cfbenchmarks

CF Bitcoin Interest Rate Curve

IN ASSOCIATION WITH Chainlink

METHODOLOGY GUIDE

Version:

1.2

Version Date:

22-11-2022

Table of Contents

1 Version History

VERSION	DATE ISSUED	SUMMARY OF CHANGE	OWNER
v1.0	1st Aug 2022	N/A	CF Benchmarks Management
v1.1	11th Nov 2022	Change to Eq.1, Eq.3 and Eq.8 Removal of FTX	CF Benchmarks Management
v1.2	22nd Nov 2022	Change to Eq.1, Eq.3 and Eq.8 relating to Perp convergence adjustment range, USDT rate treatment and funding rate conversion	CF Benchmarks Management

2 Overview

The CF Bitcoin Interest Rate Curve is intended to measure the underlying economic reality of cryptocurrency borrowing and lending, whether outright or implied in traded instruments. This is accomplished by the use of transactional input data from Cryptocurrency Futures Exchanges, DeFi Lending Protocols and OTC Cryptocurrency Lenders.

All published individual interest rates that, as a whole, constitute the interest rate curve represent transparent indicators and build on our experience to accelerate the professionalisation of cryptocurrency trading and associated borrowing and lending activity.

Each point on the interest rate curve aims to be representative, replicable and efficient to facilitate the creation of financial products such as interest rate derivative contracts.

3 Definitions

API: Application programming interface.

Calculation Day: Any day for which a CF Interest Rate Curve is published. This means any day where a sufficient number of Contributing Exchanges / DeFi protocols are open for trading.

Contributing Exchange: A cryptocurrency trading venue to serve as pricing source for the calculation of a Futures Implied Rate.

Relevant Transaction: Any cryptocurrency related trade that occurs during the TWAP Period on a Contributing Exchange in the Relevant Pair that is reported through its API to the Calculation Agent.

Retrieval Time: One minute after the end of the TWAP Period on a given Calculation Day, as given by the server clock of the Calculation Agent.

TWAP Period: A period of time equal to the TWAP Period Length leading up to the Effective Time, as defined in Section 7.

4 Methodology

4.1 Methodology Overview

The CF Bitcoin Interest Rate Curve is constructed over a fixed set of tenors and a curve is fitted locally around each of the published tenors by way of linear interpolation between neighbouring data points. Tenors are categorised as Intraday, Short Term and Medium Term, where each category is informed by a predefined set of instruments, as shown in the following table:

Category	Relevant Tenors	Instruments
Session Interest Rate	Intraday	Perpetual Futures, DeFi Lending Protocols, OTC Lending
Short Term	1 - 3 Week	Fixed Maturity Futures, OTC Lending
	1 - 5 Month	
Medium Term	6 - 12 Month	Fixed Maturity Futures, OTC Lending

4.2 Session Interest Rate

4.2.1 Perpetual Futures

4.2.1.1 Implied Rate Calculation

Implied Rates from Perpetual Futures are representative of a daily carry trade whereby an economic agent sells the Perpetual Future and buys the Spot, and the position is closed once a specified daily convergence level is reached. The implied rates are calculated based on the Relevant Transactions of each Contributing Exchange individually. For every exchange separately, transaction data is observed during the TWAP Period and calculated at Effective Time. The perpetual futures implied rate per exchange is then calculated as follows on any given Calculation Day:

1. Divide all Relevant Transactions observed during the TWAP Period into equally sized partitions
2. For each partition separately, calculate a volume-weighted median implied rate (WM) from the implied rates and sizes of all Relevant Transactions observed on a

Contributing Exchange. A volume-weighted median differs from a standard median in that a weighting factor, in this case trade size, is factored into the calculation.

3. The final perpetual futures implied rate is then calculated as the equally-weighted average of the calculated WMs.

The mathematical representation of the calculation of the WM is as follows:

Symbol	Name	Description	Type
T_1	Effective time	The time as of which a Futures implied rate is calculated	Parameter: Section 7.3
τ	TWAP period length	The length of the time-period prior to the effective time during which transaction data is collected	Parameter: Section 7.3
$\hat{\tau}$ **with** $\hat{\tau} \leq \tau$ **and** $\hat{\tau} \mid \tau$	Partition length	The length of the time periods into which the TWAP period length is partitioned	Parameter: Section 7.3
K	Number of partitions	The number of partitions, given by $K = \tau/\hat{\tau}$	Output
k **with** $k \in (1, \ldots, K)$	Partition	The kth partition	Output
X_k **for** $k \in (1, \ldots, K)$	TWAP period trades	The price-ordered collection of price / size trade pairs observed in the kth partition, i.e. between times $T_1 - \tau + (k-1)$ and $T_1 - \tau + k$	Input
I_k	TWAP period trades count	The number of trades in the kth partition	Output
$x_{k,i}$ **with** $x_{k,i} = (p_{k,i}, s_{k,i})$ **and** $x_{k,i} \in X_k$	TWAP period trade	The ith price / size trade pair of the k th partition	Input
$p_{k,i}$	TWAP period trade price	The futures price of the ith price/size trade pair of the kth partition	Input
$p_{initial}$	Initial TWAP period trade price	The futures price as observed at the start of the TWAP period	Input
$s_{k,i}$	TWAP period trade size	The size of the ith price/size trade pair of $the\ kth\ partition$	Input

