CCIX Methodology (former CCCAGG)

CC Data Limited

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1 Version History

Version	Date	Details
1	01-Jul-2017	Initial version
2	20-Nov-2017	Added review process description
3	26-Feb-2018	Outlier methodology
4	30-Aug-2018	Amendment
5	12-Sep-2019	Outlier methodology update
6	27-Sep-2019	Constituent exchanges selection methodology
7	16-Dec-2019	Mathematical representation amendments
8	20-Jul-2020	Static and Dynamic Index definitions
9	18-Sep-2020	Amendment
10	26-Oct-2020	Merge constituent methodology with CCCAGG methodology
11	28-Jan-2021	Backtesting additions
12	12-Jan-2022	Improved mathematical notation
13	18-Mar-2022	LaTeX conversion, non-material amendments to section 3, subsubsection 5.3.4 and section 6, and other minor amendments
14	21-Feb-2023	Top-Tier Exchange definition update in section 3, subsubsection 6.3.3 "Top-Tier Liquid Pairs" methodology addition, and Disclaimer update
15	29-Mar-2023	CryptoCompare to CCData brand update
16	09-Jan-2024	CCCAGG rebranded/renamed to CCIX update

2 Introduction

2.1 Index Description

CCData's Aggregated Index ("CCIX") for a given Currency Pair refers to the real-time index calculation methodology, the purpose of which is to show the best price estimation for cryptocurrency traders and investors to value their portfolio at any time. CCIX is CCData's proprietary index calculation methodology for digital assets, based on 24-hour volume-weighted average calculation, time-penalty factor and outlier methodology. It aggregates transaction data of more than 250 Exchanges, using a 24-hour volume-weighted average. The CCIX is calculated for each cryptocurrency in each market it is trading in (example: CCIX BTC-USD). A detailed list of available cryptocurrencies is available on request.

Cryptocurrencies such as Bitcoin, Ethereum, Monero, etc. are traded at various markets against multiple currencies including fiat currencies (USD, JPY, GBP, etc.) and other cryptocurrencies. Depending on the market type (exchange or OTC), liquidity level, trading volume, transaction fees, and many other factors, a coin can be traded at different prices across different markets, and therefore making it difficult to know the value of a coin at a certain time.

2.2 Index Properties

Calculation agent	CC Data Limited
Dissemination	Real-time and historical
Day close	12:00 am UTC
Methodology	24-hour volume-weighted average with time penalty and outlier adjustment
Calculation days	Every day of the week including business holidays
Markets	All cryptocurrency markets

3 Definitions

24 Hour Volume means, with respect to a Currency Pair, an Exchange and a point in time, the sum of the volume of such Currency Pair on such Exchange over the last 23 calendar hours and the cumulative volume of the current calendar hour.

API stands for Application Programming Interface.

Average Daily Volume means, with respect to a Currency Pair, an Exchange and a calendar day, the average daily trading volume in USD over the past 30 calendar days calculated as follows:

$$ADV_d^{USD} = \frac{1}{30} \sum_{i=1}^{30} DailyVolume_{d-i}^{USD} \tag{1}$$

Where:

d denotes a calendar day in UTC timezone;

i denotes a positive integer; and

$d - i$ denotes i calendar days prior to d

Each day's trading volume is converted into USD using the day's CCIX of the Currency Pair's base or quote currency, as the case may be, against USD.

Calculation Date means any day for which a CCIX is published.

CCIX means, with respect to a Currency Pair, the Crypto Coin Comparison Aggregate Index.

Constituent Exchange means, with respect to a Currency Pair, an Exchange that is selected to contribute to the respective CCIX as of the previous Constituent Exchange Selection and Review.

Constituent Exchange Selection and Review means the monthly qualitative and quantitative review process to determine which Exchanges should be included or excluded for each CCIX based on eligibility and inclusion/exclusion criteria.

Currency Pair means a pair of:

- cryptocurrencies, or
- a cryptocurrency and a fiat currency

Dynamic Index means the version of CCIX that is subject to retrospective backfilling in the event of a failure to retrieve exchange data in a timely manner.

