



Calculation Manual – Equities & Commodities

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1 Overview

1.1 Introduction

This Policy describes the mathematical approach used in computation of the Nasdaq Equity Indexes, by way of formulas and calculations. The objective is to meet the needs of users in understanding the factors affecting Index performance.

1.2 Objective

The Policy shall apply to all Nasdaq Equity Indexes. This document outlines the primary methods used in computing Equity Indexes consisting of price return, gross total return, net total return, dividend points, excess return, volatility, inversed and leveraged, currency hedged, and contract return. It also provides insights on settlement price options, applicable in different time zones.

Please note that this document does not detail Index construction or criteria information, as this information is available in each specific Index Methodology. Additionally, this document does not detail Index corporate actions handling, as this information is available in the *Corporate Actions and Events Manual – Equities*.

2 Equity Indexes Basic Terms & Calculations

The following definitions shall apply to the Policy:

2.1 General Formulas

- (a) **“Index Security”** shall mean a security that has been selected for membership in a particular index, having met all applicable eligibility requirements.
- (b) **“Index Security Market Value”** shall be calculated as follows:

$$\text{Index Security Market Value}_t = q_{i,t} \times p_{i,t} \times \text{Spot rate}_{i,t}$$

q_i = Number of shares of Index Security i applied in the Index. The number of shares can be based on any number of items which would be identified in each specific Index Methodology including total shares outstanding (TSO), application of free float, dividend yield, modification due to foreign ownership restrictions, modification due to capping etc. This can also be referred to as Index Shares.

p_i = Price in quote currency of Index Security i . Depending on the time of the calculation, the price can be either of the following:

- (1) The Start of Day (SOD) price which is the previous index calculation day's (t-1) closing price for Index Security i adjusted for corporate action(s) occurring prior to market open on date t , if any, for the SOD calculation only;
- (2) The intraday price which reflects the current trading price received from the Index Exchange during the index calculation day;
- (3) The End of Day (EOD) price refers to the Last Sale Price; or
- (4) The Volume Weighted Average Price (VWAP)

Spot rate_i = Foreign exchange rate to convert Index Security i quote currency into Index Currency. Foreign exchange rate is provided by the WM Company¹ and in the calculation of the EOD Index Value is the closing spot rate at 16:00:00 UK time, unless otherwise noted in the Index Methodology. Intraday spot rates are applied to the real time index calculations during the index calculation day. The Index Security Market Value at SOD utilizes $\text{Spot rate}_{i,t-1}$

t = current index calculation day

$t - 1$ = previous index calculation day

- (c) **“Index Exchange”** shall mean the listing market from which prices for Index Security i are received and used by Nasdaq in the Index calculation.
- (d) **“Index Currency”** shall mean the currency in which the Index is calculated.
- (e) **“Underlying Index”** shall mean a primary or parent index value utilized in a secondary index value calculation.
- (f) **“Index Market Value”** shall be calculated as follows:

¹ The WM/ Reuters Spot Rates provided by The World Markets Company plc (“WM”) in conjunction with Thomson Reuters. WM shall not be liable for any errors in or delays in providing or making available the data contained within this service or for any actions taken in reliance on the same, except to the extent that the same is directly caused by its or its employees' negligence.

$$Index\ Market\ Value_t = \sum_{i=1}^n q_{i,t} \times p_{i,t} \times Spot\ Rate_{i,t}$$

n = number of Index Securities included in the Index

- (g) “**Index Security Weight**” shall be calculated as follows:

$$Index\ Security\ Weight_t = \frac{Index\ Security\ Market\ Value_t}{Index\ Market\ Value_t}$$

2.2 Pricing Definitions

- (a) “**Last Sale Price (LSP)**” The Last Sale Price refers to the last regular-way trade reported on such security’s Index Exchange. If an Index Security does not trade on its Index Exchange on a given day or the Index Exchange has not opened for trading, the Start of Day price is used. If an Index Security is halted during the trading day, the most recent Last Sale Price is used until trading resumes. For securities where the Nasdaq Stock Market is the Index Exchange, the Last Sale Price may be the Nasdaq Official Closing Price (NOCP) when it is closed.
- (b) “**Volume Weighted Average Price**” Volume Weighted Average Price (VWAP) is used solely in calculating certain Nasdaq Global Indexes. The VWAP is received directly from the Genium Consolidated Feed (GCF) and is calculated as the aggregate traded amount for all transactions under certain trading conditions during normal trading hours divided by the corresponding aggregated number of shares traded for the day. If a VWAP is not received on a particular day, the VWAP for such Index Security on the last index calculation day on which it was possible to calculate such VWAP is used.

