AKROS

Akros Index Calculation Methodology

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Contents

1 Introduction

Akros Technologies ("Akros") is dedicated to maintaining the highest standards of integrity through a transparent and replicable index design and calculation methodology. Driven by deep expertise in indexing, portfolio analytics, and data management, Akros seeks to bring an innovative and insightful perspective to the financial market. This dedication is reflected in the meticulous processes and standards that Akros adheres to in the creation and management of its indices.

Akros Index Calculation Methodology refers to the set of rules and processes used to determine the value of the financial index developed by Akros. Akros Indices typically represents the performance of a basket of assets, such as stocks, bonds, or other securities, and is used to gauge the overall performance of a specific market or segment. The calculation process involves applying mathematical formulae to aggregate the index value using selected index constituents and assigned weights according to the Individual Index Methodology. Adjustments for corporate actions are factored in to ensure the index reflects an accurate performance in the market. **Akros Index Calculation Methodology** seeks to provide a transparent set of calculation methodologies to facilitate investors to make informed investment decisions and understand the performance of the index.

Individual Index Methodology documents outline the specific details of each index, encompassing an introduction and the objectives of the index, the construction criteria for its constituents, the frequency of rebalancing, and additional relevant information. These documents are critical to maintaining the highest standards of integrity and precision in index management. The Individual Index Methodology often refers to the Akros Index Calculation Methodology, which serves as a comprehensive and holistic guideline for the development and maintenance of Akros indices.

2 Adherence to the IOSCO Principles

Akros Technologies remains steadfast in its mission to uphold the highest standards of integrity and professionalism. This commitment is reflected in every aspect of its operations, from the development and calculation of indices to their ongoing management and administration.

Akros adheres to the IOSCO Principles regarding the quality and integrity of indices and their methodologies by providing all relevant stakeholders with detailed information regarding the calculation and maintenance of the indices that that Akros provides. This commitment to transparency is a cornerstone of Akros's approach, ensuring that each index is managed according to the highest standards. Stakeholders have access to comprehensive details about index components, their selection criteria, and the overall methodology used in index calculation and maintenance. This level of professional detail ensures that users clearly understand how indices are constructed and maintained, fostering trust and confidence in the indices provided by Akros.

In light of the EU Benchmarks Regulation (Regulation (EU) 2016/1011), the Akros Index Calculation Methodology provides a comprehensive framework that aligns with all relevant regulatory standards. The regulation sets out stringent requirements for benchmark administrators, emphasizing the need for accuracy, reliability, and transparency.

By transparently disclosing index maintenance rules and general calculation methods, the Akros Index Calculation Methodology enables investors to effectively evaluate and utilize the indices developed by Akros. Detailed documentation and regular updates regarding the index methodologies ensure that users remain well-informed about any changes to index calculations. This transparency allows stakeholders to make informed decisions based on accurate and up-to-date information, enhancing their ability to use Akros indices for various investment and analytical purposes. Akros's commitment to clear and comprehensive communication ensures that all relevant parties fully understand and benefit from its index products.

For further information, please refer to the Akros's Statement of Adherence to IOSCO Principles.

3 General Calculation Methodology

This section outlines the general methodology for calculating index shares and net asset value (NAV). The approach ensures that the index accurately reflects changes in the underlying portfolio, aligning with actual market conditions and investment strategies.

3.1 Corporate Action Adjustment

Daily holdings from the previous day are systematically adjusted to account for corporate actions, ensuring an accurate reflection of any events impacting the securities. The adjustments are made in accordance with the established Akros Corporate Action Methodology, which is designed to standardize the handling of events such as stock splits, dividends, mergers, and other corporate actions. Akros Corporate Action Methodology ensures consistency, accuracy, and compliance with industry best practices, maintaining the integrity of the reported holdings and providing stakeholders with an accurate representation of portfolio changes. Please refer to the Akros Corporate Action Methodology for further details.

3.2 Dividend and Distribution Pre-Processing

In the event of an ex-dividend or ex-distribution occurrence, the corresponding dividend or distribution amounts are first converted to U.S. dollars (USD) using the prevailing exchange rates. The converted amounts are aggregated to reflect the total dividend or distribution value for the relevant holdings. The aggregated sum is then recorded in the portfolio as Cash (USD), ensuring accurate and consistent tracking of income generated from investments. This process aligns with industry standards, ensuring transparency and precision in reporting portfolio cash flows from dividends and distributions.

