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CME Term SOFR Reference Rates Benchmark Methodology

CME Group Benchmark Administration Limited

Version 1.5

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Version Control

VERSION	KEY CHANGES	APPROVAL DATE
1.0	• Initial version	October 30th, 2020
1.1	• Defining approach for early market close days • Update pre-publication reliability checks	March 18th, 2021
1.2	• Addition of 12-month tenor	September 10th, 2021
1.3	• Updates to Eligibility of SOFR OIS	October 15th, 2021
1.3.1	• Minor update to Error Policy	December 14th, 2021
1.4	• Early Close Calendar 2023 added	May 6th, 2022
1.4.1	• Minor clarifications	October 31st, 2022
1.4.2	• Early Close Calendar 2024 added	January 20th, 2023
1.4.3	• Annual Review • Minor clarifications	June 27th, 2023
1.4.4	• Annual Review • Updates to Publication and Error Policy	April 18th, 2024
1.4.5	• Expert Judgment • January 9, 2025 Early Close Addition	January 3rd, 2025
1.4.6	• New Complaints Policy	February 20th, 2025
1.5	• Changes to the Oversight Function	November 13th, 2025

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1. Introduction

The Secured Overnight Financing Rate (SOFR) is calculated and published by the Federal Reserve Bank of New York[1] (NY Fed) and was selected as the preferred overnight reference rate for U.S. Dollar financial contracts by the Alternative Reference Rates Committee (ARRC). CME Term SOFR Reference Rates Benchmarks provide the forward-looking measurement of overnight SOFR based on market expectations implied from derivatives markets.

Each Business Day, the NY Fed publishes SOFR on the NY Fed website at approximately 8:00 a.m. ET. In addition to the daily SOFR rate, and in collaboration with the Treasury Department's Office of Financial Research, the NY Fed publishes three daily compounded averages of SOFR and a SOFR Index:

- SOFR Index
- 30-day Average SOFR
- 90-day Average SOFR
- 180-day Average SOFR

1.1. CME Group and CME Group Benchmark Administration Limited

As a leading and diverse derivatives market operator, CME Group is the parent of four U.S.-based designated contract markets (DCMs): Chicago Mercantile Exchange Inc. (CME), Board of Trade of the City of Chicago, Inc. (CBOT), New York Mercantile Exchange, Inc. (NYMEX), and the Commodity Exchange, Inc. (COMEX) (collectively, the "CME Group Exchanges"). These exchanges offer a wide range of products available across all major asset classes, including futures and options based on interest rates, equity indexes, foreign exchange, energy, metals, and agricultural commodities.

CME Group Benchmark Administration Limited (CBA) capitalizes on CME Group's wealth of electronic transaction-based data in the calculation of its indices and benchmarks. CBA is authorized and regulated by the UK Financial Conduct Authority (FCA), for the administration of the CME Term SOFR Reference Rates. The CME Term SOFR Reference Rates is a benchmark under the UK Benchmark Regulation (BMR)[2].

CBA is the Benchmark Administrator of the CME Term SOFR Reference Rates, with Chicago Mercantile Exchange Inc. (CME Inc.) providing calculation agent and distribution services.

Since 1981, CME Group has been positioned at the forefront of Money Market Interest Rates' product innovation, currently offering One-month and Three-month future contracts referencing SOFR[3].

CME SOFR Futures contracts are listed in consecutive monthly and quarterly contracts reflecting SOFR expectations, with contract expiries extending out to 10 years and providing a term structure to fulfil risk management needs.

[1] *Federal Reserve Bank of New York SOFR Data*
[2] https://www.fca.org.uk/markets/benchmarks/regulation
[3] *Secured Overnight Financing Rate (SOFR) Futures*

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2. CME Term SOFR Reference Rates Benchmarks

The CME Term SOFR Reference Rates benchmark is a daily set of forward looking interest rate estimates, calculated and published for 1-month, 3-month, 6-month and 12-month tenors. Each CME Term SOFR Reference Rates tenor will start on (and include) the second US Government Securities Business Day following the publication day and span the corresponding tenor (e.g., 1-month, 3-month, 6-month, 12-month) in accordance with Modified Following day-count conventions.