$BRTI_{k,i}$	Bitcoin Real Time Index (BRTI)	The price of the Bitcoin Real Time Index with corresponding timestamp that is closest to the timestamp of the ith price/size trade pair of the kth partition	Input
$USDTRTI_{initial}$	Initial USDT/USD Real Time Index	The price of the USDT/USD Real Time Index as observed at the start of the TWAP period	Input
$BSPOT_{k,i}$	Bitcoin Spot Rate	The Bitcoin Spot Rate as measured by $BRTI$ (in the case of CME data) and by the cross between $BRTI$ and $USDTRTI$ (in the case of all non-CME data)	Input
$BSPOT_{initial}$	Initial Bitcoin Spot Rate	The Bitcoin Spot Rate as measured by $BRTI$ (in the case of CME data) and by the cross between $BRTI$ and $USDTRTI$ (in the case of all non-CME data), as observed at the start of the TWAP period	Input
$r_{k,i}$	TWAP period trade price	The implied rate corresponding to the ith price/size trade pair of the kth partition	Input
CAF_C	Convergence Adjustment Factor	The expected level to which convergence takes place every day on a Contributing Exchange if $p_{k,i} > BRTI_{k,i}$. Calculated in percent.	Parameter: Section 7.1
CAF_B	Convergence Adjustment Factor	The expected level to which convergence takes place every day on a Contributing Exchange if $p_{k,i} < BRTI_{k,i}$. Calculated in percent.	Parameter: Section 7.1
FR	Funding Rates	The funding rates settled during the last 24 hour period. Calculated in percent, annualised.	Input
CT	Convergence Time	The expected amount of time it takes intraday for convergence to the CAF. Calculated in hours.	Parameter: Section 7.1
$AF_{k,i}$	Annualisation Factor	The annualisation factor for either the ith transaction of the kth partition	Output
$TUC_{k,i}$	Time Until Calculation	The time until T_1 for the relevant exchange for the ith transaction of the kth partition. Calculated in hours.	Input

$USDTIR_{d,T_1}$	USDT Interest Rate	The USDT Interest Rate for the (contract expiration) date d calculated at time T_1. For perpetual futures, d is the Session (ON).	Input: Section 4.5
WM_k	Weighted median	The weighted median implied rate of the kth partition	Output
FIR_{T_1}	FIR	The final Futures Implied Rate at time T_1, calculated using results from $FIR_{T_1,Sell}$ and $FIR_{T_1,Buy}$	Output

The Implied Rate r corresponding to the ith price in partition k is given by:

If $p_{k,i} > BSPOT_{k,i} \cdot (1 + CAF_C)$: $r_{k,i,Sell} = \left[\frac{p_{k,i} - BSPOT_{k,i} \cdot (1+CAF_C)}{p_{k,i}}\right] \bullet AF_{k,i}$ $r_{k,i,Buy} = \left[\frac{BSPOT_{k,i} \cdot (1+CAF_C) - p_{k,i}}{p_{k,i}}\right] \bullet AF_{k,i}$ If $p_{k,i} < BSPOT_{k,i} \cdot (1 + CAF_B)$: $r_{k,i,Sell} = \left[\frac{p_{k,i} - BSPOT_{k,i} \cdot (1+CAF_B)}{p_{k,i}}\right] \bullet AF_{k,i}$ $r_{k,i,Buy} = \left[\frac{BSPOT_{k,i} \cdot (1+CAF_B) - p_{k,i}}{p_{k,i}}\right] \bullet AF_{k,i}$ where $AF_{k,i} = \frac{24 \cdot 365}{(24+TUC_{k,i})}$ **Otherwise**: $r_{k,i,Sell} = r_{k,i,Buy} = 0\%$	**Eq. 1**

The above formulas are calculated based on the following conventions: simple compounding, UK Money Market day count fraction (ACT/365).

