Kaiko smart data | Cboe

Cboe Kaiko Digital Assets Rates

RULEBOOK

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CONTENT

Version	Publication date	Comments
1	26/10/2023	Created
2	31/05/2024	Exchange Removal: CBOE Digital

INTRODUCTION

This document describes the methodology of the Cboe Kaiko Digital Assets Rates - (together, the “Cboe Kaiko Rates”). Designed to bring greater transparency to pricing, the Cboe Kaiko Rates are solely based on executed trades from centralised exchanges.

Calculation and dissemination: All Cboe Kaiko Rates are calculated hourly.

The list of all rates can be found here:

Rate	Kaiko Symbol	ISIN
Cboe Kaiko Bitcoin Rate	Cboe-KAIKO_BTCUSD	FR001400LY68
Cboe Kaiko Ether Rate	Cboe-KAIKO_ETHUSD	FR001400LY50

REVIEW CALENDAR

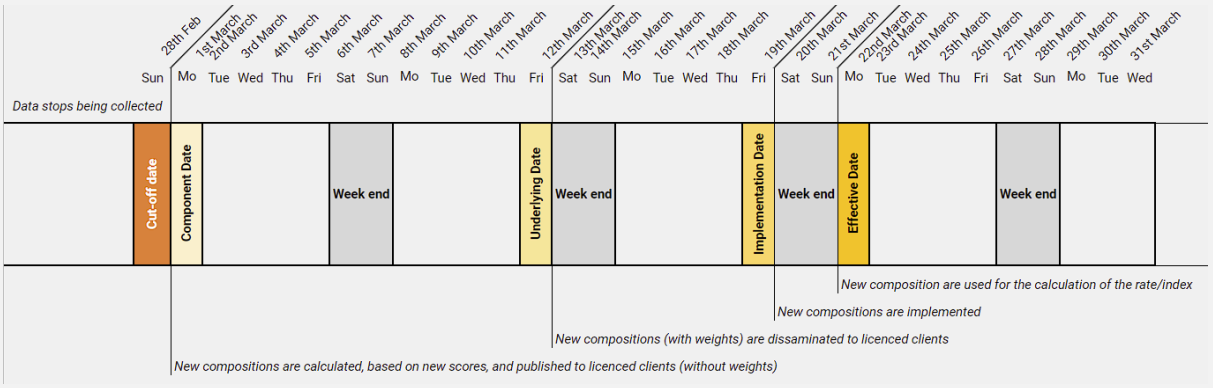
Scheduled Review and Rebalancing

Rebalancing is a scheduled, regular process designed to ensure that the Cboe Kaiko Rates are composed of the most relevant price data feeds and to ensure the Cboe Kaiko Rates continue to comply with the methodology detailed in this document, including initial vetting, liquidity and optimization requirements (in particular please refer to the Exchange Selection Model section).

All Cboe Kaiko Rates will follow the same quarterly rebalancing calendar (March, June, September and December) with cut off and effective dates structuring the data collection and processing periods followed by publication periods.

Event	Date	Description
Cut-off	Last day of the month preceding the rebalancing	Data collection for composition determination stops on that day.*
Underlying data	Second Friday of the rebalancing month	The new exchange composition with corresponding weights is available.
Effective	Monday after the third Friday of the rebalancing month	The new exchange composition becomes effective in the calculation of the rates.

**For instance, if a 3-month Average Daily Traded Volume must be calculated, the covered period will start 3 months before the cut-off date and end on the cut-off date (included).*



Extraordinary Review

On the basis of its qualified and expert judgement, Kaiko, in consultation with Cboe and other relevant stakeholders, reserves the right to exclude or replace an exchange selected during the Scheduled Review, or to suggest and consult on any methodology change that Kaiko considers necessary to ensure the Cboe Kaiko Rates continue to reflect the target underlying economic reality. Such a consultation could happen if, for example, an exchange has been found to experience an exclusion action including but not limited to:

- Fraud
- Market manipulation
- Significant loss of volume or liquidity

In such cases, the Kaiko Index Steering Committee will publish a consultation document, explaining its findings and any suggested methodology change. A clear timetable for the consultation will be outlined, including the proposed notice period that will be provided before the implementation of any change.