2.3 Equity Index Calculation Methodologies

The following versions of the Equity Indexes are calculated²:

Definition of Index Values

PR = Price Return Index Value

GTR = Gross Total Return Index Value

NPR = Net Price Return Index Value

NTR = Net Total Return Index Value

DIV = Dividend Point Index Value

ER = Excess Return Index Value

LI = Leveraged/Inverse Index Value

HIX = Hedged Index Value

OPT or EXP = Options/Settlement (U.S.) or Expiration (Nordics) Index Value

² Please refer to each specific Index Methodology for the specific versions calculated.

2.3.1 Price Return Index Calculation

The Price Return (PR) Index Value reflects changes in market value of Index Securities during trading hours. There are two calculation methods for the PR Index.

2.3.1.1 Price Return Index

The Price Return Index is calculated without regard to ordinary dividends however it does reflect special dividends. The formula is as follows:

$$PR_t = \frac{\text{Index Market Value}_t}{PR \text{ Index Divisor}_t}$$

Where:

$$PR \text{ Index Divisor}_t = \frac{SOD \text{ Index Market Value}_t}{PR_{t-1}}$$

The Index Divisor serves the purpose of scaling an Index Market Value to lower order of magnitude, which is recommended for reporting purposes. The Index Divisor is adjusted to ensure that changes in an Index Security's price or shares either by corporate actions or index participation which occur outside of trading hours do not affect the index value. An Index Divisor change occurs after the close of the Index.

2.3.1.2 True Price Return Index Calculation

The True Price Return Index is calculated without regard to ordinary or special dividends. The Index is calculated in the same manner as the Price Return Index above except for the above mentioned difference.

2.3.2 Gross Total Return Index Calculation

The Gross Total Return (GTR) Index Value reinvests cash dividends. There are two calculation methods for the GTR Index.

2.3.2.1 GTR Index Linked (Same Index Divisor) to a Corresponding PR Index

$$GTR_t = GTR_{t-1} \times \frac{(PR_t + IDP_t)}{PR_{t-1}}$$

Where:

$$IDP_t = \frac{\text{Index Dividend Market Value}_t}{PR \text{ Index Divisor}_t}$$

$$\text{Index Dividend Market Value}_t = \sum_{i=1}^n q_{i,t} \times d_{i,t} \times \text{Spot Rate}_{i,t-1}$$

Where:

d_i = Ordinary cash dividend amount of Index Security i on its ex-distribution date. In the case of receiving a late ordinary cash dividend from Japan or Korea, the dividend will be considered ex-distribution on the next index calculation day.

2.3.2.1 GTR Index Not Linked to Corresponding PR Index

For the GTR Index Not Linked to a Corresponding PR Index, the Index is calculated in the same manner as the GTR Index Linked to a Corresponding PR Index.

The only difference is that the PR Index values that are calculated to create the GTR Index are not disseminated as a separate index however values but can be found within index file reports.

2.3.3 Net Total Return Index Calculation

The Net Total Return (NTR) Index Value reinvests cash dividends based on the Index Security's incorporation withholding tax rate. The Index Security's incorporation withholding tax rate is the percentage of dividends that must be withheld for non-resident investors who do not benefit from double taxation treaties. There are three calculation methods for the NTR Index.

2.3.3.1 Net Total Return

$$NTR_t = NTR_{t-1} \times \frac{(NPR_t + NetIDP_t)}{NPR_{t-1}}$$

Where:

$$NPR_t = \frac{NPR\ Index\ Market\ Value_t}{NTR\ Index\ Divisor_t}$$

The Net Price Return Index Value (NPR_t) is calculated only as the basis for the NTR and is not disseminated as a separate index however values can be found within index file reports.

$$Net\ IDP_t = \frac{Net\ Index\ Dividend\ Market\ Value_t}{NTR\ Index\ Divisor_t}$$

Where:

$$\begin{aligned} & Net\ Index\ Dividend\ Market\ Value_t \\ &= \sum_{i=1}^n q_{i,t} \times Net\ Dividend\ Amount_{i,t} \times Spot\ Rate_{i,t-1} \end{aligned}$$

$$Net\ Dividend\ Amount_{i,t} = d_{i,t} \times (1 - w_{i,t})$$

w_i = Withholding tax rate applied for Index Security i

$$NTR\ Index\ Divisor_t = \frac{SOD\ Index\ Market\ Value_t}{NPR_{t-1}}$$

Withholding tax rates can be found in **Appendix A of the Nasdaq Withholding Tax Rates** document.