For each partition k, the volume-weighted median implied rate $WM_{k,Sell}$ across the Implied Rates $r_{k,i,Sell}$ and $WM_{k,Buy}$ across the Implied Rates $r_{k,i,Buy}$ are individually calculated from Relevant Transactions are calculated as:

$$WM_k = r_{k,j} \; where \; j \; satisfies \sum_{i=1}^{j-1} s_{k,i} < \frac{1}{2}\sum_{i=1}^{I_k} s_{k,i} \; and \sum_{i=j+1}^{I_k} s_{k,i} \leq \frac{1}{2}\sum_{i=1}^{I_k} s_{k,i}$$

$$If \; s_{k,1} \geq \frac{1}{2}\sum_{i=1}^{I_k} s_{k,i} \; then \; WM_k = r_{k,1}$$

$$If \sum_{i=j+1}^{I_k} s_{k,i} = \frac{1}{2}\sum_{i=1}^{I_k} s_{k,i}, \; then \; WM_k = \frac{r_{k,j} + r_{k,j+1}}{2}$$

Eq. 2

The Futures Implied Rate calculated per Contributing Exchange as of the Effective Time T_1 is then given by:

$$FIR_{T_1,Sell} = \frac{1}{K}\sum_{k=1}^{K} WM_{k,Sell} - \frac{BSPOT_{initial} \cdot [USDTIR_{d,T_1} - FR \cdot \frac{CT}{24}]}{p_{initial}}$$

$$FIR_{T_1,Buy} = \frac{1}{K}\sum_{k=1}^{K} WM_{k,Buy} - \frac{BSPOT_{initial} \cdot [USDTIR_{d,T_1} + FR \cdot \frac{CT}{24}]}{p_{initial}}$$

$$FIR_{T_1} = max\left[max\left[FIR_{T_1,Sell}, FIR_{T_1,Buy}\right], 0\right]$$

Eq. 3

A list of perpetual futures Contributing Exchanges and relevant tickers can be found in Section 7.1.

4.2.1.2 Final Perpetual Futures Implied Rate

The Futures Implied Rates from all Contributing Exchanges calculated in the previous steps are used to calculate the Final Perpetual Futures Implied Rate.

1. For each Contributing Exchange individually, the Futures Implied Rate across all Relevant Transactions is calculated.

2. For each Contributing Exchange, the absolute percentage deviation of the Futures Implied Rate, as calculated in the previous step, from the volume weighted median of the Futures Implied Rates of all Contributing Exchanges is calculated.

3. If for any Contributing Exchange the absolute percentage deviation, as calculated in the previous step, exceeds the Potentially Erroneous Data Parameter (see section 7.9)

then the Futures Implied Rate from the relevant Contributing Exchange is excluded in the next step.

The Final Perpetual Futures Implied Rate is then calculated as the volume weighted average of Futures Implied Rates across applicable Contributing Exchanges. The maximum percentage contribution of an individual Contributing Exchange to the Final Perpetual Futures Implied Rate is capped at the Futures Weight Cap (see section 7.11). Any excess weight allocation above the Futures Weight Cap for any individual Contributing Exchange will be distributed proportionally across uncapped weights of Constituent Exchanges. This process is repeated until all weights of Constituents Exchanges are at or below the Futures Weight Cap.

4.2.2 DeFi Lending/Borrowing Protocols

DeFi Lending and borrowing rates are calculated based on Relevant Transactions of the most used and liquid DeFi Lending/Borrowing Protocols. For every protocol separately, transaction data is observed during a 4 hour window between 12am and 4pm London Time. The DeFi Session Rate is then calculated using transaction data from all Contributing Protocols on any given Calculation Day.

4.2.2.1 Calculation Method

The calculation method for any protocol is as follows:

1. For each lending and borrowing rate rate type individually:
    a. Divide all relevant data points observed during the window length into K partitions of equal time length.
    b. Calculate the volume weighted median rate for each partition using the absolute variation of the volume inside the partition.
    c. If the protocol distributes proprietary tokens, the rate given by the token is added to the base rate of the protocol
    d. If the protocol has different types of rates (e.g.: stable, variable) the overall rate is calculated taking into consideration both the rates and the relative volumes
2. Compute the window lending and borrowing rate by calculating the average of the respective partition volume weighted median rates.

3. Compute the Aggregate Protocol Interest Rates per Contributing Protocol as the volume weighted average of variable and stable rates.

4. Compute the DeFi Session Rate by arithmetically averaging the arithmetic averages of all Aggregate Protocol Borrowing and Lending Rates.

