A Rules-Based Benchmark for the Cryptocurrency Market

Design and construction of the CCi30 Cryptocurrency Index

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ABSTRACT

This paper sets out the design of the CCi30 Cryptocurrency Index, a rules-based benchmark measuring the performance of the thirty largest cryptocurrencies by adjusted market capitalisation. The cryptocurrency market presents three features that defeat conventional index construction: volatility far above that of established asset classes, a universe of assets that renews itself continuously, and a concentration of value in its two largest assets without parallel elsewhere. The index answers each with a specific mechanism: market capitalisation smoothed by an exponentially weighted moving average with a three-day half-life; a fixed count of thirty constituents, reviewed quarterly; and weights proportional to the square root of adjusted market capitalisation, reset monthly. We state each rule and its rationale, give the calculation in full, and quantify the effect of the weighting scheme on concentration from the published weight history of 2015 to 2026.

Keywords cryptocurrency index · benchmark construction · square-root weighting · exponentially weighted moving average · digital assets

1 Introduction

The CCi30 Cryptocurrency Index was designed in 2016 and has been published in real time since 1 January 2017. It was constructed for two purposes. The first is measurement: the index is intended as a barometer of the cryptocurrency market as a whole, rather than of any single asset within it. The second is replication: the index is intended as a reference portfolio that a passive investor, fund or product issuer can hold in order to participate in the development of the asset class without selecting individual assets.

These purposes impose three requirements on the construction. The index must be diversified. It must provide deep coverage of the market. And, within the limits set by the first two requirements, it must offer the most favourable risk-adjusted profile that the construction permits. Three features of the cryptocurrency market complicate the task, and each is met by a specific element of the design.

Volatility. Price volatility in the cryptocurrency market greatly exceeds that of established asset classes; the statistical behaviour of these price movements is examined in Rivin [1]. Measured on official daily closes, the annualised volatility of the index itself has been approximately 74% since its base date in January 2015. A composition determined by instantaneous market capitalisation would turn over excessively and would be exposed to deliberate distortion on a single observation date. The index therefore selects and weights its constituents on a smoothed measure, the adjusted market capitalisation (Section 3).

Renewal of the universe. New assets are issued continuously, and the set of the largest assets changes materially from one quarter to the next. The index responds with a fixed constituent count and a quarterly review of membership (Sections 4 and 7).

Concentration. Value in the cryptocurrency market is concentrated in its two largest assets, Bitcoin and Ethereum, to a degree without parallel in mature asset classes. When the original edition of this paper was written in early 2018, the aggregate capitalisation of the market stood at approximately USD 302 billion, of which Bitcoin and Ethereum together accounted for approximately USD 180 billion. At the rebalancing of 1 October 2026, Bitcoin alone accounted for 67.7% of the combined market capitalisation of the thirty constituents, and the two assets together for 80.9%. An index weighted by market capitalisation, on the model of the S&P 500, would therefore measure little beyond these two assets. The CCi30 instead weights its constituents by the square root of their adjusted market capitalisation (Section 5).

2 Summary of the construction

Table 1 summarises the construction. Each element is developed in the sections that follow.

TABLE 1 Construction of the CCi30 Cryptocurrency Index

Element	Rule
Objective	Performance, in US dollars, of the thirty largest cryptocurrencies
Eligible universe	Assets with a reported market capitalisation, a price from the index price source and at least eleven daily observations in the selection window
Exclusions	Stablecoins and other assets designed to track an external price: commodity-referenced tokens, wrapped and bridged tokens, liquid-staking derivatives
Selection measure	Adjusted market capitalisation: exponentially weighted moving average, three-day half-life
Constituents	30
Weighting	Proportional to the square root of adjusted market capitalisation; no caps, no floors
Rebalancing	Monthly, effective 00:00 GMT on the first day of each month
Reconstitution	Quarterly, effective 00:00 GMT on 1 January, 1 April, 1 July and 1 October
Index type	Price return, denominated in US dollars
Calculation	Every ten seconds, twenty-four hours a day, every day of the year
Official close	Level at 00:00 GMT, calculated at 03:15 GMT
Base value	100.00 at the close of 1 January 2015
Real-time publication	Since 1 January 2017; earlier values calculated retrospectively
Administrator	CSP DAO LLC, Wyoming, United States · LEI 9845006BE86C7D0ZBC50

3 Adjusted market capitalisation

The index does not select or weight its constituents on a single observation of market capitalisation. In a market of this volatility, a single observation would alter the composition too often, and a single date is more easily influenced than a series. The index uses instead the adjusted market capitalisation, an exponentially weighted moving average of daily market capitalisation in which the most recent observations carry the greatest weight.