2.3.3.2 Notional Net Total Return

The Notional Net Total Return (NNTR) Index value reinvests cash dividends based on a tax withholding rate of 30%. The Index is calculated in the same manner as the Net Return Index above except for the above mentioned difference.

2.3.3.3 Gross Local Return

The Gross Local Return (GLR) Index value factors in a withholding rate that is reflective of the tax credit policies employed by companies in relation to rules governing dividend income earned by domestic investors in select countries.

The Index is calculated in the same manner as the Net Total Return (NTR) above except for the net dividend amount. Instead of using the net dividend amount, it is replaced with the local net dividend amount which is net of a “franked” amount that has been withheld by the company in the form of a tax credit on behalf of domestic investors. The net local dividend amount is calculated as follows:

$$\text{Net Local Dividend Amount}_{i,t} = \frac{d_{i,t}}{((1 - \text{Franking Rate}) + (\text{Franking Rate}/w_{i,t}))}$$

2.3.4 Dividend Point Index Calculation

A Dividend Point (DIV or DVP) Index is the running total of ordinary cash dividends paid by each security issuer of Index Securities of the Underlying Index, as expressed in index points.

$$DVP_t = \frac{\sum_{i=1}^n q_{i,t} \times d_{i,t}}{PR \text{ Index Divisor}_t} + DVP_{t-1}$$

The Index value is reset to zero at a time as defined in the specific Index Methodology. Consequently, the Index measures the total dividend points of the Underlying Index since the previous reset date.

2.3.5 Excess Return Index Calculation

An Excess Return (ER) Index seeks to capture an overall return profile reflective of the performance of an Underlying Index after accounting for a predetermined daily withholding rate. The predetermined withholding rate is the amount deducted from the daily performance of the Excess Return Index vis-à-vis that of the Underlying Index in order to provide a performance profile indicative of – though not identical to – certain deductions associated with an investment product tracking the Underlying Index. Examples of such deductions are management fees or synthetic dividend returns.

$$ER_t = ER_{t-1} \left(\frac{X_t}{X_{t-1}} - ExcRt \times \frac{day}{365} \right)$$

Where:

ExcRt = Excess return amount. The value is defined within the specific Index Methodology

X = the Underlying Index value. This could be any type of index other than another Excess Return.

2.3.6 Leverage And Inverse Index Calculation

Leveraged and Inverse Indexes aim to reflect the daily return profile of a leveraged investor. To accomplish this, the underlying index is adjusted for the degree of leverage, and also embeds assumptions about leverage-related financing costs within the performance of the Index.

Both the leverage and inverse indexes use the same basic calculation however the calculation of R differentiates the Indexes.

$$LI_t = LI_{t-1} \times (1.0 + U + R)$$

Where:

$$U = (C - 1) \times LF$$

$$C = \frac{X_t}{X_{t-1}}$$

X = Underlying Index value

LF = Leverage Factor. The value is defined in the specific Index Methodology (e.g., leverage indexes have positive factors and inverse indexes have negative factors)

2.3.6.1 Leverage Index

$$R = (r_{t-1} + SPR) \times Interest\ Factor \times \frac{days}{360}$$

Where:

$days$ = Number of calendar days between index calculation day t-1 and t

$Interest\ Factor$ = 1 - LF

r_{t-1} = Overnight Interest Rate. The value will be defined in the specific Index Methodology.

SPR = Liquidity Spread = 0.50%³

2.3.6.2 Inverse Index (Version 1)

$$R = (r_{t-1} + SBR) \times Interest\ Factor \times \frac{days}{360}$$

2.3.6.3 Inverse Index (Version 2)

$$R = (r_{t-1} \times Interest\ Factor + SBR \times LF) \times \frac{days}{360}$$

SBR = The Short Borrowing Rate = -0.25%

2.3.7 Currency Hedged Index Calculation

The Currency Hedged Indexes are designed to represent returns for global investment strategies that involve hedging currency risk, but not the underlying constituent risk. The currency hedged strategy indexes aim to eliminate the effect of currency fluctuations in the Index. By factoring the impact of selling foreign currency forwards at the one month forward rate, the Hedged Indexes mitigate the currency exposures in the index compared to the 'home' currency.

