The Data Guide for Crypto Reporting

Methodology and Usage

Context

- The FASB finally clarified reporting requirements for crypto assets confirming a fair-value approach, set to go into effect December 2024.
- Crypto assets are traded in a multi-fragmented market, which poses challenges in determining a consensus price.
- There are 2k+ crypto assets, 6k+ trading pairs, 100+ exchanges.

Goal

- Find a **consensual, relevant** and **robust** price for any pair.
- Crypto prices that are **replicable, transparent and compliant.**

Challenge

- Large discrepancies in price, volume, and liquidity across exchanges and frequent outliers.

Use Cases

Almost any business that holds crypto on their balance sheet will need data for reporting purposes, especially with new FASB requirements. Price data also powers numerous crypto infrastructure components, including charting tools and terminals. As such, it is more important than ever to have outlier-resistant, reliable, and transparent price data.

This guide will explore the methodology and usage of Kaiko's crypto pricing services, which can be used for the following purposes:

|	
Tax Reporting	Stay compliant with upcoming reporting requirements with replicable daily price feeds.
Audits	Validate historical transactions for any asset, with 10+ years of data.
Accounting	Value portfolios and transactions for investment firms or businesses that accept crypto.
Analytics	Integrate data feeds via our API into your platform, for display of price data for thousands of assets.

Kaiko empowers businesses with actionable and reliable crypto data solutions. Since 2014, we've solved complex data challenges to provide the highest-quality services, powering use cases across the investment lifecycle.

Kaiko Pricing Services

IFRS and US-GAAP Compliant

The fragmentation of crypto markets has introduced the need for dedicated pricing or valuation products that incorporate a diversity of sources while relying on traditional and robust aggregation methods to compute a representative fair value price. Kaiko provides two such pricing services, each dedicated to specific use cases.
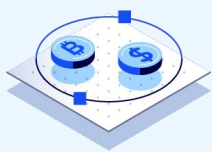
Robust Pair Price

Direct Price

Returns an aggregated price for a real traded pair across all exchanges using a **proprietary aggregation method.** This method, called RWM, reduces the impact of outliers (in prices and volumes) in the final price.

REST Docs

Cross Price

Triangulated Price

Returns an aggregated price for a pair that is **illiquid** or **not directly traded** on spot exchanges. It leverages a volume-weighted liquidity path method to convert any crypto-asset into fiat or crypto.

REST Docs

Data Coverage & Distribution

Asset Coverage: all crypto asset pairs (and 200+ fiat currencies)

Exchange Coverage: all in Kaiko's coverage (100+ CEXs & DEXs)

Granularity: from 1s to 1d

Distribution: REST API, CSV Export, Kaiko Stream

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Robust Pair Price
Outlier-Resistant Prices for Sensitive Activities

The objective of this product is to compute prices for crypto assets that are clean, representative, and resistant to outliers. This product is optimal for sensitive valuation activities that must use real trading data, rather than synthetic conversions. Robust Pair Prices provide a rigorous and high-performing methodology that satisfies the required properties for such an estimator:

- **Relevance**: reflects a price consensus

- **Manipulation Resistance**: robust against tiny and gigantic orders

- **Verifiability**: transparency of the methodology

- **Replicability**: easy to reproduce

- **Timeliness**: reactive to market movements

- **Stability**: robust against missing data and outliers

- **Parsimony**: no hyperparameters

Our methodology includes two steps :

1. **Time Series Data Augmentation**

   Reduction in the number of missing values and improvement in the quality of the price estimation.

2. **Statistical Robust Estimation**

   Rigorous, high-performing and transparent methodology based on advanced statistical analysis.