The CME Term SOFR Reference Rates calculation method leverages the work developed by Federal Reserve economists, Erik Heitfield and Yang-Ho Park, and published in the Finance and Economic Discussion Series (FEDS) 2019-014[4].

The work of Heitfield and Park lays out a method to determine a possible path of overnight rates that is consistent with the observable averages implied by SOFR based derivative contracts. Upon determining a path of overnight rates one can directly create averages over standard tenors. These will be published as CME Term SOFR Reference Rates.

The publication of CME Term SOFR Reference Rates will occur on the next Business Day following the Business Day during which futures data sampling takes place. CME Term SOFR Reference Rates are computed based on a reference period that begins two Business Days (T+2) after the Publication Date.

CME Term SOFR Reference Rates will be calculated for each Business Day, in accordance with the recommended SIFMA US Holiday Schedule[5].

CBA is the Benchmark Administrator with CME Inc. providing calculation agent and distribution services. This document describes the methodology used by CBA to calculate the CME Term SOFR Reference Rates.

[4] *Inferring Term Rates from SOFR Futures Prices," Finance and Economics Discussion Series 2019-014*

[5] *https://www.sifma.org/resources/general/holiday-schedule/*

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3. Input Data

CME Term SOFR Reference Rates Methodology uses a combination of one month and three month SOFR Futures to ensure that the term structure is appropriately calculated, providing as many data points as possible.

3.1. Use of Expert Judgement

Expert judgement is not used in the ordinary day to day determination of CME Term SOFR Reference Rates.The benchmark calculation methodology is rules-based and designed to consistently produce robust and reliable values which do not rely on expert judgement. However, CBA, in its capacity as Administrator of the CME Term SOFR Reference Rates, may exercise such expert judgement in unforeseen and extraordinary circumstances when deemed necessary to maintain the integrity, accuracy and reliability of the benchmark. These circumstances can include, but are not limited to: index restatements, periods of market stress or disruptions, or periods where data sources may be absent or become unreliable. Where such circumstances arise, a notice will be published on the CBA Notice Page.

The elements of the calculation of the benchmark in relation to which expert judgement may be exercised, can include, but are not restricted to, the following: (i) excluding certain input data from the calculation; (ii) adjusting/varying any component of the benchmark calculation; or (iii) delaying/estimating the value of input data.

Any exercise of expert judgement by the Administrator can only be carried out by suitably experienced, qualified staff members who have the authority to exercise such judgement as part of their function. The exercise of expert judgement by the Administrator will be reported to the BMR Joint Oversight Committee and the CME Term SOFR Product Advisory Committee (together the Oversight Committees) to ensure that it has been applied consistently and in accordance with the applicable benchmark administration standards and benchmark methodology. The Administrator will retain all internal records detailing the use of expert judgement and the rationale for its use to allow for any ex-post review.

4. Calculating Term Rates from SOFR Futures

As described in Computing Term Rates from Projected Overnight Rates, CME Term SOFR Reference Rates are estimated for 1-month, 3-month, 6-month and 12-month tenors.

To ensure full coverage of the above tenors, the calculation algorithm uses the following Future contract months:

- One-month SOFR Futures (SR1): 13 (thirteen) consecutive months contracts
- Three-month SOFR Futures (SR3): 5 (five) consecutive quarterly contracts (Mar, Jun, Sept, Dec).

Futures contracts are rolled according to CME Term SOFR Reference Rates Benchmarks, the day after the respective expiry day.

SR1 and SR3 sampling market hours are 7:00am CT until 2:00pm CT, sub-divided into 14 (fourteen) observation intervals of 30 (thirty) minutes each.

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For SR1 and SR3 contracts that meet the criteria above, it is necessary to include the known historical SOFR overnight rates into the calculation in order to determine the implied average value of unknown SOFR rates for the remainder of such contract; compounded returns are expressed as Actual/360.

4.1. SOFR Futures Contract Specifications

There are two variations of the SOFR Futures product set, both reference the same underlying interest rate while providing comprehensive coverage of the yield curve including more granularity in the nearby months.

One-Month SOFR Futures (SR1) is a monthly contract that follows a calendar month schedule.