Exchange means an exchange that trades cryptocurrencies and is part of our constituent exchange universe.

Exchange Benchmark means CCData's proprietary methodology for assessing exchange quality published on a semi-annual basis.

Illiquid Pair means any Currency Pair that does not meet the criteria for Liquid Pairs, and hence is not classified as a Liquid Pair.

Liquid Pair means a Currency Pair with both base and quote markets trading above 1 million USD a day on average for the last 30 days aggregated across CCIX markets, or above 5 million USD a day aggregated across all markets.

Liquidity Factor means, with respect to a Currency Pair, an Exchange and a calendar day, the ratio of the Average Daily Volume of such Currency Pair on such Exchange compared to the aggregate Average Daily Volume of all Constituent Exchanges that contribute to the respective CCIX, calculated as follows:

$$LiquidityFactor = \frac{ExchangeADV}{\sum_{e \in E} ADV_c} \tag{2}$$

Where:

e denotes an Exchange in set E; and

E is, with respect to the Currency Pair and calendar day, the set of all Constituent Exchanges that contribute to the respective CCIX

Non Top-Tier Exchange means an Exchange with grade B, C, D, E or F or an ungraded Exchange based on the Exchange Benchmark results. For the avoidance of doubt, it is any Exchange that is not a Top-Tier Exchange.

Outlier Detection Factor means a factor used for penalising a price deemed to be an outlier in the CCIX calculation and is determined in accordance with Equation 7.

Price Difference means, with respect to a Currency Pair, an Exchange and a calendar day, the price difference of such Currency Pair on such Exchange compared to the median price of such Currency Pair across all relevant Exchanges, calculated as follows:

$$PriceDifference = \frac{ExchangePrice - MedianPrice}{MedianPrice} \tag{3}$$

The assumption is that for a Currency Pair trading on multiple Exchanges, the price on the most liquid Exchanges will cluster around the median. This metric is preferred over a simple average as it can detect outliers without skewing the metric for the whole sample.

Price Impact means, with respect to a Currency Pair, an Exchange and a calendar day, a valuation metric used to assess how much of the Price Difference would materialise when added to the CCIX. For a given Currency Pair and Exchange, it is the volume-weighted Price Difference calculated as follows:

$$PriceImpact = PriceDifference \cdot LiquidityFactor \tag{4}$$

This is an important metric as a higher Price Difference on a low-volume Exchange would materialise less, in certain cases, than a lower Price Difference on a high-volume Exchange. This is due to the fact that CCIX uses a 24 Hour Volume-weighted average calculation.

Static Index means the immutable version of CCIX, which does not account for missed trades.

Time Penalty Factor means a factor used for penalising outdated prices in the CCIX calculation and is determined in accordance with Equation 10.

Top-Tier Exchange means an Exchange with grade AA, A or BB based on the Exchange Benchmark results. Grades can be found here.

UTC stands for Coordinated Universal Time.

4 Data Collection

4.1 Data Source

Transactional data (historical trades) is collected from each Exchange via public REST API polled every 2-5 seconds or websocket endpoints. All collected data will be standardized internally, stored and backed up in servers.

Exchanges and markets are added on an ongoing basis based on research or user request. Exchanges that do not meet the technical requirements (available API for transactional data) cannot be added to the data collection. Unlike many data providers, who use snapshot data, CCIX approach of using transactional data enables auditability and replicability.

4.2 Data Format

The collected data consists of:

- Trade ID: string or numerical
- Timestamp: Unix timestamp in seconds
- Price: numerical
- Amount: numerical
- Position: buy/sell

4.3 Data Validation

Each trade is validated for the following:

- Each field has the correct data format
- Price and amount is positive
- Timestamp is not in the future
- Trades are not duplicated

4.4 Failure of Data Retrieval

In the event of a failure to retrieve data from an Exchange (due to service outage of the Exchange API service), per design of the CCIX, the last price of the respective Exchange will expire over time (its weighting will decrease to close to zero). As long as the Currency Pair is trading on other Exchanges, the CCIX calculation is uninterrupted.