The calculation of the volume weighted median follows the same formula as detailed in Eq 2. in section 4.2.1.1, with the following changes to the variable definitions:

Symbol	Name	Description	Type
T_1	Effective time	The time as of which a Protocol Interest Rate is calculated	Parameter: Section 7.4
τ	TWAP period length	The length of the time-period prior to the effective time during which transaction data is collected	Parameter: Section 7.4
$\hat{\tau}$ **with** $\hat{\tau} \leq \tau$ **and** $\hat{\tau} \mid \tau$	Partition length	The length of the time periods into which the TWAP period length is partitioned	Parameter: Section 7.4
$v_{k,i}$	Protocol aggregate borrowing/lending	The aggregate borrowing/lending in an interest rate protocol corresponding to the ith trade of the kth partition	Input
$s_{k,i}$	TWAP period lending/borrowing size	The size of the ith rate/size trade pair of the kth partition, calculated as $abs[v_{k,i} - v_{k,i-1}]$	Input
$r_{k,i}$	TWAP period net lending/borrrowing rate	The net transaction borrowing or lending interest rate corresponding to the ith rate/size trade pair of the kth partition. Calculated as per Eq.4	Output
$TDR_{k,i}$	Token Distribution Rate	The Distribution APY of the relevant Contributing Protocol (relevance defined in section 7.10)	Input
N	Number of DeFi Protocols	The number of DeFi Protocols included in the calculation (section 7.10)	
$BorrowAPY_{k,i}$	TWAP period borrow rate	The transaction borrowing interest rate corresponding to the ith rate/size trade pair of the kth partition.	Input

$SupplyAPY_{k,i}$	TWAP period lending rate	The transaction lending/supply interest rate corresponding to the ith rate/size trade pair of the kth partition.	Input
PIR_{T_1}	Protocol Interest Rate	The Protocol Interest Rate at time T_1	Output
$APIR_{B,T_1}$	Aggregate Protocol Borrowing Interest Rate	The Aggregate Protocol Borrowing Interest Rate at time T_1	Output
$APIR_{S,T_1}$	Aggregate Protocol Lending Interest Rate	The Aggregate Protocol Lending Interest Rate at time T_1	Output
$DFSR_{T_1}$	DeFi Session Rate	The DeFi Session Rate at time T_1	Output

Protocol Interest Rates are calculated separately for borrowing (PIR_{B,T_1}) based on the net borrowing rates ($r_{B,k,i}$) and lending (PIR_{L,T_1}) based on observed net lending rates ($r_{L,k,i}$). Protocol Interest Rates are calculated per Contributing Protocol (section 7.10) as of the Effective Time T_1 as follows:

$r_{B,k,i} = BorrowAPY_{k,i} - TDR_{k,i}$ $r_{L,k,i} = SupplyAPY_{k,i} + TDR_{k,i}$	**Eq. 4**
$PIR_{T_1} = \frac{1}{K}\sum_{k=1}^{K} WM_k$	**Eq. 5**

Protocol Interest Rates are calculated individually for both stable and variable borrowing and lending on any given Contributing Protocol (see section 7.10 for used types). The Aggregate Protocol Interest Rates for borrowing and lending are calculated based on volume weighted stable and variable Protocol Interest Rates per Contributing Protocol as follows:

$APIR_{T_1} = \frac{\left[PIR_{Stable,T_1} \bullet \sum_{i=2}^{I_{Stable}} (v_i - v_{i-1}) + PIR_{Variable,T_1} \bullet \sum_{i=2}^{I_{Variable}} (v_i - v_{i-1})\right]}{\sum_{i=2}^{I_{Stable}} (v_i - v_{i-1}) + \sum_{i=2}^{I_{Variable}} (v_i - v_{i-1})}$	**Eq. 6**

The DeFi Session Rate is then given by:

$$DFSR_{T_1} = \frac{1}{2}\left[\frac{1}{N}\sum_{n=1}^{N} APIR_{B,T_1,n} + \frac{1}{N}\sum_{n=1}^{N} APIR_{S,T_1,n}\right]$$ **Eq. 7**

4.2.3 OTC Lending Rates

OTC Lending Rates are collected via a panel survey (see section 7.8 for panel lenders). Panel lenders submit lending rates daily, showing their Bitcoin denominated rate for a 100 Bitcoin loan on a fully collateralized basis. Lending rates submitted by panel lenders are subject to the following data quality control process:

1. The highest and the lowest submitted lending rates are removed
2. For the remaining panel lending rates, if the absolute percentage deviation of a lending rate compared to the median rate of the remaining panel lending rates exceeds the Potentially Erroneous Data Parameter (see section 7.9), then that lending rate is removed
3. The final OTC Lending Rate is the median of the remaining lending rates.