Public white paper available here

Statistical error bounds for weighted mean and median, with application to robust aggregation of cryptocurrency data

Kaiko

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Abstract

We study price aggregation methodologies applied to crypto-currency prices with quotations fragmented on different platforms. An intrinsic difficulty is that the price returns and volumes are heavy-tailed, with many outliers, making averaging and aggregation challenging. While conventional methods rely on Volume-Weighted Average Prices (called VWAPs), or Volume-Weighted Median prices (called VWMs), we develop a new Robust Weighted Median (RWM) estimator that is robust to price and volume outliers. Our study is based on new probabilistic concentration inequalities for weighted means and weighted quantiles under different tail assumptions (heavy tails, sub-gamma tails, sub-Gaussian tails). This justifies that fluctuations of VWAP and VWM are statistically important given the heavy-tailed properties of volumes and/or prices. We show that our RWM estimator overcomes this problem and also satisfies all the desirable properties of a price aggregator. We illustrate the behavior of RWM on synthetic data (within a parametric model close to real data): our estimator achieves a statistical accuracy twice as good as its competitors, and also allows to recover realized volatilities in a very accurate way. Tests on real data are also performed and confirm the good behavior of the estimator on various use cases.

Keywords: robust aggregation; weighted mean and quantile estimation; heavy tails; concentration inequalities; outliers

MSC2020: 62E17; 62G15; 62G35; 62P05
JEL: C13; C18; G15

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Robust Pair Price
Documentation and Usage

To use this product, input the base asset (ex: btc) and the denominating currency you require (ex. USD) to retrieve a time series including the aggregated price and volume. There is also the option to include or exclude data from specific exchanges.

Endpoint:
```
https://us.market-api.kaiko.io/v2/data/trades.v1/robust_pair_price/btc/usd?start_time=2023-01-01T00
:00:00.000Z&end_time=2023-11-16T00:00:00.000Z&interval=1m&sources=false&extrapolate_missing_values=
true
```

Parameters:
- base
- quote
- start_time
- end_time
- interval[1s - 1d]

Output fields:
- *timestamp*
- *price*
- *volume*
- *count (number of trades)*

```
"data": [
    {
        "timestamp": 1673740740000,
        "price": "20957.832145322154",
        "volume": "16.60651235999999",
        "count": 733,
        "extrapolate_missing_values": false
    },
    {
        "timestamp": 1673740680000,
        "price": "20958.22697207152",
        "volume": "28.832678270000066",
        "count": 781,
        "extrapolate_missing_values": false
    },
    {
        "timestamp": 1673740620000,
        "price": "20958.615477132596",
        "volume": "48.378378330000025",
        "count": 1220,
        "extrapolate_missing_values": false
    },
```


BTC-USD | Year 2023 | granularity 1min
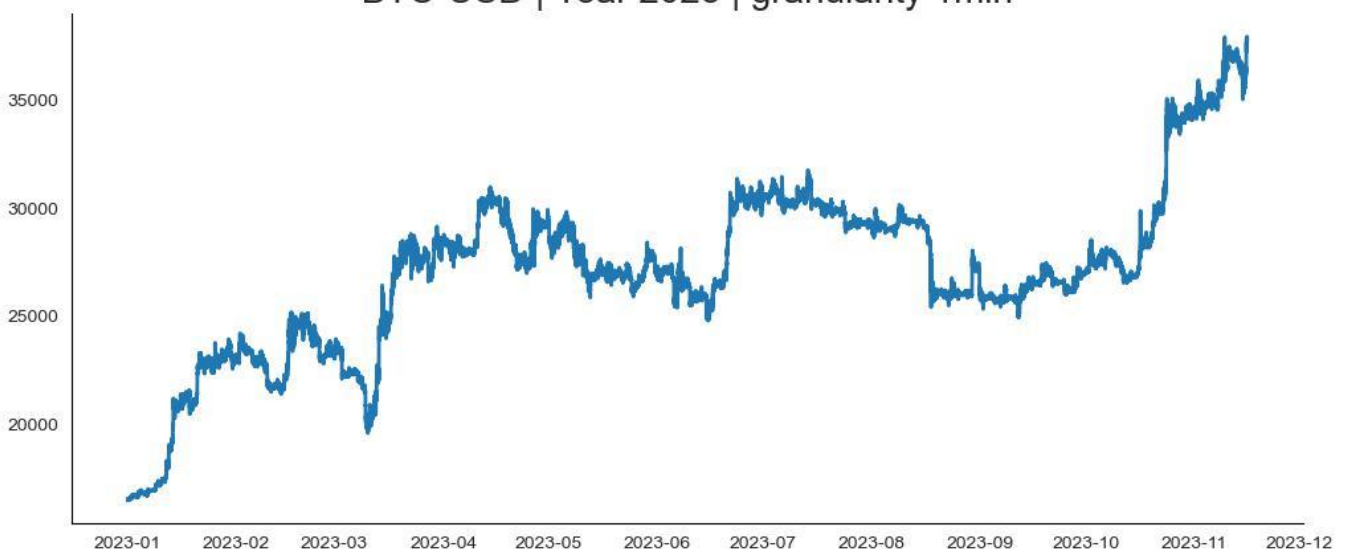
Note: Only real trading pairs are used in the aggregated price. If you require data denominated in a currency that the asset does not trade against, we recommend using Cross Prices.
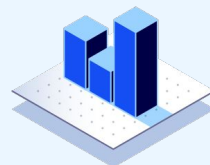
Robust Pair Price