If the missed data is recoverable, CCData makes its best effort to retrospectively backfill the data for historical accuracy. This might result in recalculation of certain CCIX pairs, therefore CCData publishes two sets of indices: the Static Index, which is immutable, and the Dynamic Index, which can be adjusted

retrospectively. The default index price retrieved from the CCData API is the Dynamic Index. The real-time index dissemination is also the Dynamic Index.

5 Index Calculation Methodology

5.1 Input Data

CCIX is calculated every time a new transaction is received. The following input data is needed from each transaction:

- Trade price
- Trade amount
- Trade timestamp
- Exchange where the transaction was executed

Input data sources are also reviewed via the qualitative review method, the Exchange Benchmark. More details can be found in subsection 6.2.

5.2 Constituent Exchanges

Constituent Exchanges are selected based on the Constituent Exchange Selection and Review process. More details can be found in section 6.

5.3 Index Calculation

5.3.1 24 Hour Volume

CCIX uses a 24 Hour Volume-weighted average, as defined in this document, to calculate prices. 24 Hour Volumes are calculated solely based on transactional data. This ensures CCIX gives greater weight to liquid market prices, and the Price Impact of illiquid (and therefore more volatile) markets is reduced.

5.3.2 Time Penalty Factor

The Time Penalty Factor is added to ensure that Exchanges that suspend trading have an expiring Price Impact. An example of a case where this methodology was particularly advantageous was the Bitfinex hack in 2016.

Bitfinex had one of the highest trading volumes in Bitcoin, and therefore had a significant weight in most price indices. As a result, when trading was suddenly suspended on Bitfinex, causing a crash on all other markets, most indices still showed a Bitcoin price close to the last price on Bitfinex, although markets had already moved on.

CCIX takes last trade time into account, therefore the last Bitfinex price expired with time and the index could move with the market.

5.3.3 Aggregation over Trading Currency

CCIX only takes direct trading pairs into consideration for calculation. For example CCIX BTC-USD only accepts trades from Exchanges trading BTC-USD directly, therefore no currency conversion is needed for the aggregated index calculation.

The reason for this methodology is that a coin can trade on multiple currency markets with a significant Price Difference (premium or discount), therefore aggregating across all markets would result in an average price that is not useful for a trader or investor who holds a crypto position in a certain currency and most likely trades in that currency.

5.3.4 Mathematical Representation

We use the notation $|\cdot|$ to represent size of sets. What follows is the calculation of each relevant variable.

For a pre-specified Currency Pair, the CCIX is a volume-weighted average (last trade) price calculated as follows:

$$P_t = \sum_{e \in E_t} w_t^e \cdot p_t^e \tag{5}$$

Where:

t denotes a point in time, where the integer value represents seconds in unix timestamps [1]

P_t is the CCIX price at time t

e denotes an Exchange in set E_t

E_t is the set of all Exchanges used in the calculation of CCIX at time t

w_t^e is the weight assigned to Exchange e at time t and is calculated in accordance with Equation 6

p_t^e is, with respect to Exchange e and time t, the price of the last trade to contribute to CCIX [2]

The weight of Exchange e at time t is calculated as follows:

$$w_t^e = \frac{\mathbb{1}_t^e \cdot V_t^e \cdot \gamma_t^e}{\sum_{x \in E_t} \mathbb{1}_t^x \cdot V_t^x \cdot \gamma_t^x} \tag{6}$$

[1] Therefore 0 represents 00:00:00 on January 1st, 1970 UTC.

[2] For a trade from an Exchange to contribute to CCIX, it should have taken place after the Exchange was last added as a constituent of CCIX.