3.3 Cash (USD) Handling based on Calculation Type

The handling of the aggregated Cash (USD) is determined by the specific calculation type applied to the index. Each calculation type follows a distinct methodology for processing and allocating cash flows, ensuring that the treatment of dividends, distributions, or other income is aligned with the intended method.

3.3.1 Price Return Index

For a price return index, the aggregated Cash (USD) is excluded from the index calculation. This means that any cash generated from dividends or distributions is disregarded, as the price return index calculation focuses solely on the capital appreciation of the underlying securities. The index therefore reflects only the changes in prices of the underlying assets, without considering any income generated.

3.3.2 Total Return Index

For a total return index, the aggregated Cash (USD) from dividends and distributions is reinvested at the index level to reflect the compounding effect of income on the overall performance of the portfolio. This reinvestment process ensures that both capital appreciation and income are captured in the index, providing a comprehensive measure of total investment returns. Equation 1 shows the calculation involved with total return index that captures the overall performance.

$$\text{Index Shares Adjusted}_{i,D} = \text{Index Shares}_{i,D} \times \left(1.0 + \frac{\text{Cash (USD)}_{I,D}}{\text{NAV (USD)}_{I,D}}\right) \tag{1}$$

3.3.3 Excess Return Index

For an excess return index, the aggregated Cash (USD) from dividends and distributions is held in a separate cash account until the next rebalancing date.

3.3.4 Net Total Return Index and Net Excess Return Index

For net calculation types, such as net excess return and net total return, tax adjustments are applied to the aggregated Cash (USD) prior to its inclusion in the index calculation. These adjustments reflect the withholding of taxes on income generated by the index constituents, ensuring the results accurately represent after-tax returns. Unless otherwise mentioned, the following tax rates are applied:

- **Options**
  A tax rate of 0% is applied, as no taxes are withheld on options.
- **Dividends and Distribution**
  A standard tax rate of 15% is applied to account for withholding taxes on dividends and distributions.

It is important to note that the applicable tax rates may vary depending on the specific index methodology. Any deviations from the standard rates will be clearly outlined in the Individual Index Methodology, ensuring full transparency and compliance with the relevant tax regulations.

3.4 Net Asset Value (NAV) Calculation

The Index Net Asset Value (NAV) for the calculation day is determined using Equation 2. This equation aggregates the adjusted index shares of each constituent, multiplied by the respective price input for each asset class, ensuring an accurate representation of the index's value.

$$\text{Index NAV}_{I,D} = \sum_{i} \text{Index Shares Adjusted}_{i,D} \times \text{Price}_{i,D} \tag{2}$$

The price input varies depending on the type of asset.

- **Options**
  For Options, unless specified otherwise, the Mid Price (the average of the bid and ask prices) is used as the price input to reflect a fair market valuation.
- **Equities**
  For Equities, the Closing Price at the market close is used as the price, representing the final price at which the equity traded during the regular trading session.

For dissemination, the resulting Index NAV is rounded to three decimal places for readability, whereas holdings and intermediate calculations are maintained at full precision.

4 Option Pricing Methodology

This section outlines the comprehensive methodology for option pricing, including data sourcing, quality assurance, theoretical pricing models, and implied volatility estimation. The approach ensures accurate and reliable option valuations for index calculation purposes.

4.1 Data Sourcing and Quality Assurance

4.1.1 Primary Data Source

For options on U.S. securities, the methodology prioritizes trading data from listed markets to ensure the most accurate and directly observable market prices for index calculation.

4.1.2 Contingency for Data Errors

When end-of-day (EOD) data exhibits potential errors, alternative data sources or pricing methods are employed. Scenarios requiring contingency measures include:

- Missing liquidity provider (LP) quotes resulting in excessive bid-ask spreads
- Instances where bid price exceeds ask price
- Cases where both bid and ask prices are recorded as zero

In such cases, either pre-close order book data (15 minutes before market close) is utilized, or theoretical pricing is performed using an appropriate option model.

