TALOS

CMBI Single Asset Series Methodology

Version 1.12

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1 Introduction

Talos' mission is to provide transparent and actionable cryptoasset market and network (on-chain) data. As one of the early providers of both market and network data, Talos is uniquely positioned to provide investors with a high quality suite of crypto indexes.

The Coin Metrics Bletchley Indexes ("CMBI") are designed to provide cryptoasset markets with a diverse range of market capitalization-weighted, equal-weighted and network data-weighted indexes to measure performance of the largest and most utilized global cryptoassets. CMBI products are operated and calculated by Talos and are designed to serve as an independent, transparent, and comprehensive measure of cryptoasset market performance.

Indexes are weighted and calculated using a robust and resilient methodology that is resistant to manipulation and adheres to international best practices for financial benchmarks, including the International Organization of Securities Commissions' (IOSCO) Principles for Financial Benchmarks. The Talos Oversight Committee (the "Oversight Committee") protects the integrity of CMBI and ensures the indexes serve as a source of transparent and independent benchmarking.

1.1 Description

The indexes ("Benchmarks") are reflective of the returns an investor would expect by purchasing the underlying asset. Index prices are quoted in real-time and assets are rebalanced on the first business day of every month at 16:00 ET to account for changes in market dynamics as outlined in our market selection framework described in the Data Inputs section of our Prices Methodology, resulting in addition or deletion of index constituents (markets).

Given the early stages and financial immaturity of the cryptoasset market, there is insufficient trading infrastructure, custody solutions, liquidity, or other financial services to support the long tail of cryptoassets. These factors have gone into the design of CMBI products and the methodology outlined below so as to create a suite of investable indexes. As the ecosystem evolves and becomes more sophisticated, it may be deemed that other indexes become investable.

1.2 Administration

Talos serves as the administrator for CMBI products and has primary responsibility for all aspects of the index construction process, including development, definition, determination, dissemination, operation, and governance. All aspects of index production are carried out by Talos; however, Talos may rely on third party agreements to obtain data inputs for index calculation.

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Talos ensures that transparency in relation to significant decisions and associated rationale are published and made available to external stakeholders. Data contingency and exclusion rules are in place to handle certain extraordinary circumstances and external factors beyond the control of Talos.

2 Other Documents

The CMBI Benchmarks are collectively governed by policies described in CMBI Index Policies, which outline the administration, oversight, conflicts of interest, significant changes and terminations, recalculations, internal controls, complaints, record retention, and compliance policies.

The CMBI Indexes are supervised by the CMBI Governance Committees Charter, which defines the roles and responsibilities of the Oversight Committee and the Index Committee.

3 Data Inputs

3.1 Candidate Markets

Constituent Markets for the CMBI Benchmarks are selected as defined in the CMBI Guidelines for Candidate Markets.

Whilst Talos is a global business, considerations around the availability of exchanges in particular regulatory jurisdictions and investor accessibility need to be considered to cater to a global audience. Decisions regarding changes to the constituent markets are made by the Index Committee.

The pool of candidate markets that are evaluated by the Talos Exchange Scorecard is determined by a hierarchy of data inputs that varies depending on the given asset.

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4 Calculation Methodology

4.1 Coverage Universe

The set of assets included in the CMBI Single Asset Benchmarks coverage universe is included in Section 5 Coverage Universe.

4.2 Calculation Algorithm for Daily and Hourly Frequencies

The calculation algorithm of the CMBI Benchmarks for daily and hourly frequencies is described below.

1. All observable transactions from Constituent Markets are combined and partitioned into time intervals, with each time interval spanning a period of one minute. The first one-minute time interval begins 60 minutes before the Calculation Time and the last one-minute time interval begins at the Calculation Time and ends one minute after the Calculation Time. In total, the calculation period spans a period of 61 minutes (the "Observation Window"). A total of 61 one-minute time intervals are created.

2. The price of each observable transaction for one unit of the given asset is converted to U.S. dollars if necessary using the Benchmark level calculated for Bitcoin (BTC), Ethereum (ETH), USD Coin (USDC), or Tether (USDT).

3. The volume-weighted median price (VWMP) of each time interval is calculated. The volume-weighted median rate is calculated by ordering the transactions from lowest to highest price, taking the cumulative sum of volumes of these transactions, and identifying the price associated with the trades at the 50th percentile of volume measured in native units.

4. The time-weighted average price (TWAP) of the 61 time intervals is calculated using a custom weight function. The weight function assigns a weight of 0 percent to the first time interval, subsequent time intervals are assigned a weight that increases linearly, and the last two time intervals are assigned a weight of 5 percent such that the sum of all weights equals 100 percent. The weight function assigns more weight to time slices that are closer to the Calculation Time. The resulting figure is the published reference rate.

