Number of coins

- The amount of coins in the index is equal to 100 at all times.

Filters for coin inclusion

- The coin has a trade history of at least 3 months.
- The coin is listed on at least one of the exchanges that we collect data from.
- The coin is not any kind of index, is not fiat-based (such as USDT), is not based on any kind of commodity or other asset that .
- The coin is not involved in any kind of scam scandal, delisting, or lawsuit.
- In the event a coin fails to meet any one of our criteria during a period, it is excluded from the index at the beginning of the next period.

Data used to calculate the index

Exchanges that we are integrated with:

- Binance
- Bitfinex
- Bitstamp
- Bittrex
- HitBTC
- Huobi
- Kraken
- OKex
- Poloniex

The data is streamed from the exchange APIs taking all trades for each particular coin (Example: timestamp, trade ID, price, volume, direction).

Frequency of the calculation

The index is calculated every second in real time, with a lag equal to one second.

Definitions

$I^j(t)$: At second j of Index Business Day t, Cryptoindex denominated in USD.

$I_b^j(t)$: At second j of Index Business Day t, Cryptoindex denominated in BTC.

$P_{i,e}^j$: At second j of Index Business Day t, price of coin i listed on exchange e in BTC (Note: the majority of the coins is traded only against BTC on the exchanges. Naturally, the price of BTC in BTC is equal to 1 at all times).

$P_{BTC,e}^j$: At second j of Index Business Day t, price of BTC in USD listed on exchange e.

$\omega_i(t)$: On each Index Business Day t, weight of coin i (Note: superscript j is omitted, as notional remains the same throughout Index Business Day).

$N_i(t)$: On each Index Business Day t, notional amount of coin i (Note: superscript j is omitted, as notional remains the same throughout Index Business Day).

$V_{i,e}^{h}(t)$: At hour h of the Index Business Day t, cumulative traded volume of coin i within the hour h, listed on exchange e. Will be described below in detail.

$V_{i,e}(t,j)$: At second j of the Index Business Day t, normalized traded volume of coin i, listed on exchange e. Will be described below in detail.

$C_i(t)$: On Index Business Day t, capitalization of coin i. The capitalization information is the courtesy of Coinmarketcap. The data for the previous day always becomes available between 1 and 3 hours after the end of the previous day (between 01:00:00 UTC and 03:00:00 UTC).

Here j equals seconds in the day, thus $0 \leq j < 86400$, where j = 0 represents UTC 00:00:00 and j= 86399 represents UTC 23:59:59. An incremental value of one represents one more second. Note that a negative value of j corresponds to the previous Index Business Day, whereas a value of j greater than or equal to 86400 corresponds to seconds of the following Index Business Day. For example:

$I^{-1}(t)=I^{86399}(t-1)$; $I^{86401}(t)=I^{1}(t+1)$

T_k: Rebalance day where T_0 represents rebalance inception day. In the current set up as rebalance occurs at each month's end, T_k is equivalent to the last index business day.
m: Eligible exchange takes values from 1 to M. In the current version, m has a maximum value of 9, so M=9 and m=1: Binance, m=2: Bitfinex, …, m=9: Poloniex.

Weights calculations

For each Index Business Day t, the weights are calculated on the last available rebalance day, T_k, such that $T_{k-1} \leq t < T_k$. Weight is calculated as the percentage of average capitalization of coin i divided by the total average capitalization across all 100 coins and within the calendar month (L=number of days in the calendar month excluding the last day and d denotes the index running over the days) on rebalance day, i.e.

$$C_{Total} = \sum_{i=1}^{100} \left(\frac{1}{L} \left(\sum_{d=1}^{L} C_i\,(d) \right) \right)$$

$$\omega_i = \left(\frac{1}{L}\left(\sum_{d=1}^{L} C_i\,(d)\right)\right) \Big/ C_{Total}$$

such that $\sum_{i=1}^{100} \omega_i = 1$.

The new weights are calculated as soon as the capitalization data is available at UTC 03:00:00.