4.2.4 SIRB

4.2.4.1 Calculation Source Weighting

The Session Interest Rate for Bitcoin (SIRB) is calculated by combining the rates calculated for the relevant instruments. The nominal weights are summarised in the following table and are reviewed quarterly:

Instrument	Nominal Weight
Perpetual Futures	70%
DeFi Lending	10%
OTC Lending	20%

The Nominal Weights are subject to an annual review factoring in liquidity data.

4.2.4.2 Publication

The Intraday Rate is published at 4.15pm London Time on any given Calculation Day, subject to Contingency Calculation Rules.

4.3 Short Term Rates

4.3.1 Fixed Maturity Futures

4.3.1.1 Implied Rate Calculation

Fixed Maturity Futures Implied Rates are calculated individually for each Relevant Tenor and Contributing Exchange based on the expiry dates of contracts traded on the respective exchange. The definitions and mathematical representation of the calculation of the individual Futures Implied Rates are congruent with section 4.2.1.1, with the exception that Eq. 1 is replaced with:

$$r_{c,k,i,Sell} = \left[\frac{p_{k,i} - BSPOT_{k,i}}{p_{k,i}}\right] \bullet AF_{k,i}$$

$$r_{c,k,i,Buy} = \left[\frac{BSPOT_{k,i} - p_{k,i}}{p_{k,i}}\right] \bullet AF_{k,i}$$

where

$$AF_{k,i} = \frac{24 \cdot 365}{24 \cdot ACT_c + TUC_{k,i}}$$

Eq. 8

with

Symbol	Name	Description	Type
c	Contract Expiry	Contract Expiry c	Input
ACT_c	Actual Days	The actual number of days to maturity for the relevant contract expiry c	Input

Furthermore, Fixed Maturity Futures do not have a funding rate mechanism, such that $FR = 0$ for Eq. 3.

The above formulas are calculated based on the following conventions: simple compounding, UK Money Market day count fraction (ACT/365).

The calculation results in a matrix of Future Implied Rates FIR for each Contributing Exchanges for all contract expiry dates available per Contributing Exchange on that Calculation Day. A list of Fixed Maturity Futures Contributing Exchanges and relevant tickers can be found in Section 7.2.

4.3.1.2 Fixed Maturity Futures Implied Rate

The implied rates per contract expiry date calculated for each Contributing Exchange in the previous step are further processed as follows on a per tenor basis:

1. For each Contributing Exchange individually, the Futures Implied Rate across all Relevant Transactions for the Relevant Tenor is calculated.

2. For each Contributing Exchange, the absolute percentage deviation of the Futures Implied Rate, as calculated in the previous step, from the volume weighted median of the Futures Implied Rates of all Contributing Exchanges for that tenor is calculated.

3. If for any Contributing Exchange the absolute percentage deviation, as calculated in the previous step, exceeds the Potentially Erroneous Data Parameter (see section 7.9) then the Futures Implied Rate for that tenor from the relevant Contributing Exchange is excluded in the next step.

The Fixed Maturity Futures Implied Rate per contract expiry date is then calculated as the volume weighted average of implied rates across Contributing Exchanges. The maximum percentage contribution of an individual Contributing Exchange to a Fixed Maturity Futures Implied Rate is capped at the Futures Weight Cap (see section 7.11). Any excess weight allocation above the Futures Weight Cap for any individual Contributing Exchange will be distributed proportionally across uncapped weights of Constituent Exchanges. This process is repeated until all weights of Constituents Exchanges are at or below the Futures Weight Cap.

4.3.1.3 Fixed Maturity Futures Implied Rate Interpolation

Implied Rates for different expiration dates are, where necessary, interpolated linearly to fit the Relevant Tenors defined in Section 4.1. The Fixed Maturity Futures Implied Rate per contract expiry date calculated in the previous step are interpolated to yield the final fixed maturity futures implied rate curve. The linear interpolation is calculated only using Implied Rates from the two expiry dates directly neighbouring the Relevant Tenor (one expiring before

and another expiring after the Relevant Tenor). If a Relevant Tenor does not have two directly neighbouring expiry dates - either because the relevant contract is not available for trading or because no Futures Implied Rate was calculated following the Contingency Calculation Rules - no Futures Implied Rate is calculated for the Relevant Tenor on the relevant calculation day.

The definition of number of days associated with the Relevant Tenors for interpolation purposes can be found in Section 7.5 and is based on UK Money Market (ACT/365) convention.

4.3.2 OTC Lending Rates

See section 4.2.3.

