure to the Component is determined in accordance with the steps outlined in *Appendix B: Exposure Determination Process*. The exposures are then transformed into units of the Component (see *Rebalancing process* section below).

Rebalancing process

Subject to a Hedge Adjustment, each Index is rebalanced up to seven times per Index Day using the Intraday Windows as detailed in *Appendix C: TWAP Calculation and Intraday Windows*. The number of units of the Component scheduled to be notionally held in the Index after the completion of Intraday Window i for Index Day t is determined in accordance with the following formula:

$$U_{t,i} = \frac{I_{t-1} \times FE_{t,i}}{P_{t,i}^{OBS}}$$

where:

$U_{t,i}$ = the number of units of the Component for Intraday Window i of Index Day t.

$FE_{t,i}$ = the final exposure for the Component for Intraday Window i of Index Day t (see *Appendix B: Exposure Determination Process*).

[3] The maximum change in exposure across each Intraday Window.

I_{t-1} = the closing Index value for Index Day $t-1$.

$P_{t,i}^{OBS}$ = the TWAP of the Component for Observation Window i of Index Day t.

If a scheduled Execution Window is a Disrupted Window, then the change in the units for that Execution Window will be reduced to reflect the portion of the scheduled Execution Window that was disrupted, as determined by the Index Administrator. The adjusted number of units of the Component to be notionally held in the Index after the completion of disrupted Intraday Window i for Index Day t is determined in accordance with the following formula:

$$U_{t,i} = U_{t,i-1} + \left(U_{t,i}^{'} - U_{t,i-1}\right) \times \frac{q_i}{Q}$$

where:

$U_{t,i}^{'}$ = the number of units as determined above ($\frac{I_{t-1} \times FE_{t,i}}{P_{t,i}^{OBS}}$), for Intraday Window i of Index Day t before any adjustment for disruptions.

$U_{t,i-1}$ = the number of units of the Component for the Intraday Window immediately preceding Intraday Window i of Index Day t.

q_i = the number of valid last tick values as defined in *Appendix C: TWAP Calculation and Intraday Windows*.

Q = the scheduled number of last tick values for an Execution Window (see *Appendix C: TWAP Calculation and Intraday Windows* for more information). Q = 16.

For the Index Base Date (t_0), the initial units of the Component are determined based on information from the Intraday Windows prior to the Index Base Date and calculated in accordance with the following formula:

$$U_{t_0,i} = \frac{Index\_Base\_Value \times FE_{t_0,i}}{P_{t_0,i}^{OBS}}$$

INDEX CALENDAR

Holiday schedule

The Indexes are calculated Monday through Friday, except on days when the Exchange is scheduled to be closed (the "Holiday Schedule").

Index calculation and dissemination schedule

Index values are made available after the market close on each Index Day via the Nasdaq Global Index Watch (GIW) website.

ADDITIONAL INFORMATION

Announcements

Nasdaq announces Index-related information via the Nasdaq Global Index Watch (GIW) website.

For more information on the general Index Announcement procedures, please refer to the Nasdaq Index Methodology Guide.

Recalculation and restatement policy

For information on the Recalculation and Restatement Policy, please refer to the Nasdaq Index Recalculation Policy.

Contact information

For any questions regarding an Index, please contact the Nasdaq Index Client Services team at indexservices@nasdaq.com.

Index dissemination

Where applicable, Index values and weightings information are available through the Nasdaq Global Index Watch (GIW) website as well as the Nasdaq Global Index FlexFile Delivery Service (GIFFD) and Global Index Dissemination Services (GIDS). Similar to the GIDS offerings, Genium Consolidated Feed (GCF) provides real-time Index values and weightings for the Nordic Indexes.

For more detailed information regarding Index Dissemination, please see the Nasdaq Index Methodology Guide.

Website

For further information, please refer to the Nasdaq Global Index Watch (GIW) website.

FTP and dissemination service

Where applicable, Index values and weightings are available via FTP on the Nasdaq Global Indexes FlexFile Delivery Service (GIFFD). Index values are available via Nasdaq's Global Index Dissemination Services (GIDS).

GOVERNANCE

Index governance

All Nasdaq Indexes are managed by the governance committee structure and have transparent governance, oversight, and accountability procedures for the index determination process. For further details on the Index Methodology and Governance overlay, please refer to the Nasdaq Index Methodology Guide.