Final settlement price is determined by the formula 100-R, where R represents the annualized rate of interest calculated as a simple average of individual rates applied to all days in the month.

An overnight rate is assigned to every day in the contract month (SOFR values are published on the next good Business Day after transaction date); weekends and holidays are assigned the prevailing rate from the last preceding day for which a rate was published.

To calculate the final settlement of a one-month SOFR Future, the simple arithmetic average of the daily SOFR rates of the calendar month is calculated (i.e. the sum of all rates in the month period divided by the number of calendar days in the month period). The arithmetic average is rounded to the nearest 1/10th of a basis point, and the contract Final Settlement Price is equal to 100-the rounded arithmetic average.

Three-Month SOFR Futures (SR3) is a quarterly contract that follows the IMM schedule.

The final settlement price of an expiring SR3 contract is based on SOFR benchmark values for all US government securities market Business Days occurring within the contract reference quarter.

A contract reference quarter starts on (and includes) the third Wednesday of its contract name identification month (SR3M0 begins on June 17, 2020) and ends on (and not including) the third Wednesday of the next quarterly month (SR3M0 ends on Sept 16, 2020).

Final settlement price is determined by the formula 100-R where R represents the annualized rate of interest derived from compounding of all SOFR benchmark settings during the reference quarter, rounded to the nearest 1/100th of a basis point. Simple interest is accrued to all non-Business Days in the reference quarter (weekends and holidays) based on the SOFR benchmark from the preceding good Business Day.

Then all Business Days' interest is compounded. The resulting rate is represented as an annualized interest rate using money market day count convention (Actual/360).

CME SOFR Futures Contract Specifications and settlement methodologies are available on the CME Group website.

4.2. Sampling Market Prices

CME Term SOFR Reference Rates use executed transactions and executable bids and offers in SOFR Futures, traded on the CME Designated Contract Market (DCM)[6], with contract specifications detailed in SOFR Futures Contract Specifications.

[6] CME Group Designated Contract Markets are subject to regulation by the US Commodity Futures Trading Commission ("CFTC"). In addition, CME Group Designated Contract Markets are subject to the rules and regulations of the local jurisdictions in which they conduct business, including the European Securities and Markets Authority ("ESMA") and the UK Financial Conduct Authority ("FCA").

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A set of Volume Weighted Average Prices (VWAP) are calculated using transaction prices observed during an observation interval, along with a snapshot of executable bid/ask prices at a random moment during the observation interval.

Candidate solution sets are identified using trade activity in outright contracts during the interval. First a set of seed values is determined on a VWAP or, where there are no transactions occurring in a given interval, the midpoint of the bid/ask.. A candidate solution price is one within 5 increments of the seed value, with the increment being 0.01 basis points.

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Exhibit 1: Example Selected Prices derived from the VWAP while staying within Bid/Ask constraints

	BID	ASK	VWAP	SELECTED PRICE
MAY	5.0	5.25	5.22	5.22
JUN	4.5	5.0	4.85	4.85
JUL	3.5	4.0	3.50	3.5
AUG	2.0	2.5	2.54	2.5
SEP	1.5	2.5	2.5	2.5
OCT	0.5	1.5	1.64	1.5
NOV	0.5	1.0	0.85	0.85

4.2.1. Linear Optimization

For the first 7 SR1 contracts and the 5 SR3 contracts; an algorithm selects the price among the candidates, applying linear optimization to find a "best fit" set of values that minimize violations of the bid/ask quotations in outright markets, calendar spread markets and butterfly markets. The algorithm locates the set of relevant SOFR futures contract prices that accommodates the maximum number of bids and asks in these instruments. It then selects the "optimum" as the candidate solution set that, in aggregate, is closest to the VWAP seed values, weighted so as to give higher priority to futures contracts nearer to expiration.

For a given candidate solution set, the score for the candidate solution is the sum of the squared differences between each contract's price in the solution set and the VWAP price. The same calculation is repeated for each candidate solution set. The candidate solution set with the lowest aggregate score is selected as the "optimal" solution.

4.2.2. Boundary Conditions

For the 8th to 13th SR1 contacts; bid/ask quotations in outright markets, calendar spread markets and butterfly markets are used to construct an upper and lower bound for each SR1 contract. Where the VWAP seed value is within the boundaries, the seed value becomes the selected price. Where the VWAP seed value is outside of the boundaries, the closest of the upper or lower bound to the VWAP seed value is used for the selected price.