4.3.3 Final Short Term Rates

4.3.3.1 Calculation Source Weighting

The Short Term Rates are calculated by combining the rates calculated for the relevant instruments. The nominal weights are summarised in the following table and are reviewed quarterly:

	Nominal Weight	
Tenor	Fixed Maturity Futures	OTC Lending
1 – 3 Week	50%	50%
1 Month	50%	50%
2 Month	50%	50%
3 Month	50%	50%
4 Month	50%	50%
5 Month	50%	50%

4.3.3.2 Publication

The Short Term Rates are published for all Relevant Tenors at 4.15pm London Time on any given Calculation Day, subject to Contingency Calculation Rules.

4.4 Medium Term Rates

Medium Term Rates are currently not in scope of this methodology due to lack of available liquid input sources.

4.5 USDT Interest Rate Curve

The USDT Interest Rate Curve is constructed on a daily basis at 4pm London Time based on the data sources specified in section 7.6. If on any calculation day there is no input data available for a specific tenor on the Short Term or Medium Term segment of the USDT interest rate curve, the applicable interest rate for that tenor will be calculated as a spread to the corresponding tenor of the US Dollar Interest Rate Curve (see section 7.7 for sources). The spread will be calculated as the difference between the interest rate for the relevant tenor on the US Dollar Interest Rate Curve and the corresponding rate from the USDT Interest Rate Curve that was successfully calculated using the largest recorded volume from all available tenors of the USDT Interest Rate Curve.

5 Contingency Calculation Rules

5.1 Delayed or Missing Data

Delayed data and missing data are treated according to the following rules:

1. Any Relevant Transaction for a given Calculation Day that is not available from a Contributing Exchange's or DeFi Protocol's API by the Retrieval Time is disregarded in the calculation of the Interest Rate Curve for that Calculation Day.

2. If no Relevant Transaction occurs on a Constituent Exchange or DeFi Protocol on a given Calculation Day or one or more Relevant Transactions occur but for any reason cannot be retrieved by the Calculation Agent, the Contributing Exchange or DeFi Protocol is disregarded in the calculation of the Interest Rate Curve for that Calculation Day.

3. If, for any of the partitions K, no Relevant Transaction occurs for any Contributing Exchange or DeFi Protocol or one or more Relevant Transactions occur but for any reason cannot be retrieved by the Calculation Agent, the partition remains empty and will be disregarded in the calculation of the Interest Rate Curve for that Calculation Day. The denominator in Eq. 3 will then be decremented by the number of empty partitions

4. If there are no viable futures exchanges due to potentially erroneous data exclusion, then the following procedure applies:

    a. Calculate the volume weighted average of all Future Implied Rates across Contributing Exchanges

    b. If this volume weighted average is within the range [-5%,+5%] relative to the volume weighted average of 1) OTC and 2) DeFi Rates, then include Futures as input source and calculate SIRB / Short Term Rates with usual weights (as per sections 4.2.4.1 and 4.3.3.1)

    c. If the volume weighted average is not within the applicable range, Final Futures Implied Rates are removed from the final rate calculation and new weights apply (66.67%OTC/33.33%DeFi for SIRB, 100% OTC for Short Term Rates)

5.2 Erroneous Data

All Relevant Transactions retrieved by the Calculation Agent for a given Calculation Day are subject to an automated screening for erroneous data according to the following rules:

1. If a Relevant Transaction shows a non-numeric or non-positive trade size, it is flagged as erroneous.
2. If a Relevant Transaction is reported in a format that deviates from the expected format such that it cannot be parsed, it is flagged as erroneous.

All Relevant Transactions flagged as erroneous for a given Calculation Day are disregarded in the calculation of the Interest Rate Curve, on that Calculation Day.

5.3 Delayed Calculation & Publication

Where for any reason the Administrator is not able to calculate and publish the index within the Publication Time on any given Calculation Day then the Administrator shall publish a notification on its website at blog.cfbenchmarks.com informing index users that calculation and publication has been delayed. The Administrator will seek to publish the index for that Calculation Day as soon as it is able to. Should the Administrator not be able to calculate and publish the index by 23:59:59 London time then the provisions of Rule 5.6 shall come into effect.

5.4 Expert Judgement

The Administrator does not utilise expert judgement in the day-to-day calculation of the Index. In extraordinary circumstances Expert Judgement may be exercised by the Administrator in accordance with its codified policies and processes which are available upon request.

5.5 Calculation Failure

If any tenor on the interest rate curve cannot be calculated for a given Calculation Day before 23:59:59 London time, for instance because:

- no Relevant Transaction occurs from any input source related to that tenor on that Calculation Day, or
- sufficient Relevant Transactions occur but for any reason cannot be retrieved from the relevant input sources, or
- all Relevant Transactions retrieved by the Administrator are flagged as erroneous or potentially erroneous (see Section 5.2); or any other reason or circumstance that prevents the orderly calculation of the index

then the interest rate related to that tenor for that Calculation Day undergoes Calculation Failure and NO value is published for that day, subject to Restatement & Republishing Rules.