For a rebalancing effective on day D, let $M_i(d_k)$ denote the market capitalisation of asset i on its k-th most recent observation date, with $d_0 = D - 1$, and let K_i be the number of observations available in the sixty-one-day window ending on $D - 1$. The adjusted market capitalisation is

$$M_i^* = \frac{\sum_{k=0}^{K_i-1} \lambda^k M_i(d_k)}{\sum_{k=0}^{K_i-1} \lambda^k} \tag{1}$$

with decay factor

$$\lambda = 2^{-1/h} = e^{-\alpha}, \quad h = 3, \quad \alpha = \frac{\ln 2}{3} \approx 0.2310 \tag{2}$$

The half-life h is three observations: the weight attached to a given day's market capitalisation is half that attached to the observation three days later. The denominator normalises the weights over the observations actually available, so that a missing day reduces the sample rather than being counted as zero. No data from day D itself enters the calculation.

The calibration has the following properties. The most recent observation carries approximately 20.6% of the total weight, and the three most recent observations exactly half. A one-day movement in an asset's market capitalisation therefore moves its adjusted market capitalisation by roughly one fifth of that movement, while a movement sustained for three days or more moves it by half or more.

4 Constituent selection

4.1 Eligibility

An asset is eligible for selection if the index's market data provider reports a positive market capitalisation for it, if the index's price source supplies a price for it, and if it has more than ten daily observations in the sixty-one-day window of Section 3. The last condition prevents a newly listed asset from entering the index on the strength of a few days of data.

4.2 Exclusions

Assets whose price is designed to follow the price of something else are excluded: stablecoins referenced to a fiat currency, tokens referenced to a commodity such as gold, wrapped or bridged representations of another cryptocurrency, liquid-staking derivatives, and any other asset designed to track an external price. The price of such an asset carries no independent information about the cryptocurrency market, and its inclusion would dilute the measurement the index exists to provide. Exclusion is applied automatically on the classification published by the market data provider, and is supplemented by a named exclusion list maintained by the administrator, on which every entry is recorded with its reason.

4.3 Selection

At each quarterly reconstitution, eligible assets are ranked by adjusted market capitalisation and the thirty highest-ranked become constituents. Membership is then fixed until the following reconstitution: an asset that enters the top thirty during a quarter is admitted only if it qualifies at the next review.

4.4 Why thirty constituents

The constituent count reflects three considerations that converge on the same number.

Statistical sufficiency. Thirty is the smallest number of constituents at which the index remains a statistically significant estimator of the market as a whole. A thirty-constituent index represents the aggregate cryptocurrency market at a 99% confidence level, with a margin of error of 1.11% in the index level.

Liquidity. Below the thirtieth rank, liquidity deteriorates to the point at which inclusion would impair the index as a replicable portfolio. A larger constituent set would raise the cost of replication without a material gain in accuracy.

Coverage. When this paper was first published, the thirty largest assets accounted for approximately 90% of aggregate cryptocurrency market capitalisation; in October 2026 the figure was approximately 86%. A smaller set would reduce diversification and increase the probability of omitting assets that subsequently appreciate materially.

5 Weighting

At each rebalancing, the target weight of constituent i is proportional to the square root of its adjusted market capitalisation:

$$f_i = \frac{\sqrt{M_i^*}}{\sum_{j=1}^{N} \sqrt{M_j^*}} \tag{3}$$

The target weights are positive and sum to one. No caps or floors are applied, so that the weights follow observed market proportions without administrative intervention.