A currency hedged Index is calculated by hedging beginning-of-period balances using relevant, rolling forward FX contracts. Daily hedge returns are computed by interpolating between the spot rate and forward rate.

There are two components to a Hedged Index return:

- (a) The performance of the unhedged underlying index in the portfolio home currency

³ If and when the combination of the variable Fed Funds Effective Rate and the fixed SPR of 50 basis points or the fixed SBR of -25 basis points, deviates meaningfully from market conditions, and/or fails to properly reflect the cost of leverage experienced by passive investors, Nasdaq's Index Management Committee (IMC) may choose to adjust the respective index methodologies accordingly.

- (b) The Hedge Impact (aimed to represent the profit or loss on the forward contracts) in the portfolio home currency

“Home Currency” shall mean the Index Currency (currency of the country of the investor).

“Foreign currencies” shall mean all currencies in the Underlying Index that is a non-home currency.

Example: Index A is calculated in EUR by converting the component securities from USD into EUR using the EURUSD spot rate. Index B is the hedged version of Index A.

Step 1: Determine Home and Foreign Currency. NDXEUR is calculated in EUR for Euro investors so home currency is EUR. Foreign currency is the currencies of the underlying components of NDXEUR which in this example is USD.

Step 2: Combine Home Currency and Foreign Currency to create the spot rate for Hedge Impact calculation as the amount of foreign currency worth of one unit home currency: EURUSD

Step 3: Calculate weights for each foreign currency in Index A by aggregating the market cap weight of each security quoted in that currency. In the example USD will have 100% weight.

Step 4: Calculate Hedge Impact based on EURUSD Spot and Forward Rates and foreign currency weights

Step 5: Calculate the Hedged Index value of Index B by combining the Index A return with the Hedge Impact

The Hedged Index Value (HIX) is calculated as follows:

$$HIX_t = HIX_m \times \left(\frac{UNHIX_t}{UNHIX_m} + HI_t \right)$$

Where:

$UNHIX$ = Underlying Unhedged (parent) Index Value in home currency

HI = Weighted Hedge Impact (profit or loss) for the currency/ies i . Formula varies in monthly and daily hedged calculations

m = Close on the last index calculation day in in the previous month (referred to as rebalance day)

$m - 1$ = Close one index calculation day prior to the last index calculation day in month m (referred to as reference day)

2.3.7.1 Monthly Hedged Index

The monthly hedge impact (HI) is calculated as follows:

$$HI_t = MAF \times \sum_{i=1}^n Weight_{i,m-1} \times HedgeRatio_i \times \left(\frac{SpotRate_{i,m-1}}{ForwardRate_{i,m}} - \frac{SpotRate_{i,m-1}}{FIR_{i,t}} \right)$$

Where:

$$MAF = \frac{HIX_{m-1}}{HIX_m}$$

$Weight_{i,m-1}$ = Weight of the currency i in the underlying unhedged (parent) index one day prior to the last index calculation day in the previous month m taking into account any changes in the underlying unhedged (parent) index as of m .

$HedgeRatio_i$ = The hedge ratio assigned for currency i is the proportion of the portfolio's currency exposure that is hedged. Nasdaq standard Indexes use a hedge ratio of 100%.

$ForwardRate_i$ = Forward Rate (WM Reuters 1M-One Month) for currency i

$$FIR_{i,t} = SpotRate_{i,t} + \left((ForwardRate_{i,t} - SpotRate_{i,t}) \times \frac{Days\ left_{i,t}}{D} \right)$$

Where:

$Daysleft_{i,t}$ = Number of days from the current index calculation day (not including t) until the last index calculation day of the month

D = Total number of days in month from the first calendar day until the last index calculation day of the month

During the index calculation day, the intraday forward and spot rates are used and at the EOD the closing forward and spot rates are used.

2.3.7.2 Daily Hedge Return Index

Formulas differ from the Monthly Hedge Impact calculations by adjusting on a daily basis the notional value of forward contracts that mature at the month end with the performance on the underlying unhedged (parent) index.