Comparison With Other Methodologies

We tested other common aggregation methods vs. Robust Pair Price (RPP) and found that ours resulted in the least volatility while best reflecting the consensus price for a crypto asset.
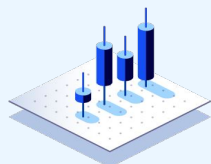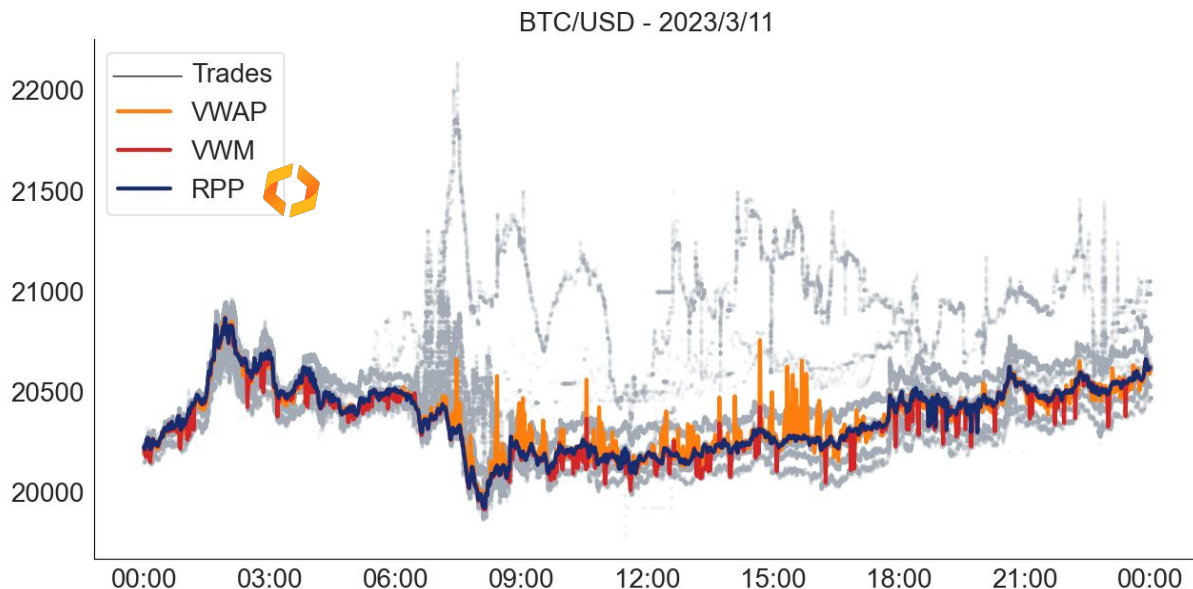

Volume Weighted Average Price (VWAP)

Computed by averaging traded prices with a weight equal to the traded volume.

Volume Weighted Median (VWM)

Computed as a usual median, though each price is weighted by its volume.