5.1 Rationale

The square root is best understood as one member of the family of power weightings

$$f_i^{(p)} = \frac{(M_i^*)^p}{\sum_{j=1}^{N} (M_j^*)^p}, \qquad 0 \le p \le 1 \tag{4}$$

in which $p = 1$ gives capitalisation weighting and $p = 0$ gives equal weighting. Capitalisation weighting, in this market, produces an index dominated by its two largest constituents. Equal weighting, or any scheme that decays much more slowly than the square root, transfers weight to the smallest constituents, which are also the least liquid, and so raises both the risk of the index and the cost of replicating it. The square root, $p = ½$, lies midway between the two: it preserves the ordering of constituents by size while halving the dispersion of log-weights relative to capitalisation weighting.

5.2 Effect on concentration

A convenient measure of breadth is the effective number of constituents, the inverse of the Herfindahl index of the weights:

$$N_{eff} = \frac{1}{\sum_{i=1}^{N} f_i^2} \tag{5}$$

It equals N for an equal-weighted index and approaches one as weight concentrates in a single asset. Because the published target weights are proportional to the square root of market capitalisation, the weights that capitalisation weighting would have assigned on the same date follow directly as $f_i^2 / \Sigma_j f_j^2$. Table 2 compares the three schemes at the rebalancing of 1 October 2026.

TABLE 2 Weighting schemes compared, rebalancing of 1 October 2026

	Capitalisation (p = 1)	Square root (p = ½)	Equal (p = 0)
Largest constituent (Bitcoin)	67.73%	**26.63%**	3.33%
Two largest constituents	80.91%	**38.38%**	6.67%
Smallest constituent	0.10%	**1.02%**	3.33%
Effective number of constituents	2.08	**9.55**	30.00

Square-root column: published target weights. Capitalisation column: derived from the published target weights as $f_i^2 / \Sigma f_j^2$. Equal column: 1/30. The capitalisation and equal-weighted figures are counterfactual and shown for comparison only.

Square-root weighting reduces the weight of the largest constituent from about two thirds of the index to about one quarter, and raises the effective number of constituents from about two to above nine, while the smallest constituent

receives about 1% of the index rather than the 3.3% that equal weighting would assign it. The result is not specific to that date. Across all 144 monthly rebalancings from January 2015 to October 2026, the weight of the largest constituent averaged 27.0% under the square-root rule against 65.2% under capitalisation weighting, and the effective number of constituents averaged 10.0 against 2.3.

6 Calculation of the index

The index level at time t is the value of the quantities of each constituent that the index holds:

$$I(t) = \sum_{i=1}^{N} u_i P_i(t) \tag{6}$$

where $P_i(t)$ is the US dollar price of constituent i and u_i is the number of units of it held, fixed at the most recent effective time T_0. At each effective time the units are set from the target weights and the level then prevailing:

$$u_i = \frac{I(T_0) f_i}{P_i(T_0)} \tag{7}$$

Substituting (7) into (6) gives the equivalent form

$$I(t) = I(T_0) \sum_{i=1}^{N} f_i \frac{P_i(t)}{P_i(T_0)} \tag{8}$$

The level at any time is thus the level at the last effective time multiplied by the weighted average of constituent price relatives since then. At the effective time the new units value the index at exactly its prior level, so that rebalancing and reconstitution change the composition of the index but not its value, and no separate divisor is required. Between effective times each constituent's share of the index drifts with its price:

$$w_i(t) = \frac{u_i P_i(t)}{I(t)}, \qquad \sum_{i=1}^{N} w_i(t) = 1. \tag{9}$$

A replicating portfolio that holds quantities proportional to u_i therefore tracks the index without trading between rebalancings.

6.1 Calculation and publication

The index is a price return index: staking rewards, interest, and airdropped or forked tokens are not credited to it. It is calculated every ten seconds, twenty-four hours a day, on every day of the year; cryptocurrency markets observe no holidays, and neither does the index. Constituent prices are taken from a single commercial cross-exchange price source and market capitalisations from a separate market data provider, both identified in the Methodology Manual. A real-time value is withheld rather than published when any constituent lacks a price or more than three constituents carry a price older than fifteen minutes.

Real-time values are indicative. The official close of each day is the level at 00:00 GMT, calculated from stored data at 03:15 GMT, and it is the sole value on which published statistics, performance figures and licensed reporting are based.

7 Index maintenance

Maintenance runs on two schedules, which change different things.