4.1.3 Error Detection

Data quality is maintained through Akros' proprietary algorithm, which systematically identifies pricing anomalies that could impact index accuracy.

4.2 Option Theoretical Pricing Models

4.2.1 European Options

The Black-Scholes model serves as the primary framework for European option pricing. The model calculates option prices using the following formula:

$$C = SN(d_1) - Ke^{-r\tau}N(d_2) \tag{3}$$

$$P = Ke^{-r\tau}N(-d_2) - SN(-d_1) \tag{4}$$

where:

$$d_1 = \frac{\ln(S/K) + (r + \sigma^2/2)\tau}{\sigma\sqrt{\tau}}$$

$$d_2 = d_1 - \sigma\sqrt{\tau}$$

and:

- S is the current price of the underlying asset
- K is the strike price
- r is the risk-free interest rate
- τ is the time to expiration
- σ is the implied volatility
- $N(\cdot)$ is the cumulative normal distribution function

4.2.2 American Options

The Binomial Options Pricing Model (BOPM) is employed for American options to account for early exercise possibilities. The model constructs a discrete-time framework where the underlying asset follows a multiplicative binomial process.

4.3 Implied Volatility Estimation Process

The implied volatility estimation process employs a sophisticated approach to match and interpolate volatility data from similar options, ensuring accurate estimation for any given strike price and expiration date.

4.3.1 Time-to-Expiry Filtering

The process begins by identifying options with similar time-to-expiry characteristics:

$$\Delta\tau_i = |\tau_i - \tau_{target}| \tag{5}$$

$$\tau_{min,d} = \min_{i \in \mathcal{I}_d} \Delta\tau_i \tag{6}$$

where:

- τ_i is the time-to-expiry of option i
- τ_{target} is the target time-to-expiry
- $\mathcal{I}_d$ is the set of options available on date d
- $\tau_{min,d}$ is the minimum time-to-expiry difference for date d

Options with zero time-to-expiry are explicitly excluded from consideration to avoid expiration-day effects, by replacing zero values with NaN before computing differences.

4.3.2 Date Selection and Temporal Matching

The methodology employs a hierarchical approach to select the most relevant options data:

$$\mathcal{O}_{selected} = \begin{cases} \{o_i \in \mathcal{O}_t : \Delta\tau_i = \tau_{min,t}\} & \text{if } t_{target} \text{ exists in data} \\ \{o_i \in \mathcal{O}_{t_{max}} : \Delta\tau_i = \tau_{min,t_{max}}\} & \text{otherwise} \end{cases} \tag{7}$$

where:

- $\mathcal{O}_t$ is the set of options on target date t
- t_{max} is the most recent available date
- o_i represents an individual option contract

4.3.3 Option Type Selection

For the selected options, implied volatilities are determined based on the option type:

$$IV_{mid}(K, S) = \begin{cases} IV_{call,mid} & \text{if option type is call} \\ IV_{put,mid} & \text{if option type is put} \end{cases} \tag{8}$$

where $IV_{call,mid}$ and $IV_{put,mid}$ represent the mid-market implied volatilities for calls and puts respectively.

4.3.4 Log-Moneyness Calculation

Log-moneyness (LM) is calculated for each option record using:

$$LM(K, S) = \ln\left(\frac{K}{S}\right) \tag{9}$$

where:

- K is the strike price
- S is the underlying price on the selected date

4.3.5 Cubic Spline Interpolation and Extrapolation

A natural cubic spline is fitted to the observed implied volatilities as a function of log-moneyness. For the selected option type, the mid-market implied volatility (IV_{mid}) is used:

$$IV_{mid}(LM) = \begin{cases} s(LM) & \text{if } LM_{min} \leq LM \leq LM_{max} \\ s(LM_{min}) + s'(LM_{min})(LM - LM_{min}) & \text{if } LM < LM_{min} \\ s(LM_{max}) + s'(LM_{max})(LM - LM_{max}) & \text{if } LM > LM_{max} \end{cases} \tag{10}$$

where:

- $s(LM)$ is the cubic spline function
- $s'(LM)$ is the first derivative of the spline
- LM_{min} is the minimum observed log-moneyness
- LM_{max} is the maximum observed log-moneyness

4.3.6 Natural Cubic Spline Conditions

The natural cubic spline satisfies the following conditions at each knot point LM_i:

$$s(LM_i^-) = s(LM_i^+) \quad \text{(continuity)} \tag{11}$$
$$s'(LM_i^-) = s'(LM_i^+) \quad \text{(first derivative continuity)} \tag{12}$$
$$s''(LM_i^-) = s''(LM_i^+) \quad \text{(second derivative continuity)} \tag{13}$$
$$s''(LM_{min}) = s''(LM_{max}) = 0 \quad \text{(natural boundary conditions)} \tag{14}$$

4.3.7 Volatility Bounds

To maintain realistic market conditions, the estimated implied volatility (σ) is bounded:

$$\sigma = \max(\min(IV_{mid}(LM), 3.00), 0.01) \tag{15}$$

This ensures:

- Minimum implied volatility of 1%
- Maximum implied volatility of 300%

5 Rebalancing Calculation Methodology

In the process of rebalancing the index and its constituents, Akros coins three key terms to clarify the stages: *Determination Date*, *Implementation Date*, and *Effective Date*. These terms help outline the timeline and actions required to adjust the index constituents, ensuring transparency and minimizing tracking errors for portfolio managers. The steps below elaborate on the details of each stage involved with the rebalancing process. Please take care to differentiate between the usage of previous constituents prior to rebalancing and

Date	Description
[D] Determination Date	The date when the weights of the next index constituents are calculated. The determination date is usually set as the last trading day of the month.
[D+1] Pro-Forma Date	The date when the weights of the next index constituents are published.
[T] Implementation Interval	The interval between the determination date and the implementation date. The implementation interval is usually set as three trading days.
[D+T] Implementation Date	The day when the index is rebalanced at the closing hours.
[D+T+1] Effective Date	The day when the rebalancing becomes effective at the opening hours.

Table 1: Dates involved with Rebalancing Event

the usage of next constituents post rebalancing. Note that Variables i and I are used to indicate previous components prior to rebalancing and the values evaluated using them, and variables j and J refer to next constituents post rebalancing and the corresponding values.

Note: For option constituents, the Price variable already includes the Option Contract Multiplier. For US equity and index options, this multiplier is typically 100. Therefore, there is no need to multiply option prices by 100 in the formulas.

5.1 Index Shares Calculation as at Determination

The weight of each index constituent i is determined according to the corresponding Individual Index Methodology.

For computational accuracy, Index $\text{NAV}_{I,D}$ is derived directly from the underlying holdings without rounding, preventing the accumulation of errors across rebalancing cycles. Note that the Index NAV disseminated to stakeholders is rounded to three decimal places for readability.

If i is an equity constituent, the index shares is given by:

$$\text{Index Shares}_{i,D} = \frac{\text{Index NAV}_{I,D} \times \text{Notional Weight}_i}{\text{Price}_{i,D}} \tag{16}$$

If i is an option constituent, the equation to calculate the index shares depends on the weight type (either notional weight or NAV weight, where this is equal to notional weight unless otherwise specified).

For *notional weight*, the index shares is given by

$$\text{Index Shares}_{i,D} = \frac{\text{Index NAV}_{I,D} \times \text{Notional Weight}_i}{\text{Underlying Price}_{i,D}} \tag{17}$$

and for *NAV weight*, the index shares is given by

$$\text{Index Shares}_{i,D} = \frac{\text{Index NAV}_{I,D} \times \text{NAV Weight}_i}{\text{Price}_{i,D}} \tag{18}$$

Note that the definition of $\text{Price}_{i,D}$ is the same as Section 3.4.

The calculated index shares are made available on the Pro-Forma Date. This is because the index shares can only be calculated after the market closes on the determination date.

5.2 Index Shares Calculation as at Implementation

In contrast to the traditional divisor calculation methods used by other index providers, Akros' approach utilizes a standard calculation method to directly adjust the index shares. The adjustment reflects changes in the index NAV to accurately align with the value outlook of the underlying constituents.