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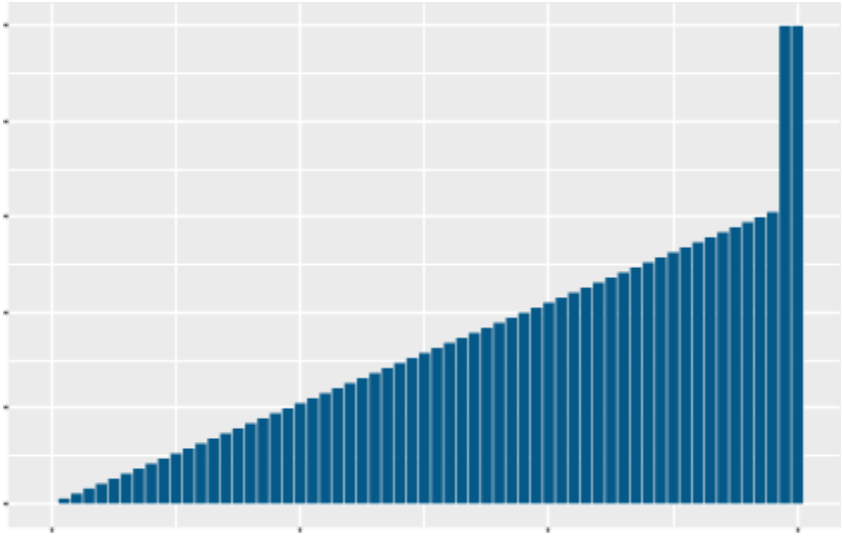
A chart of the weights is included below:

Time-Weighted Average Price (TWAP) Weight Function



The Time-Weighted Average Price (TWAP) weight function rises from 0% at the first time interval to a peak of approximately 5% and holds at 5% for the last two time intervals, so that the total of all 61 weights equals 100%.

4.3 Data Contingency Rules for Daily and Hourly Frequencies

The following contingency rules are followed to address situations where data is delayed, missing, or unavailable due to periods of illiquidity, extraordinary market circumstances, or outside factors beyond the control of Talos.

1. If observable transactions from a constituent market are unable to be collected due to technical problems specific to the constituent market's exchange during the calculation of a Benchmark, the observable transactions from the constituent market are not included in the calculation of the specific instance of the given reference rate.

2. If no observable transactions from constituent markets occur during the first one-minute time interval, the next one-minute time interval's volume-weighted median price is used as the volume-weighted median price. This contingency rule is applied recursively if necessary.

3. If no observable transactions from constituent markets occur during any one-minute time intervals, excluding the first and last one-minute time intervals in the Observation Window, the next one-minute time interval's volume-weighted median price is used as the volume-weighted median price. This contingency rule is applied recursively if necessary.

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4. If no observable transactions from constituent markets occur during the last one-minute time interval, the previous time interval's volume-weighted median price is used as the volume-weighted median price. This contingency rule is applied recursively if necessary.

5. If no observable transactions from constituent markets exist during the Calculation Window for a Benchmark, the reference rate will be determined to equal the previous hourly reference rate in which there were trades during that hour's Observation Window.

4.4 Calculation Algorithm for Real-Time Frequencies

The calculation algorithm of the CMBI Benchmarks for the real-time frequencies is described below.

1. Collect all trades for the Constituent Markets over the previous 60 minutes. Sort the combined trade stream in ascending order of trade time. For each pair of consecutive trades, calculate the time difference (in seconds). The mean trade interval is the arithmetic mean of these time differences. Establish the active market cutoff by multiplying the mean trade interval by 100.

2. For each of the Constituent Markets, measure the elapsed time since its most recent trade relative to the calculation time. Exclude any venue whose "time-since-last-trade" exceeds the active market cutoff from the set of Constituent Markets. If every Constituent Market is filtered out, override the exclusion and treat Constituent Markets as active.

3. Calculate the volume denominated in units of the given asset from observable transactions that occurred over the trailing 60 minutes for each of the Constituent Markets. Calculate the volume weight for each of the Constituent Markets by dividing the volume figure for each of the Constituent Markets by the total volume across all Constituent Markets. The resulting figure is referred to as the volume weight.

4. Convert the trade price of all observable transactions over the trailing 60 minutes for each of the Constituent Markets to U.S. dollars if necessary using the Real-Time Reference Rate calculated for Bitcoin (BTC), Ethereum (ETH), USD Coin (USDC), or Tether (USDT). Calculate the inverse variance of the trade price converted to U.S. dollars for each of the Constituent Markets using the population mean in the calculation of variance, where the population mean is defined as the mean price of all trades from Constituent Markets over the trailing 60 minutes. If a Constituent Market has an infinite or undefined inverse price variance, the inverse price variance for that Constituent Market is set to zero. Calculate the inverse price variance weight for each of the Constituent Markets by dividing the inverse price variance by the total inverse price variance across all Constituent Markets. The resulting figure is referred to as the inverse price variance weight.