Where:

x denotes an Exchange (including Exchange e) in set E_t

$\mathbb{1}_t^e$ is, with respect to Exchange e and time t, the Outlier Detection Factor determined in accordance with Equation 7

V_t^e is, with respect to Exchange e and time t, the 24 Hour Volume calculated in accordance with Equation 8

γ_t^e is, with respect to Exchange e and time t, the Time Penalty Factor determined in accordance with Equation 10

The Outlier Detection Factor, with respect to Exchange e and time t, is determined as follows:

$$\mathbb{1}_t^e = \begin{cases} 0 & \text{if } |E_t| > 2 \text{ and } (p_t^e > A \cdot P_{l_t} \text{ or } A \cdot p_t^e < P_{l_t}) \\ 1 & \text{otherwise} \end{cases} \tag{7}$$

Where:

E_t and p_t^e are as defined above

A is a constant that denotes the price deviation threshold; it is currently set to 4

l_t is, with respect to t, the time of the last trade from any Exchange to contribute to CCIX [3]

P_{l_t} is the CCIX price at time l_t

The 24 Hour Volume, as defined in this document, with respect to Exchange e and time t, is calculated as follows:

$$V_t^e = \sum_{h_t \leq s < t} v_s^e \tag{8}$$

Where:

h_t is, with respect to time t, the timestamp of the last calendar hour in UTC in the previous 24-hour period determined as follows:

$$h_t = t - (23 \cdot 3600 + c) \tag{9}$$

Where:

c is the number of seconds past in the current hour

[3] This would be the last time that the CCIX was calculated.

s denotes a point in time between h_t (inclusive) and t (exclusive) for which there was a trade on Exchange e

v_s^e is the quantity traded on Exchange e at time s [4]

The Time Penalty Factor, with respect to Exchange e and time t, is determined as follows:

$$\gamma_t^e = \begin{cases} 1 & \text{if } \tau_t^e < 5 \\ 0.8 & \text{if } 5 \leq \tau_t^e < 10 \\ 0.6 & \text{if } 10 \leq \tau_t^e < 15 \\ 0.4 & \text{if } 15 \leq \tau_t^e < 20 \\ 0.2 & \text{if } 20 \leq \tau_t^e < 25 \\ 0.001 & \text{otherwise} \end{cases} \tag{10}$$

Where:

τ_t^e is, with respect to Exchange e and time t, the length of time in minutes since the last trade on Exchange e calculated as follows:

$$\tau_t^e = \frac{t - l_t^e}{60} \tag{11}$$

Where:

l_t^e is, with respect to Exchange e and time t, the time of the last trade on such Exchange e to contribute to CCIX

5.3.5 Outlier Detection

Along with the real-time outlier detection dictated by $\mathbb{1}_t^e$ in Equation 7, CCData will manually remove trades that are deemed outliers for other reasons, such as exchange errors.

5.4 Auditability and Replicability

CCIX is auditable and replicable since its calculation is based on transaction data retrieved from Exchanges via public API. Anyone who has access to this data can recreate the CCIX.

[4] Note we include the volumes of trades deemed to be outliers.

6 Constituent Exchange Selection and Review Methodology

6.1 Introduction

CCData has integrated with a list of Exchanges, but only a subset of them count towards the calculation of CCIX.

While CCData strives to include as many Exchanges as possible after a testing period, exclusion generally happens in the following cases:

- Volatile prices compared to market average (OTC markets excluded)
- Exchange suspends trading activity
- Malfunctioning API (from a Constituent Exchange)
- Exclusion due to risk factors identified in the Exchange Benchmark

The Constituent Exchange Selection and Review methodology consists of a qualitative component, using the CCData Exchange Benchmark (see more information in subsection 6.2), and a quantitative component, looking at historical price movements and liquidity (see more information in subsection 6.3).

Review component	**Method**	**Frequency**
Exchange Benchmark	Qualitative	Semi-annual
Monthly Constituent Selection	Quantitative + using Exchange Benchmark results	Monthly

The Exchange Benchmark is conducted as a due diligence process on Exchanges, it is updated semi-annually and its results are used in the quantitative part of the Constituent Exchange Selection and Review process. The Constituent Exchange Selection and Review, as described in this section, is conducted to decide whether an Exchange should be included or excluded from the CCIX of each Currency Pair in scope.

When assessing the eligibility of an Exchange to be included/excluded in each CCIX, CCData differentiates between the most liquid pairs (Liquid Pairs) and other pairs. This is because, for Liquid Pairs, the main goal is to maintain price integrity, while for Illiquid Pairs, the goal is to give the best price discovery. The difference in incentives means that the eligibility rules also differ.