As a result, index shares calculated as at determination date may change during the implementation interval due to fluctuations in the index NAV prior to the rebalancing on the implementation date. The index NAV prior to the rebalancing is influenced by the fluctuations in the prices of the positions of the previous index constituent.

Consequently:

- If the index NAV as at implementation date increases more than the index NAV as at determination date [as provided in Pro-Forma]: **Index Shares increases**
- If the Index NAV as at implementation date decreases more than the index NAV as at determination date [as provided in Pro-Forma]: **Index Shares decreases**

The adjustment is analogous to how portfolio managers recalibrate the index constituents based on the index shares provided on the pro-forma. Portfolio managers invest proportionally to the provided index shares while ensuring the index NAV is fully utilized by calculating and placing orders accordingly.

5.3 Conversion: Index Shares from Determination to Implementation

Several steps are involved in converting index shares calculated as at Determination Date to index shares calculated as at Implementation Date.

5.3.1 Projected Index NAV of Next Constituents on Determination as at Implementation

The projected index NAV of next index constituents on determination date as at implementation date can be calculated using index shares calculated as at determination date, and the price of the next index constituents as at implementation date using Equation 19.

$$\text{Projected Index NAV}_{J,D+T} = \sum_{j} \text{Index Shares}_{j,D} \times \text{Price}_{j,D+T} \tag{19}$$

5.3.2 Projected Option NAV of Next Constituents on Determination as at Implementation

The projected option NAV of next index option constituents on determination date as at implementation date can be calculated using number of contracts calculated as at determination date, and the mid price of the option as at implementation date using Equation 20.

$$\text{Projected Option NAV}_{J,D+T} = \sum_{j} \text{Number of Option Contracts}_{j,D} \times \text{Mid Price}_{j,D+T} \tag{20}$$

5.3.3 Index NAV of Previous Constituents on Implementation

The index NAV of previous index constituents on implementation date can be calculated using index shares calculated as at implementation date, and the price of the previous index constituents as at implementation date using Equation 21.

$$\text{Index NAV}_{I,D+T} = \sum_{i} \text{Index Shares}_{i,D+T} \times \text{Price}_{i,D+T} \tag{21}$$

5.3.4 Cash Received from Next Option Positions Sold

Cash received is determined based on Equation 22, which calculates the sum of the product of the number of option contracts and the option price on the implementation date for all option positions sold as next index constituent j. Unless otherwise specified, the bid price is used for the option price.

$$\text{Cash Received}_{D+T} = \sum_j \text{Number of Option Contracts Sold}_{j,D} \times \text{Bid Price}_{j,D+T} \tag{22}$$

5.3.5 Transaction Cost from Options Rebalancing

The transaction cost for options rebalancing is calculated using Equation 23, which accounts for the cost of selling or buying option positions for the rebalancing portfolio J.

$$\begin{aligned}\text{Transaction Cost}_{D+T} = &\sum_j \text{Number of Option Contracts Sold}_{j,D} \times (\text{Mid Price}_{j,D+T} - \text{Bid Price}_{j,D+T}) \\ &+ \sum_j \text{Number of Option Contracts Bought}_{j,D} \times (\text{Ask Price}_{j,D+T} - \text{Mid Price}_{j,D+T})\end{aligned} \tag{23}$$

5.3.6 Projection Factor

The projection factor is a factor that adjusts the index shares of next constituents post rebalancing as at determination date to the index shares of next constituents as at implementation date. There are two possible scenarios: the first is where either the sold option positions are not projected or no option positions are involved, and the second is where the sold option positions are projected.

Case 1: **Option Positions Sold are not Projected** or **No Option Positions are Involved**

The projection factor is calculated using Equation 24 by substituting the values obtained from Equation 19, Equation 20, Equation 21, Equation 22, and Equation 23.

$$\begin{aligned}\text{Projection Factor}_{D+T} = &\frac{\text{Index NAV}_{I,D+T} - \text{Projected Option NAV}_{J,D+T}}{\text{Projected Index NAV}_{J,D+T} - \text{Projected Option NAV}_{J,D+T}} \\ &- \frac{\text{Cash Received}_{D+T} + \text{Transaction Cost}_{D+T}}{\text{Projected Index NAV}_{J,D+T} - \text{Projected Option NAV}_{J,D+T}}\end{aligned} \tag{24}$$

