



Crypto Asset Indices Methodology Guide

May 2018

LIMEYARD Crypto Asset Index (LYCAI)

LIMEYARD's approach to the Crypto Asset Index construction aims to factor in the following meritable features:

1. **Representativeness.** The index aims to represent the market as a whole, weighting only those constituents that have large market capitalization.
2. **Adaptiveness.** The methodology is tailored to reflect the key features of the cryptocurrency market and is subject to a regular review process to track developments in the research field and the underlying market. Monthly reviews ensure the index captures the market dynamics. Furthermore, the design of the index has benefited from the partnership with Decentriq AG, a Swiss-based asset manager with proven experience in the management and tokenization of digital assets.
3. **Investability.** The index puts investors' needs at the center of its construction. Only investable assets with large liquidity and market capitalization trading on major trusted exchanges are eligible. The index is composed of diversified weightings of constituents. Turnover cost is reduced by using a buffer rule at the monthly rebalancings.
4. **Transparency.** The index is rules-based, using only public information.
5. **Regulatory compliance.** The index considers only those assets whose protocols are designed to preclude anonymity, factoring in legal risk criteria in the methodology.

1. Universe and eligibility

- a. Crypto assets traded on at least two out of a list of thirteen trusted exchanges maintained by LIMEYARD are eligible. Trusted exchanges—in order to be eligible—must fulfill a minimum requirement of at least \$100 million of monthly average daily trading volumes. The exchanges must facilitate public access to their data through APIs, and information about the exchanges should be available in English. These exchanges must be located in the jurisdictions of Financial Action Task Force (FATF) members to be eligible. The list is subject to ongoing review by the Advisory Committee.
- b. Crypto assets with the following technologies enabling anonymity are not eligible: Darksend, i2P, TOR, blackhole, Ring Signature, RSA, Zerocoin Protocol, zk-Snark. The list is subject to ongoing review by the Advisory Committee.
- c. Crypto assets pegged to fiat currency are not eligible. At the moment these include Tether (USDT). The list is subject to ongoing review by the Advisory Committee.
- d. The structures of the crypto assets (whether they are pre-mined or not or whether they are based on a centralized blockchain, including the case of Ripple, etc.) do not affect their eligibility.
- e. All types of units (coins, tokens, etc.) are included in the calculation.

- f. Crypto assets—in order to be considered for the list of eligible constituents—must have a trading history of at least 90 days in at least two of the exchanges listed in Step 1a, regardless of the currency base of trading (either BTC, USD, or USDT).

2. Number of constituents

- a. The index is composed of a fixed number of constituents. At launch the index comprises 20 assets.
- b. In cases where there are fewer than 20 eligible assets fulfilling the inclusion criteria, the index will be calculated with fewer than 20 constituents. This does not affect the method of weighting the constituents as specified below.

3. Rebalance period

- a. Constituents and weightings are reviewed after market close on the third Thursday of each month. The close value for a day is the most recently published real-time data at 17:30 CET or 17:30 CEST. The new index composition is effective from UTC±00:00 the following Monday.
- b. The information considered for the current review starts from immediately after the close of the third Thursday of the previous month until the close of the third Thursday of the current month.
- c. A new crypto asset satisfying all the criteria above is considered for inclusion in the index as of the next index review.

4. Publication

- a. The index value is published real time at a frequency of 15 seconds per calculation. The publication period is 24 hours a day, 7 days a week.
- b. Published values are in both USD and BTC. Both versions of the index are price index.
- c. Published values are rounded to four decimal places. A base value of 100 is used for the inception day of the index, i.e., at the market close of January 18, 2015.

5. Aggregation of data

- a. The prices of all assets for each base of trading in either BTC or USD are aggregated throughout the 15-second time intervals and then are aggregated over the trusted exchanges (as in Step 1a) where the asset is traded. This aggregated price is used in all subsequent calculations.
- b. For each asset in either BTC or USD base traded on a particular exchange over a 15-second interval t LIMEYARD calculates the total sum of the traded volume and the volume-weighted average traded price over that interval t for that exchange.
- c. For each asset in either BTC or USD base the price aggregated over a given time interval t as above is then further aggregated over all the trusted exchanges where it is traded (the price of the crypto asset BTC in the base of BTC is always a constant equal to 1). This aggregated price $p(t)$ is calculated as a weighted sum over all the exchanges, according to the following formula:

$$p(t) = \frac{\sum(w_i(t) * p_i(t))}{\sum w_i(t)} \quad (1)$$

Where:

$p_i(t)$ is the volume-weighted average traded price for the 15-second interval t on the i -th exchange

The weighting $w_i(t)$ is calculated as:

$$w_i(t) = s_i(t) * \exp(-\text{abs}(p_i(t)/vwap(t) - 1)) \quad (2)$$

Where:

$s_i(t)$ is the total sum of the traded volume for the 15-second interval t on the i -th exchange