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5. Calculate the final weight for each of the Constituent Markets by taking a mean of the volume weight and the inverse price variance weight.

6. Extract the most recent observable transaction from each of the Constituent Markets. Convert the trade price of the most recent observable transactions to U.S. dollars if necessary using the Reference Rate calculated for Bitcoin (BTC), Ethereum (ETH), USD Coin (USDC), or Tether (USDT).

7. Calculate the weighted median price of the most recent observable transactions using the prices calculated in step 4 and the final weights calculated in step 3. The weighted median price is calculated by ordering the transactions from lowest to highest price, and identifying the price associated with the trades at the 50th percentile of final weight. The resulting figure is the published reference rate for the given asset.

4.5 Data Contingency Rules for Real-Time Frequencies

The following contingency rules are followed to address situations where data is delayed, missing, or unavailable due to periods of illiquidity, extraordinary market circumstances, or outside factors beyond the control of Talos.

1. If observable transactions from a constituent market are unable to be collected due to technical problems specific to the constituent market's exchange during the calculation of a real-time Benchmark, the observable transactions from the constituent market are not included in the calculation of the specific instance of the given real-time Benchmark.

2. If no observable transactions from constituent markets exist during the trailing 60 minutes, the value of the real-time Benchmark will be determined to equal the value calculated during the previous second.

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5 Appendix A: Coverage Universe

The following table lists the current coverage universe.

Index Name	Index Ticker	Asset
CMBI Bitcoin Index	CMBIBTC	Bitcoin
CMBI Bitcoin Total Return Index	CMBIBTCT	Bitcoin
CMBI Ethereum Index	CMBIETH	Ethereum
CMBI Ethereum Total Return Index	CMBIETHT	Ethereum
CMBI Litecoin Index	CMBILTC	Litecoin
CMBI Chainlink Index	CMBILINK	Chainlink
CMBI Polkadot Index	CMBIDOT	Polkadot
CMBI Solana Index	CMBISOL	Solana
CMBI Cardano Index	CMBIADA	Cardano
CMBI Cosmos Index	CMBIATOM	Cosmos
CMBI Avalanche Index	CMBIAVAX	Avalanche
CMBI Aave Index	CMBIAAVE	Aave
CMBI Uniswap Index	CMBIUNI	Uniswap
CMBI ApeCoin Index	CMBIAPE	ApeCoin
BITA ETH Realtime Internal Index	_GFOXER	NA
BITA BTC Realtime Internal Index	_GFOXBR	NA

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6 Change Log

Release	Date	Changes
Version 1.0	December 26, 2019	Finalized CMBI Single Asset Series Methodology
Version 1.1	March 12, 2021	Added clarification for CMBI Constituent Market Eligibility Criteria. The coverage universe is expanded to include CMBILTC.
Version 1.2	September 1, 2021	The coverage universe is expanded to include CMBISOL.
Version 1.3	February 17, 2022	The coverage universe is expanded to include CMBIEOS and CMBIXTZ.
Version 1.4	March 17, 2022	The coverage universe is expanded to include CMBISAND and CMBIMANA.
Version 1.5	May 12, 2022	The coverage universe is expanded to include CMBIAAVE, CMBIAPE, CMBIAVAX, CMBIATOM, CMBILINK, CMBIDOT and CMBIUNI.
Version 1.6	June 7, 2022	The coverage universe is expanded to include CMBIADA and CMBIBAT.
Version 1.7	October 24, 2022	Added 1s calculation frequency.
Version 1.8	October 2, 2023	Annual Methodology Review. Terminated CMBIBAT, CMBIMANA, CMBISAND, CMBIEOS, CMBIXTZ and CMBIALGO from the coverage universe.
Version 1.9	January 18, 2024	Defined investability considerations in accordance with the Trusted Exchange Framework.
Version 1.10	September 20, 2024	Annual Methodology Review
Version 1.11	September 18, 2025	Annual Methodology Review
Version 1.12	September 18, 2026	Annual Methodology Review Corporate rebrand from Coin Metrics to Talos Coverage Universe updated: remove CMBIMATIC (terminated), and Derivative Fixing indexes (BTCFIX, ETHFIX - now CMBTCD and CMETHCD covered under the Derivative Benchmark methodology) Added inactive markets monitoring to the Real-Time Calculation Algorithm (§4.2): an active market cutoff is established from the trailing

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Release	Date	Changes
		60-minute trade stream, and Constituent Markets exceeding that cutoff since their last trade are excluded from the calculation, with an override if every market would otherwise be excluded.