While the review takes the Exchange Benchmark grades into consideration, a top grade does not automatically imply inclusion. Historical prices are used to assess the Price Differences for each trading pair. Moreover, further metrics are used for assessment, such as Price Impact and Liquidity Factors.

Each case for exclusion is reviewed by the Technical Committee with sign-off by the Oversight Function. This process occurs every calendar month, and on an ad-hoc basis when necessary. An excluded Exchange can be re-included if the Technical Committee finds that the problem causing the market disturbance has been solved. Changes in Constituent Exchanges are communicated via a published report on the second Tuesday of the calendar month on ccdata.io, and implemented on the third Tuesday of the calendar month (adjusted if not a business day).

6.2 Qualitative Reivew: Exchange Benchmark

The CCData Exchange Benchmark seeks to bring clarity to the digital asset exchange sector by providing a framework for assessing risk, bringing transparency and accountability to a complex and rapidly evolving market. This is approached in several dimensions using a comprehensive data set, covering over 160 Exchanges across 8 categories of evaluation:

- Legal/Regulation
- Data Provision
- Security
- Team/Exchange
- Investment
- Trade Monitoring
- Market Quality
- Negative Events Penalty

The output of the Exchange Benchmark framework is a rating system, whereby each Exchange receives a grade from AA (best quality) to E (lowest quality). This framework is used as a qualitative assessment for the eligibility review.

Benchmark results are updated semi-annually and published on ccdata.io. The full methodology can be found here: ccdata.io/research.

For the purposes of constituent selection, Top-Tier Exchanges are those that receive an AA, A or BB grade in the Exchange Benchmark and Non Top-Tier Exchanges are those receiving a B, C, D, E or F grade or are non-graded. Top-Tier Exchanges meet our minimum threshold for acceptable risk.

With the exception of 'dry pairs' (as defined in Section 6.3.3.2), Exchanges with grade F or non-graded Exchanges are automatically excluded from the CCIX calculation for all other Currency Pairs.

The Exchange Benchmark is updated and published semi-annually.

The Exchange Benchmark results are used in the quantitative part of the Constituent Exchange Selection and Review process as described in subsection 6.3.

6.3 Quantitative Review: Monthly Constituent Selection

6.3.1 Overview

Constituent selection is divided into two main components: review of Liquid Pairs and review of Illiquid Pairs. This is an important distinction, as the incentives of review for the two groups are different. For Liquid Pairs, the review prioritizes price integrity, so Top-Tier Exchanges are preferred with strict rules for inclusion. For other pairs, the incentive is to provide the best price discovery, therefore eligibility rules are more relaxed.

This process is conducted once every calendar month, aggregating the data of the last 30 days.

The following metrics are calculated for each Currency Pair for each Exchange before conducting the selection process:

- Price Difference
- Price Impact
- Liquidity Factor
- Average Daily Volume

6.3.2 Liquid Pairs

Liquid Pairs are determined based on Average Daily Volumes of each base and quote asset that may form a Currency Pair.

For each Liquid Pair, the following reviews are done: Top-Tier Exchanges to include, all Exchanges to exclude and other Exchanges to include.

6.3.2.1 Top-Tier Exchanges to Include

For inclusion review of Top-tier Exchanges that have not been included in certain markets, CCData uses 30-day average Price Difference and 30-day average Price Impact. Exchanges with low Price Difference and low Price Impact are added to the CCIX. Both of the conditions in the table below need to be met for a Top-Tier Exchange to be eligible for inclusion:

Metric	Threshold	Condition
30-day average Price Difference (absolute)	2%	Less
30-day average Price Impact (absolute)	10%	Less

6.3.2.2 Exchanges to Exclude

Certain exclusion tests are done with all Exchanges including Top-Tier Exchanges. This is important for Liquid Pairs as the goal is to maintain price integrity. The metrics used for the exclusion test are 30-day average Price Difference and 30-day average Price Impact. Exchanges with high Price Difference or high Price Impact are excluded from the CCIX. Either of the conditions in the table below need to be met for an Exchange to be eligible for exclusion:

Metric	Threshold	Condition
30-day average Price Difference (absolute)	10%	Greater
30-day average Price Impact (absolute)	50%	Greater

Exclusion thresholds are higher than inclusion thresholds as we need to account for periodical differences due to the overall market liquidity seasonalities.