Second j=84600 corresponds to UTC 23:30:00, when the rebalancing calculation begins thirty minutes prior to the end of the Index Business Day.

Although the index with the weights of the previous period is still relevant, the new index is being constantly recalculated, as if we were to sell the previous period's index $I^j(t)$ (or $I_b^j(t)$, in BTC) and purchase the new index with the new weights. Each second, as the prices of the coins update, the amounts of coins change. Here $N_i(T_k, j)$ refers to the number of coins we would hypothetically have at second j within day T_k.

$$N_i(T_k, j) = [I_b^j(T_k) \cdot \omega_i(t)]/(P_i^j(T_k)$$

The continuous recalculation is done in order to provide absolutely seamless merging of the indices of the previous and the new periods.

In essense there are two indices being calculated in parallel between UTC 23:30:00 and UTC 23:59:59, one consisting of the weights of the previous period and one consisting of the newly calculated weights. Up until UTC 23:59:59 the previous index is relevant and at UTC 00:00:00 the new index becomes relevant with the amounts of coins:

$$N_i(T_k) = [I_b^{86400}(T_k) \cdot \omega_i(t)]/(P_i^{86400}(T_k)$$

Price

For each day t, the price of coin i in BTC, at second j is calculated as the weighted average of prices across all exchanges e, weighted by normalized traded volume*** of the relevant exchange (volume-based weights are assigned to each exchange).

$$P_i^j(t) = [\sum_{e=1}^{M} P_{i,e}^j(t) \cdot V_{i,e}(t, j)] / \sum_{e=1}^{M} V_{i,e}(t, j)$$

Then the index price in BTC is given by:

$$I_b^j(\mathrm{t}) = \sum_{i=1}^{100} N_i(t) \cdot P_i^j(t)$$

where the price of BTC in BTC is equal to 1 at all times.

After that, we use the value of the index in BTC to get the value of the index in USD:

$$I^j(t) = I_b^j(\mathrm{t}) \cdot \mathrm{P}_{BTC,e}^j$$

***normalized traded volume refers to the smoothing methodology we apply for calculating the volume-based weights for the exchanges.

Normalized traded volume calculation

In order to assign volume-based weights to the exchanges, we collect the trades that happened in the last 12 hours excluding the current hour and the previous hour. For example, if the calculation is being done at 12:48:30 UTC, we exclude the hour between 12:00:00 UTC and 12:59:59 UTC, and we exclude the hour between 11:00:00 UTC and 11:59:59 UTC. The period we look at is between 23:00:00 UTC of the previous day and 10:59:59 UTC current day. Thus, the volume-based weights are calculated on an hourly basis.

The motivation for this exclusion is that when trades arrive late from the exchanges, the volume-based weight is constantly updated and does not allow to have fixed weights.

$V_{i,e}^h(t)$ is calculated for h between 0 and 11. In the above example:

$V_{i,e}^0(t)$ refers to the hour between 23:00:00 UTC and 23:59:59 UTC, $V_{i,e}^1(t)$ between 00:00:00 UTC and 00:59:59 UTC, and so on. K is the number of trades in a particular hour. $V_{i,e,k}(j)$ is trade number k at second j, where j is within hour 0 (in our example, between 23:00:00 UTC and 23:59:59 UTC).

$V_{i,e}^0(t) = \sum_{k=1}^{K} V_{i,e,k}(j)$ for $j \in day\ 0$.

$V_{i,e}(t,j)$ refers to the exponentially smoothed volumes calculated from the previous 12 hours (as described above) which is used for calculations at second j for coin i on exchange e (if two seconds lay within the same hour, the value of $V_{i,e}(t,j)$ is the same for them). It is calculated as follows:

$$V_{i,e}(t,j) = \frac{\sum_{h=0}^{11} V_{i,e}^h(t) \cdot e^{-\alpha h}}{\sum_{h=0}^{11} e^{-\alpha h}}$$

where α is the coefficient inside the exponent giving more or less weight to the hour that is closest to the current moment in time, and the value is normalized. This

exponentially weighted volume is the volume-based weight used in calculating the weighted average price for each coin.