METHODOLOGY

Cboe Kaiko Rates emphasise data quality. Before any rate can be computed, each eligible exchange is screened for both quantitative and qualitative aspects. Said screenings compose a key element to ensure the reliability and authenticity of each and every rate.

Data Source

The daily price levels are based on the historical tick-by-tick trade data provided by Kaiko.

Kaiko is the leading source of cryptocurrency market data, providing businesses with industrial-grade and regulatory-compliant data. Kaiko empowers market participants with global connectivity to real-time and historical data feeds across the world's leading centralized and decentralized cryptocurrency exchanges. Kaiko's proprietary products are built to empower financial institutions and cryptocurrency businesses with solutions ranging from portfolio valuation to strategy backtesting, performance reporting, charting, analysis, indices, pre-and post-trade.

Exchange Selection Model

Markets in crypto assets are by nature highly fragmented, with hundreds or even thousands of exchanges spread over different geographical areas, each with their own regulatory framework. Each crypto asset trading platform works as an independent dark pool, and as such, official statistics and research data are rarely publicly available.

As a global digital asset market data provider, Kaiko covers more than one hundred cryptocurrency exchanges. However, not all exchanges offer the same level of standards in terms of legal and compliance frameworks, infrastructure security, liquidity, data quality or even technology.

An asset-agnostic vetting is built on Kaiko Exchange Ranking parameters. The Exchange Ranking assessment is carried out on a quarterly basis by the Kaiko team, and approved by the Kaiko Exchange Ranking Steering Committee.

Criteria	
Absent from any sanction list	Yes
Has been operating for the past	5 Years
Located in stable and open country	Yes
Regulated by an independent government body	Yes
KYC/AML controls	Strong
Trading Policies	Significant
Offers reliable REST API & WebSocket data feeds	Yes
Offers reliable live & historical trade data	Yes
Provide cold storage for customers funds	Yes

All exchanges fulfilling **all** criteria mentioned above constitute the Kaiko Vetted Exchanges List (KVEL) for the respective rates. Upon each quarterly review of the Exchange Ranking, a new associated KVEL is created. Kaiko's Exchange Ranking history goes back to January 2022. For the purposes of index and rate performance history older rebalancing periods will be associated with the January 2022 Exchange Ranking Review. Subsequent exchange selections will rely on their respective Exchange Ranking Review.

Additionally, the liquidity of each exchange in the relevant pairs is assessed to only consider meaningful contributors, defined as at least 0.5% of the total observed liquidity over the past 3 months in the relevant pair.

For the purpose of the Cboe Kaiko Rates computation, only market data coming from the following members of the KVEL are considered: LMAX, itBit, and Bitstamp. In accordance with the Extraordinary Review section above, any material change to the methodology would be subject to consultation with all relevant stakeholders.

Publication Events

The Cboe Kaiko Rates are published on an hourly basis and use a fixed calculation window:

Rate	Publication Interval	Calculation Window
Cboe Kaiko Bitcoin Rate	Hourly fixings	Fixed at 3600 seconds
Cboe Kaiko Ether Rate	Hourly fixings	Fixed at 3600 seconds

Rates Calculation

The aggregation methodology consists of splitting the calculation period considered into equal size partitions and, for each of them, extracting the most representative trade whose price will be used for the final rate calculation.

All trades in the relevant pair from the relevant exchanges are pooled together and grouped into relevant time partitions. For each partition, the most representative trade is defined as the volume median one.

1. Step-by-step Methodology

- At fixing time, collect all executed trades in the calculation window (before the fixing) on all selected exchanges.
- Merge all the executed trades from the different exchanges in the same dataset sorted by prices in ascending order.
- Create K partitions of S_{part} size from the calculation window (eg. 1h calc. window with 10 partitions of 6 min).
- Each partition is then subject to a Volume Weighted Median (outlier resistant by nature). A detailed description of this aggregation method is provided below.
- A time weight is associated with each partition's volume-weighted median (more weights to the last partitions which are the most recent).
- Aggregation of those weighted prices (eg. 10 prices aggregated on 1h calc. window) to obtain the fixing price for this publication event.