APPENDIX A: DEFINITIONS

Term	Description
Calculation Disruption Event	In respect of an Index, the occurrence of one or more of the following events that affects a Component of that Index, or any underlying instrument of such Component, and that the Index Administrator deems to be material to the Index: • **Price Failure:** Any event that impairs or prevents the ability of the Index Administrator to obtain a relevant price, level, rate, value or any other information from an exchange or other source necessary, on a timely basis and in a manner acceptable to the Index Administrator, in order to perform the calculation of the Index. • **Inaccurate Data:** The price or value of a component, or other input data, used directly or indirectly in the Index that, in the determination of the Index Administrator, is inaccurate, incomplete and/or does not adequately reflect the true market price or value of such component or input data. • **Force Majeure:** Any event or circumstance (including, without limitation, a systems failure, natural or man-made disaster, act of God, armed conflict, act of terrorism, riot or labor disruption or any similar intervening circumstance, or restrictions due to emergency powers enforced by federal, state or local government agencies), that is beyond the reasonable control of the Index Administrator and that the Index Administrator determines, in its sole discretion, affects the Index, a Component of the Index, any input data required to calculate the Index, or that prevents the ability of the Index Administrator to calculate the Index. • **General Moratorium:** the Index Administrator observes on any day that there has been a declaration of a general moratorium in respect of banking activities in any relevant jurisdiction.
Component	In respect of an Index, the Component as detailed in the *Index parameters* section.
Consequences of a Market Disruption Event or a Calculation Disruption Event	In respect of an Index, if a Market Disruption Event or a Calculation Disruption Event occurs or is occurring on an Index Day that the Index Administrator determines materially affects the Index, the Index Administrator may: • Delay the calculation of the Index and halt the dissemination of the value of the Index and /or other information relating to the Index until such time, which may be a subsequent Index Day, that the Index Administrator determines that such Market Disruption Event or Calculation Disruption Event is no longer occurring. • Determine a good faith estimate of any affected or missing input data required to calculate the Index or the value of the Index for such Index Day or time for such Index Day.
Disrupted Window	In respect of an Index and a Component, a scheduled Execution Window in which there is a Market Disruption Event that affects that Execution Window either partially or in its entirety, as determined by the Index Administrator.
Exchange	The Nasdaq Stock Exchange.

Execution Window	In respect of an Index, a Component, and an Index Day, one of up to seven execution periods for that Index Day, subject to the occurrence of any Market Disruption Events, as detailed in *Appendix C: TWAP Calculation and Intraday Windows.*
Half Trading Day	An Index Day on which markets are scheduled to close early at 1:00 PM ET instead of 4:00 PM ET, as published by Nasdaq and subject to change from time to time.
Hedge Adjustment	In respect of an Index, and a Component, if a scheduled Execution Window is a Disrupted Window, then the change of units of that Component shall be adjusted to reflect the proportion of that Execution Window that was disrupted, as detailed in the *Rebalancing process* section.
Index Administrator	Nasdaq, Inc.
Index Base Date	January 2, 2009.
Index Base Value	100.00
Index Day	In respect of an Index and starting with the Index Base Date, each weekday that is not a scheduled holiday according to the Holiday Schedule as defined in the *Index Calendar* section.
Intraday Window	In respect of an Index and a Component, an Observation Window and an Execution Window.
Market Disruption Event	In respect of an Index and a Component, the occurrence of one or more of the following events that affects that Component, or any underlying instrument of that Component, and that the Index Administrator deems to be material to the Index: • **Trading Disruption:** Any unscheduled closure of the relevant exchange; a material suspension, limitation or disruption of trading on such exchange; a failure of such exchange to publish the relevant price, level, value or other information; a halt in trading, such as a circuit breaker or other exchange imposed halt, including an exchange imposed daily "limit price"; or any other event that materially affects the ability of market participants to trade, effect transactions in, maintain or unwind positions in that Component or any underlying instrument of that Component. • **Exchange Disruption:** Any exchange-related event on a relevant exchange that disrupts or impairs the ability of market participants to effect transactions or obtain market values or price discovery of a component used directly or indirectly in the Index.
Observation Window	In respect of an Index, a Component, and an Index Day, one of up to seven observation periods for that Index Day, as detailed in *Appendix C: TWAP Calculation and Intraday Windows.*
Regular Trading Day	An Index Day that is not a Half Trading Day.

For additional key terms not defined above, please refer to the Nasdaq Index Methodology Guide.

APPENDIX B: EXPOSURE DETERMINATION PROCESS

In order to consistently target the desired level of volatility, each Index has the ability to adjust the notional exposure to the Component up and down during each Intraday Window for each Index Day, subject to a maximum exposure constraint and a maximum exposure change constraint (see *Index parameters* section). In other words, when the measured volatility is below the target level, the Index has the potential to increase exposure. Alternatively, when the measured volatility is above the target level, the Index may reduce exposure.