The occurrence of a calculation failure of the index is reported to the CF Oversight Function and announced at blog.cfbenchmarks.com

6 Restatement & Republishing

The Administrator may restate and republish the interest rate curve values where the published values are found to be incorrect. This will only occur if both the below conditions are met:

1. **Timeliness** – where the Administrator can **RESTATE** and **REPUBLISH** the index value before the publication of the index value for the next Calculation Day
2. **Materiality** – where the **RESTATED** Index value has an absolute variance greater than **0.20%** for the Index for the given Calculation Day

Example:

- The 3 month interest rate on a given Calculation Day is published as 5%
- The index will only be **RESTATED** if it is:
    - Greater than **5.20%**

      OR
    - Less than **4.80%**

Where the above conditions are met the Administrator shall announce on its website that a restatement and republishing of the Interest Rate Curve will take place for that Calculation Day.

The Administrator shall restate the Interest Rate Curve as soon as possible and shall do so by overwriting the previously published Interest Rate Curve. This restated Interest Rate Curve will carry no mark when published and will be final and not subject to any further change or republication.

7 Parameters

7.1 Perpetual Futures Contributing Exchanges

Contributing Exchanges	Relevant Tickers	Funding Rate Settlement Interval	CT	CAF_B	CAF_C
Binance Futures	BTCUSDT	00:00 UTC; 08:00 UTC and 16:00 UTC	24hr	-0.02%	0.02%
Bitmex	XBTUSDT	04:00 UTC, 12:00 UTC, and 20:00 UTC	24hr	-0.02%	0.02%
OKX	BTC-USDT-SWAP	00:00 UTC; 08:00 UTC and 16:00 UTC	24hr	-0.02%	0.02%
Bybit	BTCUSDT	00:00 UTC; 08:00 UTC and 16:00 UTC	24hr	-0.02%	0.02%

7.2 Fixed Maturity Futures Contributing Exchanges

Contributing Exchanges	Relevant Tickers
OKX	BTC-USDT-{expirydate}
Binance Futures	BTCUSDT_{expirydate}
Bitmex	XBTUSDT{expirysymbol}
CME	BTC{expirysymbol}{expiryyear}

7.3 Parameters for the Futures Implied Rates Calculation

	Fixed Maturity Futures Implied Rate	Perpetual Futures Implied Rate
Effective Time T_1	4:00 p.m. London Time	4:00 p.m. London Time

TWAP Period Length (τ)	60 minutes	60 minutes
TWAP Period	3:00pm to 4:00 pm London time	
Partition Length ($\hat{\tau}$)	10 minutes	10 minutes
Number of Partitions (K)	6	6

7.4 Parameters for DeFi Rates Calculation

	DeFi Borrowing/Lending
Effective Time T_1	4:00 p.m. London Time
TWAP Period Length (τ)	240 minutes
TWAP Period	12:00am to 4:00 pm London time
Partition Length ($\hat{\tau}$)	30 minutes
Number of Partitions (K)	8

7.5 Actual days ACT associated with Relevant Tenors (UK MM convention)

Tenor	ACT
1 Week	7.01923
2 Week	14.03846
3 Week	21.05769
1 month	30.41667
2 month	60.83333
3 month	91.25000
4 month	121.66667
5 month	152.08333
6 month	182.50000
7 month	212.91667
8 month	243.33333
9 month	273.75000
10 month	304.16667

11 month	334.58333
12 month	365.00000

7.6 USDT Interest Rate Curve Sources

Curve Segment	Data Sources	Applicable Sections in Methodology
SIR	DeFi	4.2.2 & 4.2.4
	OTC	4.2.3 & 4.2.4
Short Term Rates	OTC	4.3.2

7.7 US Dollar Interest Rate Curve

Curve Segment	Data	Data Source
SIR	Secured Overnight Financing Rate (SOFR), published 8am ET	https://www.newyorkfed.org/markets/reference-rates/sofr
1 week - 3 week	Linear interpolation between SOFR and Daily Treasury Par Yield Curve	
1 month - 5 month	Daily Treasury Par Yield Curve Rates, published at 3.30pm ET 4 month and 5 month rates are linearly interpolated between 3m and 6m tenors.	https://home.treasury.gov/resource-center/data-chart-center/interest-rates/TextView?type=daily_treasury_yield_curve&field_tdr_date_value=2022