TABLE 3 Rebalancing and reconstitution

	Rebalancing	Reconstitution
What changes	Constituent weights	Membership and weights
Frequency	Monthly	Quarterly
Effective	00:00 GMT, first day of each month	00:00 GMT, 1 January, 1 April, 1 July, 1 October
Data cut-off	Close of the preceding day	Close of the last day of the quarter

The separation follows established practice among major equity benchmarks. Monthly rebalancing keeps the weights of the index in close correspondence with prevailing market proportions; quarterly reconstitution limits membership turnover and, with it, the transaction costs borne by products that replicate the index. The smoothing of market capitalisation described in Section 3 further prevents transient changes in ranking from reaching the composition.

All inputs to a rebalancing are dated on or before the day preceding its effective date, and the new composition takes effect at 00:00 GMT on that date. Because both the rules and the inputs are public, any party can anticipate the result of a rebalancing from public data before the administrator publishes it.

7.1 Extraordinary events

Events that the scheduled rules do not resolve alone, including the delisting or failure of a constituent, a prolonged loss of pricing, a fork in which the identity of the continuing asset is unclear, and the discovery after selection that a constituent is a pegged asset, are governed by Section 11 of the Methodology Manual [2]. Every resulting decision is recorded and published with its reason. No action is taken with hindsight to improve the past performance of the index: a constituent is never removed after the fact because its price has fallen.

8 Governance and transparency

The index is administered by CSP DAO LLC, which also acts as its calculation agent. The index is administered in a manner aligned with the IOSCO Principles for Financial Benchmarks [3].

Selection and weighting follow the published rules alone. The administrator's discretion is confined to a small number of enumerated questions of eligibility, principally additions to the named exclusion list and the identity of a continuing asset after a fork. Each such decision states the asset, the rule applied, the evidence and the date, and is published.

The construction is fully disclosed. The target weights of every rebalancing and the membership of every reconstitution since January 2015 are published, together with the complete daily history, so that any party holding the same input data can reproduce the published values. The inputs and results of each rebalancing are recorded and available to auditors. Errors in official closes are corrected by restatement, with a notice identifying the affected values and the cause; changes to the rules themselves take effect only prospectively, under the change procedure set out in the Methodology Manual.

The base value of 100.00 is set at the close of 1 January 2015. Real-time publication began on 1 January 2017; values for 2015 and 2016 were calculated retrospectively.

9 Applications

The index serves three functions. It is a performance benchmark for asset managers and trading desks with mandates in the asset class. It is a measurement instrument for the cryptocurrency market and the wider digital asset sector, in research as in reporting. And it is a replicable underlying for passive funds, exchange-traded products, certificates and structured notes.

Exposure is obtained by replicating the published composition or by holding a product that references the index under licence. Index-level exposure carries a materially different risk profile from concentrated positions in individual assets: it retains participation in the appreciation of constituents that cannot be identified in advance, while bounding the effect of any single constituent's decline by its weight.

Use of the index as the underlying of a financial product, and access to real-time data, require a commercial licence from the administrator. A licence at no cost is available to universities and research institutions for non-commercial research.

10 Extensions

The problems the index addresses (extreme concentration in a few issuers, rapid renewal of the universe and high volatility) are not unique to cryptocurrencies. Developed equity markets present them in milder form. The debt market, far larger than the cryptocurrency market and in many respects more dynamic, presents several of them directly, and the construction described here may prove useful there.

References

[1] Rivin, I. (2018). *Fear Universality and Doubt in Asset Price Movements*. arXiv:1803.07138 [q-fin.MF].

[2] CSP DAO LLC (2026). *CCi30 Cryptocurrency Index: Methodology Manual*. https://cci30.com/methodology/

[3] International Organization of Securities Commissions (2013). *Principles for Financial Benchmarks: Final Report*, FR07/13. Madrid: IOSCO.

IMPORTANT INFORMATION

This paper is provided for information only. It does not constitute investment advice, or an offer or solicitation in respect of any financial instrument, and should not be relied upon in making any investment decision. The index is not itself an investable instrument. Past performance of the index is not indicative of future results. CCi30 is a registered trademark (United States Reg. No. 5,640,753; European Union Trade Mark No. 017282351); use of the index or its name in connection with a financial product requires a licence.

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