BTC/USD - 2023/3/11

Trades for BTC-USD (gray) can vary greatly depending on the spot exchange, with many outliers, especially during a volatile market event such as the banking crisis on March 11, 2023. As markets collapsed and stablecoins depegged, huge price swings were observed. RPP (blue) was best able to manage the fragmentation, showing the least volatility compared with VWAP (orange) and VWM (red).

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Cross Price
## Prices For Illiquid or Non-Listed Pairs

The objective of this product is to calculate a robust price to convert a crypto asset into a different crypto or fiat currency, even if the pair is illiquid or isn't listed. This product is optimal for reporting and valuation of illiquid tokens that don't trade against a fiat currency or only on a handful of markets. The calculation method relies on two steps:

- The search for the path with the highest liquidity to transition from the requested base asset to the requested quote asset (using one or several intermediary assets).
- The calculation of all prices within the path using an aggregation method.

The Most Liquid Path

To find the best path to go from an asset X to another asset Y, we build a graph whose vertices are all the assets we cover and edges are liquidity scores. Finally, we look for the path with the best liquidity score. In our definition, the liquidity score is computed based on traded volumes and the lowest score corresponds to the best path in terms of liquidity.

Example: find the best path to get a stETH-GBP price
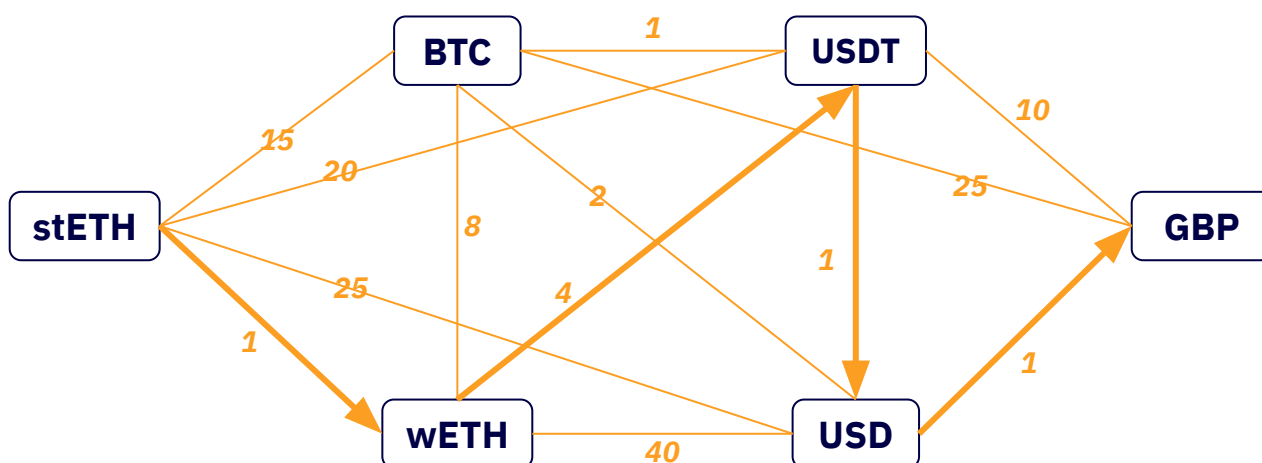
In this example, the path with the lowest score, i.e. the best path in terms of liquidity is stETH-wETH-USDT-USD-GBP.

Price Computation

The price of each selected pair is computed with Robust Pair Price, then we multiply all of them to get the final cross-price:

$$stETH\text{-}GBP = stETH\text{-}wETH * wETH\text{-}USDT * USDT\text{-}USD * USD\text{-}GBP$$

FX Conversion

The final pair USD-GBP requires a FIAT/FIAT rates with 2 potential sources:

1/ **Open Exchange Rate**: Free | Not SOC2 compliant (by default)

2/ **OANDA FX Rate**: Fee-based offer | SOC2 compliant

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Cross Price
Documentation and Usage

To use this product, input the base asset (ex. BTC) and quote asset (can be any fiat OR crypto currency), to return a time series of price data. There is an option to extrapolate missing values, which for illiquid assets that may not have any trades over a time interval.