7.8 OTC Lending Panel

Panellists as of 1 August 2022
TBD
TBD
TBD

TBD

7.9 Potentially Erroneous Data Parameters

Data Input	Parameter
Perpetual Futures Implied Rate	5%
Fixed Maturity Futures Implied Rate	5%
OTC Lending Rates	5%

7.10 Contributing DeFi Protocols

Contributing Protocol	Borrow (Stable)	Borrow (Variable)	Lend (Stable)	Lend (Variable)	Token Distribution
Aave	Yes	Yes	No	Yes	No
Compound	Yes	No	No	Yes	Yes

7.11 Futures Exchange Weight Caps

Source	Futures Weight Cap
Term Futures	40%
Perpetual Futures	40%

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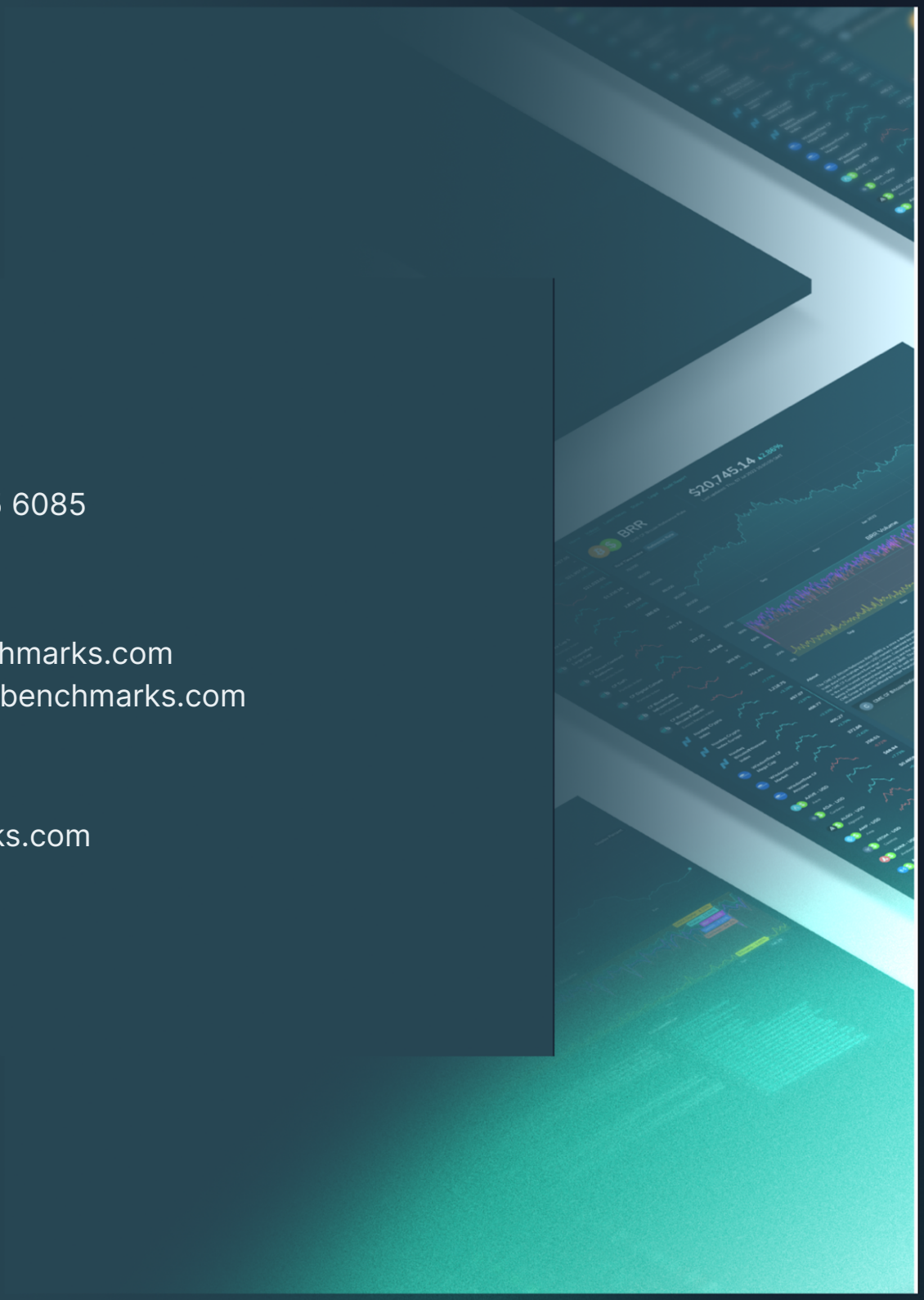

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