6.3.2.3 Non Top-Tier Exchanges To Include

Non Top-Tier Exchanges are also reviewed for inclusion. The metrics used for this review are 30-day average Price Difference, Liquidity Factor and Daily Average Volume. First, Currency Pairs need to meet a minimum trading activity threshold to avoid stale prices. Once that is met, the 30-day average Price Difference needs to meet a certain level. It is also important that the liquidity ratio is reasonably high, adding price liquidity to the CCIX. Exchanges graded D or below, or non-graded are not included. All of the conditions in the table below need to be met for a Non Top-Tier Exchange to be eligible for inclusion:

Metric	Threshold	Condition
30-day average Price Difference (absolute)	10%	Less
30-day Average Daily Volume	5 million USD	Greater
Liquidity Factor	50%	Greater

6.3.3 Top-Tier Liquid Pairs

Liquid Pairs with four or more Top-Tier Exchanges included in the CCIX calculation are called "top-tier liquid pairs". Once a Liquid Pair has four or more Top-Tier Exchanges eligible for inclusion, all Non Top-Tier Exchanges are removed from CCIX for that pair, and only Top-Tier Exchanges are considered for inclusion from then on. Any pairs falling into the "top-tier liquid" category following a monthly review are considered eligible for inclusion in the CCIX Benchmark Family.

6.3.4 Illiquid Pairs

Any pair that is not in the list of Liquid Pairs is reviewed as an 'Illiquid Pair'. The main motivation for this review is to provide the best price discovery possible. As such pairs are less liquid, data sources are scarce. As of writing this version of the methodology, there are around fourteen thousand (14,000) other pairs from thirty thousand (30,000) Exchanges. This means, on average, an Illiquid Pair is listed on 2 Exchanges.

6.3.4.1 Top-Tier Exchanges to Include

All Top-Tier Exchanges are reviewed for Illiquid Pairs that are not dry pairs (see subsubsection 6.3.5 below). Although Top-tier Exchanges are trusted for their data quality, they may have illiquid markets too as they launch new products. The following Price Difference and Liquidity Ratio conditions need to be met for a Top-Tier Exchange to be eligible for inclusion:

Metric	Threshold	Condition
30-day average Price Difference (absolute)	5%	Less
Liquidity Factor	50%	Greater

6.3.4.2 Non Top-Tier Exchanges To Include

Non Top-Tier Exchanges are also reviewed for inclusion. The metrics used for this review are 30-day average Price Difference, Liquidity Factor and Daily Average Volume. First, Currency Pairs need to meet a minimum trading activity threshold to avoid stale prices. Once that is met, the 30-day average Price Difference needs to meet a certain level. It is also important that the liquidity ratio is reasonably high, adding price liquidity to the CCIX. Exchanges graded D or below, or non-graded are not included. All of the conditions in the table below need to be met for a Non Top-Tier Exchange to be eligible for inclusion:

Metric	Threshold	Condition
30-day average Price Difference (absolute)	10%	Less
30-day Average Daily Volume	5 million USD	Greater
Liquidity Factor	50%	Greater

6.3.5 Dry Pairs (Less than 4 Exchanges)

Pairs with less than 4 Exchanges are called "dry pairs", and will allow all price feeds to be included (up to 3 Exchanges), unless the Price Difference with respect to an Exchange is significantly high (10x magnitude). A minimum of 3 Exchanges is required for the outlier detection methodology, described in Equation 7 and subsubsection 5.3.5, to work.