This exposure determination mechanism consists of the following determination steps:

1. Determine the historical volatility of the Component ($CHV_{t,i}$) for Intraday Window i in accordance with the following formula:

$$CHV_{t,i} = \sqrt{252 \times 7} \times \sqrt{\frac{\sum_{k=1}^{140}\left(\lambda^k \times \left(\frac{P_{t,i-k+1}^{OBS}}{P_{t,i-k}^{OBS}} - 1\right)^2 \times \omega_{i-k+1}\right)}{\sum_{k=1}^{140} \lambda^k \times \omega_{i-k+1}}}$$

where:

$\lambda = 0.99$

$P_{t,i-k}^{OBS}$ = the TWAP of the Component for the k-th Observation Window preceding the i-th Intraday Window of Index Day t.

ω_{i-k+1} = the Intraday Normalizing Factor for Intraday Window $i-k+1$, as defined in *Appendix C: TWAP Calculation and Intraday Windows*.

2. The volatility adjustment factor (VAF_t) is used to adjust the realized volatility back to the target and correct for any temporary over- or under-shoots. The volatility adjustment factor for an Index is determined in accordance with the following formulae:[4]

$$VAF_t = \begin{cases} min\left(1.2, max\left(0.8, \sqrt{max\left(0, 2 - \frac{VarObs_t}{VarBudget_t}\right)}\right)\right) & if\ |VAF_t - VAF_{t-1}| > 5\% \\ VAF_{t-1} & otherwise \end{cases}$$

$$VarBudget_t = \frac{TV^2}{252}$$

$$VarObs_t = \frac{1}{20} \times \sum_{k=1}^{20}\left(\frac{I_{t-k+1}}{I_{t-k}} - 1\right)^2$$

where:

TV = the Target Volatility as detailed in the *Index parameters* section.

I_{t-k} = the closing Index value for Index Day $t-k$.

[4] $VAF_{t,i}$ for the first 20 Index Days (exclusive), including the Index Base Date, is set as $VAF_{t,i} = 1$.

3. Determine the "Trend Following" mechanism ($TF_{t,i}$) based on intraday returns according to the following formula:

$$TF_{t,i} = \begin{cases} max\left(0, 0.5 + 25 \times ret_{t,i}\right) & if\ ret_{t,i} < -1.5\%\ and\ i \neq 7^{5} \\ 1 & otherwise \end{cases}$$

where:

$ret_{t,i}$ = the intraday return of the Component = $\frac{P_{t,i}^{OBS}}{P_{t-1}^{CLOSE}} - 1$.

P_{t-1}^{CLOSE} = the closing price of the Component for Index Day $t-1$.

4. The Intraday-End-of-Day Adjustment Factor is determined as follows:[6]

$$Adj_t = median_{k=1}^{504} \frac{CHV_{t-k+1,N}}{IHV_{t-k+1}}$$

$$IHV_t = \sqrt{252} \times \sqrt{\frac{\sum_{k=0}^{19} \lambda^k \times \left(\frac{P_{t-k}^{CLOSE}}{P_{t-k-1}^{CLOSE}} - 1\right)^2}{\sum_{k=0}^{19} \lambda^k}}$$

where:

$CHV_{t,N}$ = the historical volatility ($CHV_{t,7}$) of the Component for Intraday Window 7 in the case of a Regular Trading Day or the historical volatility ($CHV_{t,4}$) of the Component for Intraday Window 4 in the case of a Half Trading Day.

P_{t-k}^{CLOSE} = the closing price of the Component for Index Day $t-k$.

λ = 0.9330329915368074

5. Determine the target exposure ($TE_{t,i}$) in accordance with the following formula:

$$TE_{t,i} = max\left(Min\_Exp, min\left(Max\_Exp, \frac{TV}{CHV_{t,i}} \times VAF_{t-1} \times TF_{t,i} \times Adj_{t-1}\right)\right)$$

where:

Min_Exp = the Minimum Exposure to the Component as detailed in the *Index parameters* section.

Max_Exp = the Maximum Exposure to the Component as detailed in the *Index parameters* section.

TV = the Target Volatility as detailed in the *Index parameters* section.

$VAF_{t,i}$ = the volatility adjustment factor for Intraday Window i for Index Day t, as determined in step 2 above.

[5] $i \neq 7$ for Regular Trading Days and $i \neq 4$ for Half Trading Days.

[6] Adj_t for the first 524 Index Days (exclusive), including the Index Base Date, is set as $Adj_t = 0.84$.

$TF_{t,i}$ = the Trend Following mechanism for Intraday Window i for Index Day t, as determined in step 3 above.