$vwap(t)$ is the volume-weighted average aggregated price $p_i(t)$ over all the exchanges, calculated as:

$$vwap(t) = \sum(s_i(t) * p_i(t)) / \sum s_i(t) \quad (3)$$

- d. In cases where for a given asset there are no price data available throughout a 15-second time interval in all the exchanges for one of the trading bases USD or BTC, the price is calculated using data from the other available trading base. The formulas for these calculations have the same form as in Step 5c, except for the quantities $p_i(t)$ and $s_i(t)$, which are modified as follows: Now $s_i(t)$ is the total sum of the traded volume for the 15-second interval t on the i -th exchange but in the other available base. Similarly,

$$p_i(t) = p_i^{other_base}(t) * FX_i(t) \quad (4)$$

Where:

$FX_i(t)$ is the volume-weighted average BTC/USD rate for the 15-second interval t on the i -th exchange, as calculated in Step 5c

$p_i^{other_base}(t)$ is the volume-weighted average traded price in the other available trading base for the 15-second interval t on the i -th exchange as calculated in Step 5c.

In cases where there is no BTC/USD value for an exchange the value aggregated over all exchanges as in Step 5c will be used instead.

6. Selection criteria

- Eligible constituents must pass a liquidity threshold, which is defined as follows: The daily trading volume for each asset is calculated in units of USD to take into account combined volumes from all trusted exchanges and in all bases of trading—BTC, USD, or USDT. Volumes traded in the base of BTC must be converted to units in USD; the conversion is detailed in Step 5d. On each review date the median value of these daily volumes is taken over the month prior to the review date, as detailed in Step 3b. Eligible candidates are ordered by the median values as calculated above; only the top 60% of constituents in this ranking are eligible.
- Daily market capitalization for a given crypto asset is calculated as the product of its circulating supply at market close and its close price in USD aggregated as in Step 5.
- The exponential moving average of the daily market capitalization is calculated over the month prior to the review, as detailed in Step 3a. This average (which LIMEYARD denotes as $MCAP^{EMA}$) is calculated as:

$$MCAP^{EMA} = \sum_{k=0}^{T-1} (1 - \alpha)^k * MCAP(t_{rev} - k) / N \quad (5)$$

Where:

normalization
$$N = \sum_{k=0}^{T-1} (1 - \alpha)^k \quad (6)$$

$MCAP(t_{rev} - k)$ is the closing value of market capitalization k days before the review date t_{rev}

T is the total number of relevant days for this averaging

α is the decay factor

The decay factor is computed according to the span parameter based on the following formula:

$$\alpha = \frac{2}{1 + span} \quad (7)$$

The index has chosen a span parameter of 30, which corresponds to a relative decay rate of 0.94, as commonly used in the finance literature. This smoothing improves robustness over simply using a value at a fixed time, which is desirable for a very volatile market.

- d. All eligible constituents are ranked by their $MCAP^{EMA}$ from the previous step. The 20 top constituents are included for selection.
- e. To reduce index turnover and enhance index stability buffer rules are applied at review periods to 80% of the fixed number of assets. The LIMEYARD Crypto Index targets 20 assets within the crypto market-eligible universe, and the buffers are applied between ranks 16 and 20. Crypto assets are ranked based on $MCAP^{EMA}$; those ranked within the top 80% of the target asset count are automatically chosen for index inclusion. The remaining stocks necessary to achieve the target coverage (fixed number of stocks) are selected from the highest ranked remaining assets between the upper (16) and lower (24) limits. All assets that are current constituents that fall within the top 120% of the target stock count are then chosen for index inclusion in the order of their $MCAP^{EMA}$. In the event that at the end of this process the target constituent count has not been reached, the remaining assets are selected based on their $MCAP^{EMA}$.

7. Index calculation

- a. The target weighting w_n for each asset at review is calculated as follows: LIMEYARD first calculates the percentage weightings of $MCAP^{EMA}$ for each asset, denoted by u_n , as given by:

$$u_n = MCAP_n^{EMA} / \sum_{n=1}^{20} MCAP_n^{EMA} \quad (8)$$

These values are then transformed by a shifted and scaled logistic function of the form:

$$score_n = \frac{2}{1 + \exp(-\lambda * u_n)} - 1 \quad (9)$$

where LIMEYARD defines the transformed values as $score_n$. This diversifies the constituent weightings for a heavily skewed market. The index has chosen the diversification rate λ to be 10. This parameter is chosen such that a portfolio with an undiversified weighting of 90%/10% split is diversified to an approximate weighting split of 70%/30%. The applicable features of sigmoid functions include smoothness, boundedness, positive slope, and concavity (for $x > 0$). The target weighting w_n for each crypto asset is calculated as:

$$w_n = score_n / \sum_{n=1}^{20} score_n \quad (10)$$

- b. The synthetic number of units s_n for the n -th constituent is calculated as:

$$s_n = Index(t_{rev}) * w_n / p_n(t_{rev}) \quad (11)$$

Where:

$Index(t_{rev})$ is the market close value of the index on the review date

$p_n(t_{rev})$ is the market close price of the n -th constituent on the review date

- c. The new index value at any time t after the review is calculated as:

$$Index(t) = \sum_{n=1}^{20} (s_n * p_n(t)) / D \quad (12)$$

Where:

$p_n(t)$ is the aggregated price as calculated in Step 5 of the n -th constituent at time t

The divisor D is calculated as:

$$D = \frac{Index(t_{rev})}{Index(t_{eff})} * \sum_{n=1}^{20} w_n * \frac{p_n(t_{eff})}{p_n(t_{rev})} \quad (13)$$

Where:

$Index(t_{rev})$ is the close value of the index on the review date

$Index(t_{eff})$ is the value of the index at UTC±00:00 of the Monday after the review

Both the divisor D and the synthetic number of units s_n are held constant until the next review.

8. Advisory Committee

An independent Advisory Committee is part of the LIMEYARD governance structure that underpins the focus of the LIMEYARD Crypto Asset Index. The Advisory Committee ensures that the index continues to meet investors' requirements and that the index methodology evolves in line with the highest standards of the cryptocurrency industry.

The scope of the Advisory Committee is to provide a forum to discuss any developments in the underlying index segment that are worth considering in the methodology and to provide market input to enhance the credibility and reputation of the specific index product.

The Advisory Committee consists of senior market practitioners at the most experienced level who are also representative of the appropriate sector within the investment community that the specific index is intended to cover.

The appointed persons are free from potential conflicts of interest with respect to the key decisions affecting the index.

Members of the Advisory Committee do not include persons who have been subject to sanctions of an administrative or criminal nature relating to financial services, in particular manipulation or attempted manipulation.

The Advisory Committee shall prevent the improper disclosure of confidential or sensitive information received, produced, or discussed by the Advisory Committee.

9. Maintenance

LIMEYARD strives to maintain all crypto assets in its crypto indices with the objective of reflecting on a timely basis the evolution of the underlying cryptocurrency market that the indices are intended to represent.

- a. Any event that affects a particular constituent regarding its eligibility criteria 1a, 1b, and 1c may lead to a fast exit, where the constituent drops out of the index and the weighting proportionally redistributes to the rest of the constituents. The index consists of the rest of

the constituents until the next review. This is done on a case-by-case basis and is subject to review by the Advisory Committee. The decision enters into effect at 17:30 CET or 17:30 CEST two business days after its announcement.

- b. **Forking.** If there is a newly created crypto asset as the result of this event, the asset is not immediately included in the index. Its eligibility for inclusion is considered only after it reaches a trading history of at least 90 days in at least two of the exchanges listed in Step 1a. The original asset remains in the index with the same synthetic units only if it continues to satisfy eligibility criteria 1a, 1b, and 1c; otherwise, a fast exit may apply, as in Step 9a. In the case of forks with a relatively significant market impact and liquidity, early inclusion can be considered by the Advisory Committee. Because of the complexity of forking in the crypto market, the Advisory Committee has the right to make the final decision. Any decision of early inclusion enters into effect at 17:30 CET or 17:30 CEST at least two business days after its announcement.
- c. **ICOs.** Coins and tokens in ICOs are eligible for inclusion in the index only after they have a trading history of at least 90 days in at least two of the exchanges listed in Step 1a. For ICOs with a relatively significant market impact and liquidity early inclusion can be considered by the Advisory Committee. Because of the complexity of ICOs in the crypto market, the Advisory Committee has the right to make the final decision. Any decision of early inclusion enters into effect at 17:30 CET or 17:30 CEST at least two business days after its announcement.

10. Trade suspensions and market distortions

- a. For a particular constituent, if trading data are temporarily unavailable in all the relevant exchanges of its trading and in both currency bases of its trading, the most recent data for each base are used.
- b. When a situation such as in Step 10a persists for more than 48 hours, the constituent may be subject to a fast exit, where the constituent drops out of the index and the weighting proportionally redistributes to the remainder of the constituents. The index consists of the remainder of the constituents until the next review. Decisions are made on a case-by-case basis and are subject to review by the Advisory Committee. The decision enters into effect at 17:30 CET or 17:30 CEST at least two business days after its announcement.

11. Index corrections for calculation errors

- a. If a material error in a given index calculation occurs and the impact of an error is greater or equal to 50 basis points (bps) of the index value, the index affected by 50 bps or more is restated. Advance notice of the restatement is given to customers and issuers of financial products pegged to the wrongly calculated index.
- b. Intraday tick data are not corrected retroactively.
- c. LIMEYARD applies a 12-month correction period. Errors in historical values older than 12 months are not revised.

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