7 Ongoing Maintenance

7.1 Methodology Review and any Changes to Methodology

The methodology is reviewed at least every quarter by the Technical Committee to ensure that it remains representative of the relevant market or economic reality that it is intended to measure. If the Technical Committee requires any material changes to the methodology, any change must be signed off by the Oversight Function before entering a period of public consultation of no less than thirty (30) days. The Oversight Function shall undertake an internal review of the methodology at least annually.

In accordance with Article 13(1)(c) of the Benchmark Regulation (BMR), the consultation exercise provides notification to users, at a minimum, of the key elements of the methodology that would be affected by the proposed material change. CCIX consumers will be notified of the methodology consultation and proposed changes via the API newsletter and other direct client communication channels, and benchmark users will be invited to review the proposed changes and submit feedback.

7.2 Backtesting and Benchmarking

In order to maintain confidence that the CCIX for a Currency Pair is representative and replicable, each quarter the following tests are conducted:

- Compare daily CCIX values for the last 3 months with the median price of the Constituent Exchanges. It is expected that CCIX follows the market median closely.
- Compare daily CCIX volatility to Constituent Exchange volatility over the last 3 months. It is expected that CCIX is less volatile than each individual Constituent Exchange.
- Recalculate daily CCIX values using raw trade data for the last 3 months. This ensures that the index is replicable and transparent.

7.3 Constituent Exchange Review

Constituent Exchange selection is reviewed by the Technical Committee at least once every calendar month or on an ad-hoc basis, when market or technical events require. Market or technical events may include:

- Suspended Trading
- False Data Provision
- Service Outage

The Exchange Benchmark, which forms the qualitative aspect of the Constituent Exchange Selection and Review process occurs on a semi-annual basis and is reviewed and updated no less than twice annually.

The Constituent Exchange Selection and Review methodology, outlined in section 6 of this document, describes the complete process and criteria by which Constituent Exchanges are selected and considered towards the calculation of a CCIX.

7.4 Discretion Regarding the Use of Input Data

Pursuant to Art. 12 No.1. (b) of the BMR, CCData has established the following rules identifying how and when discretion may be exercised in the administration of CCIX.

In cases where input data is or appears to be qualitatively inferior or different sources provide different data, or a situation is not covered by this index methodology document, CCData may use or change the data at its own discretion according to the following discretion policy after a plausibility check. This may include:

- Liquidity and size data
- Event information
- Classifications and other secondary data

Any changes to input data that CCData intends to apply because of missing data, different data from different sources, or other information concluding the inappropriateness or incorrectness of data must be subject to reasonable discretion. The decision on any change must be required, appropriate, commensurable, and in line with the respective index scope and objective and must reasonably consider in a balance weight the interest of users, investors in related products and the integrity of the market.

The Technical Committee ensures consistency in the use of discretion in its judgement and decision. Employees involved in the Technical Committee must have shown the respective experience and skills. Significant decisions are subject to sign-off by a supervisor. In case of material changes to data, the relevant situation will be analysed in detail, described and presented to the Oversight Function and discussed and reviewed with the Oversight Function.

The broad range of possible data quality problems does not allow to define specific steps for each possible instance. CCData will always weigh the different interests of CCIX users, the integrity of the market and other involved parties, and determine the least disadvantageous measure that equally considers the relevant interests best.

In order to avoid individual decisions on the use of data in similar cases for the future, an update of the index rules can be taken into consideration, if applicable.

Other possible mitigation measures may include the change of input data sources or providers and/or own data research where possible and reasonable.

Records are kept about material judgement or discretion and will include the reasoning for said judgement or discretion.

7.5 Potential Limitation

The CCIX methodology works best for liquid markets where multiple Exchanges provide data sources for the index calculation. For a given CCIX, if the number of Exchanges eligible for inclusion is low or each individual Exchange is illiquid, then the volume-weighted average price will give an indicative value that might not sufficiently reflect the market.

CCIX also relies on frequent trade updates. If no trading occurs on a market for more than 24 hours, then the index will become stale.

8 Dissemination

CCIX is disseminated via REST API and Websocket API. The relevant API endpoint can be found here: https://min-api.cryptocompare.com/documentation?key=Historicalcat=dataHistohour.

9 Disclaimer

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