2. Inputs

Symbol	Name	Description
t	Event	The timestamp at which the fixing price (FP) is calculated.
S_{wind}	Calculation Window Size	Size of the calculation period for which trades are collected and aggregated.
S_{part}	Partition Size	Size of each partition in the calculation window.
K	Number of Partitions	The number of partitions is an integer calculated as S_{wind}/S_{part}.
k	Partition Number	k_{th} partition.
I_k	Partition Trade Distribution	List of trades included in partition k and ordered by ascending price.

p_i^k	Partition Trade Price	i^{th} trade price in the k_{th} partition (price-ordered distribution).
v_i^k	Partition Trade Volume	i^{th} trade volume in the k_{th} partition (price-ordered distribution).
VWM_k	Volume-Weighted Median	Volume-weighted median of the k_{th} partition.
FP_t	Fixing Price	Fixing price (FP) at time t.

3. Volume Weighted Median

The volume-weighted median (VWM_k) is calculated as the price (p_j^k) of the j^{th} trade where the j^{th} trade is the trade that lies at 50% of the cumulative volume for the partition k. VWM_k is calculated for each partition in S_{wind}:

$$VWM_k = p_j^k \text{ where } j \text{ satisfies } \sum_{i=0}^{j-1} v_i^k < \frac{\sum_{i=1}^{I_k} v_i^k}{2} \text{ and } \sum_{i=j+1}^{I_k} v_i^k \leq \frac{\sum_{i=1}^{I_k} v_i^k}{2}$$

$$\text{If } \exists\ j : v_j^k > \frac{\sum_{i=1}^{I_k} v_i^k}{2} \text{ then } VWM_k = p_j^k$$

$$\text{If } \exists\ j : \sum_{i=j+1}^{I_k} v_i^k = \frac{\sum_{i=1}^{I_k} v_i^k}{2} \text{ then } VWM_k = \frac{p_j^k + p_{j+1}^k}{2}$$

4. Fixing Price

The Fixing Price (FP) is calculated as a time weighted average price (TWAP) of all the VWM_k of all the K partitions. We implement a sensitivity calibration method on partitions to increase the weight of the most recent prices included in the calculation window.

First, we apply a specific weighting function in order to obtain weights which are inversely proportional to time t. It gives:

$$w_k = \frac{1}{n} \sum_{j=0}^{I_k} 1_{j \leq k}$$

The weights are then normalised:

$$\overline{w_k} = \frac{w_k}{\sum_j w_j}$$

Thus, the fixing price is equal to:

$$FP_T = \sum_{k=1}^{K} (VWM_k \times \overline{w_k})$$

5. Partitioning Scheme

Each rate breaks down the window size into n partitions of equal size. Here is a summary of all the window size / partitions number combinations:

Rate	Number of partitions	Calculation Window
Cboe Kaiko Bitcoin Rate	10	Fixed at 3600 seconds
Cboe Kaiko Ether Rate	10	Fixed at 3600 seconds

6. Data Rounding

All rates are calculated with all available decimals but published with two decimals.

7. Blockchain Forks

In the event of a fork of the blockchain, the ticker used on each Constituent Exchange may be adjusted in order to represent the relevant instrument.

8. Data Gaps

Missing Data

At the time of the calculation (t), some relevant transactions may be missing for an array of reasons. If no relevant transactions are recorded on the relevant partition, the corresponding partition is excluded from the calculation and weights are adjusted accordingly. If no relevant transactions are recorded in the entire calculation window, the price is not published.

Delayed Data

If for any reason Kaiko was unable to retrieve relevant transactions at the Calculation Time, the corresponding partition is excluded from the calculation.

Spurious Data

If for any reason any transactions were identified as potentially suspect within a partition, the most representative trade may be adjusted to disregard the spurious data.