Formula (1) - Hedge Impact (HI) calculation for daily hedged index where **day t is not the last index calculation day in the month** (e.g. from the first index calculation day in month until the close one index calculation day prior the last index calculation day in the month) is calculated as follows:

$$HI_t = \sum_{i=1}^D AdjFactor_t \times Weight_{i,m-1} \times HedgeRatio_i \times \left(\frac{SpotRate_{i,m}}{FIR_{i,t-1}} - \frac{SpotRate_{i,m}}{FIR_{i,t}} \right)$$

Where:

$$AdjFactor_t = \frac{UNHIX_{t-1}}{UNHIX_m}$$

Formula (2) - Hedge Impact (HI) calculation for daily hedged index **where day t is the last index calculation day in the month** as follows:

$$HI_t = \sum_{i=1}^{D-1} AdjFactor_t \times Weight_{i,m-1} \times HedgeRatio_i \times \left(\frac{SpotRate_{i,m}}{FIR_{i,t-1}} - \frac{SpotRate_{i,m}}{FIR_{i,t}} \right)$$

+

$$AdjFactor_t \times Weight_{i,m-1} \times HedgeRatio_i \times \left(\frac{SpotRate_{i,m}}{FIR_{i,t-1}} - \frac{SpotRate_{i,m}}{SpotRate_{i,t}} \right)$$

The Price Return Version is based on the underlying unhedged (parent) price return index, a Total Return Version is based on the corresponding underlying unhedged (parent) Total Return Index, and a Net Return is based on the Net Total Return Index of its underlying unhedged index.

2.3.8 Index Options Settlements and Expirations (OPT (U.S.) and EXP (Nordics))

Nasdaq calculates Index Option Settlements and/or the Value of Expired Index Options based on conditions contained within an Underlying Index. The calculation uses the Price Return Index formula in Section 2.3.1 or the GTR Index Not Linked to Corresponding PR Index in Section 2.3.2, however the specific prices used in the calculation of the Index Market Value are different.

2.3.8.1 U.S. Index Options

The price used in U.S. Index Option Settlement Values is the opening price or the Last Sale Price depending on the settlement schedule; however, where the Nasdaq Stock Market is the Index Exchange the following is applicable:

AM Settled Options

The prices used in the calculation of the AM settled options are the Nasdaq Official Opening Price (NOOP). The NOOP is calculated once there is an Opening Cross however when a cross does not occur at the open for a stock, the Nasdaq system designates the NOOP from the first eligible trade execution. If a stock does not trade on a given day, the NOOP is zero and the Index Security's SOD price will be used.

The AM Index Option Settlement Value calculation is based on the timing of when each Index Security is officially opened by the listing market and is not the same as the first calculated Index value which is disseminated at 09:30:01 a.m. ET. It is possible and likely that the Settlement Value will differ substantially from the first disseminated index value and/or the previous day's closing index value.

PM Settled Options

The prices used in the calculation of the PM settled options are based on the Nasdaq Official Closing Price (NOCP).

Corrections for a Security's Official Opening or Closing Price

Generally, Nasdaq will not make adjustments to any Nasdaq Official Opening or Nasdaq Official Closing Price. Therefore, the Nasdaq Official Opening and Nasdaq Official Closing prices published by Nasdaq will be considered final, unless the trade on which the price is based is cancelled or corrected by the firm entering the price, or a set of highly unusual system factors has interfered with the setting of the NOOP or the NOCP (See Head Trader Alert #2003-134). If a change to the Official Closing Price is deemed necessary after 4:00 PM for NOCP or 9:45 AM Eastern Time for NOOP, (ET), it must have the approval of Nasdaq senior management. If a security's NOCP or NOOP is adjusted after the Settlement Value is calculated, the Settlement Value for any Index in which the security participates will be recalculated using the new NOCP or NOOP value for that security. The new Settlement Value will be re-disseminated to Nasdaq's data feed and an additional email will be distributed.

Timing of the Dissemination

The timing of the dissemination of the settlement value will vary by Index. The settlement value calculation cannot commence until all Index Securities are open for trading. For the AM Settlement values, the calculation and dissemination are likely to occur soon after market open (normally by 9:40 a.m., ET). For the PM Settlement Values, the calculation and dissemination will usually occur just after market close (normally 4:00 p.m., ET) because it is likely that there will be some Index Securities that do not trade on a given day.

2.3.8.2 Nordic Index Expirations

The price used in calculating Nordic Expiration Indexes can be VWAP, Last Sale, Bid or Ask. The method for a specific Index is identified in the Index methodology.

In cases when the Index is to be calculated for part of a trading day only, such calculation shall nonetheless be made in line with the above principles.

3 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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