6. Determine the final exposure ($FE_{t,i}$) in accordance with the following formula:[7]

$$FE_{t,i} = FE_{t,i-1} + min\Big(Max\_Change, max\big(-Max\_Change, TE_{t,i} - FE_{t,i-1}\big)\Big)$$

where:

Max_Change = the Maximum Exposure Change to the Component as detailed in the *Index parameters* section.

$TE_{t,i}$ = the target exposure for Intraday Window i for Index Day t, as determined in step 4 above.

[7] For Index dissemination purposes, the Index Administrator may publish the effective exposure ($EE_{t,i}$) for each Execution Window or end-of-day as of after the market close. The effective exposure is determined as follows:

$$EE_{t,i} = \frac{U_{t,i} \times P_{t,i}^{EXEC}}{I_{t,i}}$$

Where $P_{t,i}^{EXEC}$ is either the TWAP of the Execution Window or the end-of-day closing price of the Component.

APPENDIX C: TWAP CALCULATION AND INTRADAY WINDOWS

TWAP calculation

The time-weighted average price (TWAP) indicates the average price of the Component during a specified time window. The TWAP is calculated by taking a simple average of the last tick values for the Component of each minute within the relevant time windows:

$$TWAP_{t,i} = \frac{\Sigma_{j=1}^{q_i} PT_{i,j}}{q_i}$$

where:

$TWAP_{t,i}$ = the TWAP for the Component for Intraday Window i for Index Day t.

$PT_{i,j}$ = the last tick value of the Component for each minute *j* (inclusive of the start time and exclusive of the end time).

q_i = the number of last tick values ($PT_{i,j}$) observed in the intraday window i.

Intraday windows

Each Index rebalances up to seven times each Regular Trading Day, based on the TWAP Intraday Windows for observation and execution, an Observation Window and Execution Window, respectively, as detailed below.

Intraday Windows – Regular Trading Days

Window (i)	Observation		Execution		Intraday Normalizing Factor (ω)
	Start	End	Start	End	
1	09:30:00	09:33:00	09:37:00	09:53:00	0.2
2	10:09:00	10:15:00	10:29:00	10:45:00	1.2
3	11:09:00	11:15:00	11:29:00	11:45:00	1.2
4	12:09:00	12:15:00	12:29:00	12:45:00	1.2
5	13:09:00	13:15:00	13:29:00	13:45:00	1.2
6	14:09:00	14:15:00	14:29:00	14:45:00	1.2
7	15:24:00	15:30:00	16:00:00	16:00:00	0.9

On Half Trading Days, there are up to four TWAP Intraday Windows for observation and execution, as detailed below:

Intraday Windows – Half Trading Days

Window (i)	Observation		Execution		Intraday Normalizing Factor (ω)
	Start	End	Start	End	
1	09:30:00	09:33:00	09:37:00	09:53:00	0.2
2	10:09:00	10:15:00	10:29:00	10:45:00	1.25
3	11:09:00	11:15:00	11:29:00	11:45:00	1.25
4	12:09:00	12:15:00	13:00:00	13:00:00	1.25

Disruption events

The following adjustments may be applicable due to certain disruption events:

- For any Calculation Disruption Event or Market Disruption Event that affects the ability to obtain accurate and reliable Component values that span the entirety of an Observation Window, the prior TWAP observation price will be used to calculate the target exposure. If such event impacts part of an Observation Window, then the TWAP observation price is calculated according to the TWAP formula using the available data observed.
- For any Calculation Disruption Event or Market Disruption Event that spans the entirety of a scheduled Execution Window, $P_{x,y}^{EXEC}$ for such corresponding period shall be equal to the last available P^{EXEC} determined prior to such period, as determined by the Index Administrator.
- For any Market Disruption Event that impacts only part of an Execution Window, the TWAP execution price shall be calculated according to the TWAP formula using the available data.

Historical intraday prices

For Index history beginning on July 1, 2014, XNDX intraday tick data was used for TWAP calculation purposes. For Index history prior to July 1, 2014, E-mini Nasdaq-100 Futures (symbol: NQ) intraday tick data was used as a proxy for XNDX's intraday TWAP prices. This proxy method assumes a 100% roll out of the current futures contract and into the next futures contract effective after the close on the Index Day preceding the third Friday (expiration day) of each quarter (March, June, September, and December) and assumes the application of the previously outlined disruption events treatment.

DISCLAIMER

Nasdaq may, from time to time, exercise reasonable discretion as it deems appropriate in order to ensure Index integrity, including but not limited to, quantitative inclusion criteria. Nasdaq may also, due to special circumstances, if deemed essential, apply discretionary adjustments to ensure and maintain the high quality of the index construction and calculation. Nasdaq does not guarantee that any Index accurately reflects future market performance.

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