Case 2: **Option Positions are Projected**

When option positions are projected, portfolio managers may adjust the contract count on the Implementation Date to maintain the target notional exposure and cover ratio relative to the Index NAV. Accordingly, transaction costs must reflect the implemented portfolio rather than the pro-forma portfolio calculated on the Determination Date. The implemented transaction cost is defined in Equation 25.

$$\text{Implemented Transaction Cost}_{D+T} = \text{Transaction Cost}_{D+T} \times \left(\frac{\text{Index NAV}_{I,D+T}}{\text{Projected Index NAV}_{J,D+T} + \text{Cash Received}_{D+T}}\right) \tag{25}$$

The projection factor is evaluated using Equation 26 by substituting the values obtained from Equation 19, Equation 21, Equation 22, and Equation 25.

$$\text{Projection Factor}_{D+T} = \frac{\text{Index NAV}_{I,D+T} - \text{Implemented Transaction Cost}_{D+T}}{\text{Projected Index NAV}_{J,D+T} + \text{Cash Received}_{D+T}} \tag{26}$$

5.3.7 Projected Index Shares of Next Constituents on Determination as at Implementation

The projected index shares of next index constituents post rebalancing on determination date as at implementation date is calculated using the projection factor using either Equation 23 or Equation 26.

$$\text{Projected Index Shares}_{J,D+T} = \text{Index Shares}_{J,D} \times \text{Projection Factor}_{D+T} \tag{27}$$

5.3.8 Reinvestment Factor

The reinvestment factor is determined using either Equation 28 or 29, depending on the scenario. When option positions are reinvested, received cash is immediately re-injected into the investment. This calculation applies only to the Total Return (TR) and Net Total Return (NTR) indices. Otherwise, the reinvestment factor considers the effect of holding both the existing equity index shares and the cash received without reinvestment. Depending on each index methodology, one of Case 1 or Case 2 applies.

Case 1: Option Positions are Reinvested

$$\text{Reinvestment Factor}_{D+T} = 1.0 + \frac{\text{Cash Received}_{D+T}}{\sum_j \left(\text{Projected Index Shares}_{j,D+T} \times \text{Price}_{j,D+T}\right)} \tag{28}$$

Case 2: Option Positions are Not Reinvested

In this scenario, the reinvestment factor for *option index shares* remains at:

$$\text{Reinvestment Factor}^{(\text{option})}_{D+T} = 1.0$$

For *equity index shares*, since the received cash is reinvested into the existing holdings, the reinvestment factor is calculated as:

$$\text{Reinvestment Factor}^{(\text{equity})}_{D+T} = 1.0 + \frac{\text{Cash Received}_{D+T}}{\sum_j \left(\text{Projected Equity Index Shares}_{j,D+T} \times \text{Price}_{j,D+T}\right)}. \tag{29}$$

5.3.9 Index Shares of Next Constituents as at Implementation

Equation 28 and Equation 29 show the calculation of the index shares of next index constituents post rebalancing as at implementation date using the projected index shares of next constituents on determination date as at implementation date, and the reinvestment factor.

$$\text{Index Shares}_{J,D+T} = \text{Projected Index Shares}_{J,D+T} \times \text{Reinvestment Factor}_{D+T} \tag{30}$$

5.3.10 Index NAV of Next Constituents as at Implementation

Equation 31 shows the calculation of the final index NAV of next constituents post rebalancing as at implementation date. The final index NAV is rounded to three decimal places.

$$\text{Index NAV}_{J,D+T} = \sum_j \text{Index Shares}_{j,D+T} \times \text{Price}_{j,D+T} \tag{31}$$

6 Conclusion

The Akros Index Calculation Methodology provides a systematic approach to calculating the Net Asset Value of the index and adjusting index shares during rebalancing events. By directly reflecting changes in the index NAV and market prices, it ensures that the index remains aligned with the actual performance and composition of the underlying portfolio. The Akros Index Calculation Methodology thereby promotes transparency and accuracy, to facilitate investors and portfolio managers to make informed investment decisions.