Endpoint:
`https://us.market-api.kaiko.io/v2/data/trades.v2/spot_exchange_rate/wbtc/udsc?start_time=2023-04-04T00:00:00.000Z&end_time=2023-04-04T00:00:00.000Z&interval=1m&extrapolate_missing_values=true&sources=false`

Parameters:
- base
- quote
- start_time
- end_time
- Interval [1s – 1d]

Output fields: for each asset
- *Timestamp*
- *Price*
- *Extrapolated Value**

*For illiquid pairs that might not have a value over the time interval

```
"data": [
    {
        "timestamp": 1678751940000,
        "price": null,
        "extrapolated": false
    },
    {
        "timestamp": 1678751880000,
        "price": null,
        "extrapolated": false
    },
    {
        "timestamp": 1678751820000,
        "price": null,
        "extrapolated": false
    },
```

wbtc-usdc | 2023/4/4-2023/5/1 | Granularity 1h
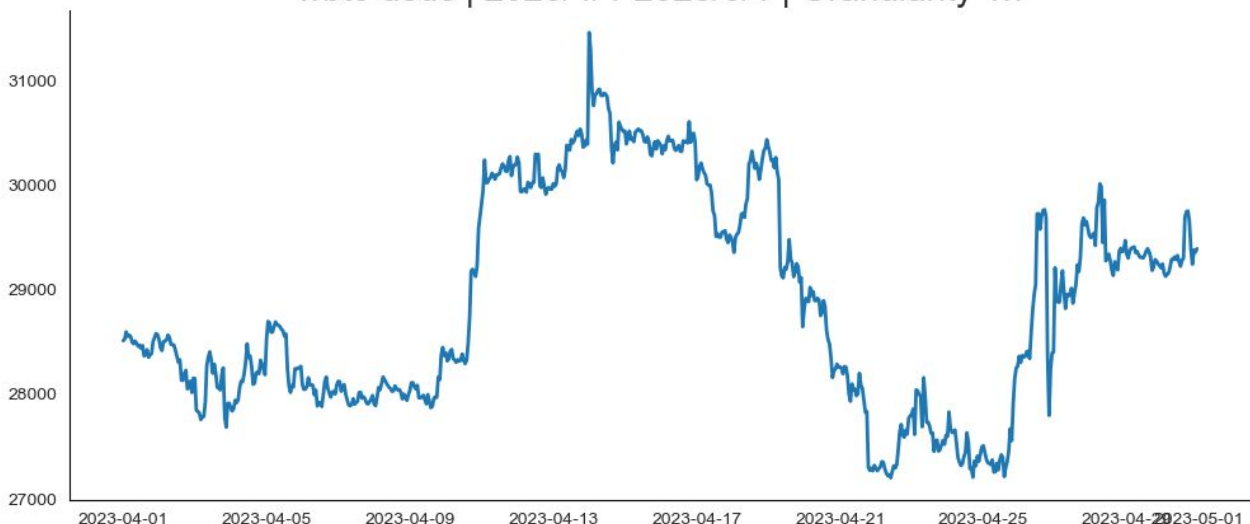
Data Solutions Trusted by Industry Leaders

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Since 2014, we've solved complex data challenges to provide the highest-quality services. Our trusted market data, indices, DeFi data and analytics power use cases across the investment lifecycle for crypto-native and financial institutions. For each of our enterprise clients, we build custom data plans and offer integration support. Contact us to get started today.

100+
CEXs and DEXs

20+
Data Types

>99%
API uptime

AICPA SOC

Petabytes
Of Tick-Level Data

10+ yrs
Historical Data

260,000+
Spot, Futures, & Options

BMR

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Build powerful strategies with highly-granular data.

Financial Products

Design innovative products with reliable prices.

Market Infrastructure

Seamlessly integrate data into your platform.

Tax and Accounting

Stay compliant with reporting requirements.

Government

Enhance market oversight and enforcement.

Research

Produce original and in-depth market analysis.

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