4.3. Defining Observation Intervals

The CME Term SOFR Reference Rates Benchmarks use observation intervals configured, in duration and number, to provide as many meaningful VWAP solutions as possible.

The duration of each observation interval is set at 30 minutes, covering in total 14 daily observation intervals, between the hours of 7:00am CT to 2:00pm CT.

On days where there is an early market close (in accordance with the SIFMA US Holiday Schedule), the 30 minute observation intervals will cover a reduced portion of the day, see Appendix II for further details. Appendix II will be updated by the Administrator.

During each interval, snapshots of executable Bid/Offer quotes are taken at a randomized point, ensuring that consecutive snapshots are not too proximate in time (i.e. at the end of one interval and at the beginning of the subsequent interval).

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4.4. Eligible Observation Intervals

Each observation interval is eligible for the final calculation if it has executed transactions in any of the SOFR Futures contracts.

For each SOFR Future contract, a VWAP of transactions executed during the interval is calculated and optimized, as described in Sampling Market Prices; the resulting VWAP becomes the Selected Price for that SOFR Future contract, for the observation interval.

For SOFR Future contracts with no executed transactions, but with executable Bid/Offer quotes, the mid-price of the random Bid/Offer snapshot is optimized, as described in Sampling Market Prices; and becomes the Selected Price for that SOFR Future contract, for the observation interval.

For SOFR Future contracts with no VWAP and no executable Bid/Offer quotes, the previous interval Selected Price is adjusted by the net change of the preceding contract's price. This value is optimized, as described in Sampling Market Prices; and becomes the Selected Price for that SOFR Future contract, for the observation interval.

The Selected Prices, formed as above, are aggregated and used for the final calculation on a volume weighted basis of the eligible observation intervals.

Only one interval is required for the final calculation. If all intervals have no executed transactions, the previous day's Aggregated Prices, as described in Aggregating the Intervals, will be re-applied to the final calculation.

4.5. Aggregating the Intervals

Once a solution is found for each observation interval, the final result will be calculated by averaging the values at each futures contract, weighted by the aggregate volume of trade during the observation interval from which they were derived.

This calculation can be illustrated by the formula:

$$P(Final) = \left(\sum P(Observation\ Interval) * \frac{Volume\ of\ all\ Contracts\ (Observation\ Interval)}{Volume\ of\ all\ Contracts\ (\ All\ Observation\ Intervals)}\right)$$

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5. Modelling Forward Rates

As mentioned in CME Term SOFR Reference Rate Benchmarks, the work of Heitfield and Park is leveraged in calculation of CME Term SOFR Reference Rates. Though overnight SOFR rates are not directly observable, as suggested in the paper and as utilized by various market participants for other overnight indexes, CME determines the path of overnight SOFR rates by assuming the overnight SOFR rates follow a piecewise constant step function and can only jump up or down the day after FOMC Policy Rate announcement dates and remains at those levels across all dates in between the FOMC Policy Rate announcement dates.

CME One-month SOFR Futures[7] (SR1) and CME Three-month SOFR Futures[8] (SR3) contracts provide estimates of values of overnight SOFR on average over the specific contract reference periods; CME SOFR Futures do not directly provide estimates of individual overnight SOFR rates.

The optimal path for the overnight SOFR rates is determined such that the implied value of selected SR1 and SR3 contracts under the optimal path matches the observed prices (determined from the sections below) as closely as possible. Final term rates will be constructed by compounding overnight SOFR rates following specific conventions.

Details of the algorithm are highlighted in the sections below.

5.1. Calculation Methodology

Supposing that the as of date for CME Term SOFR Reference Rate is t_0 and t represents a day after t_0 that is a Business Day (in accordance with the SIFMA US Holiday Schedule), the following notations are used for the calculation of projected overnight SOFR rates:

M_k: the date of the k th FOMC policy rate announcement date that occurs on or after t_0;

θ_0: the initial overnight SOFR rate as of date t_0;

θ_k: the jump size in overnight SOFR rate occurs on the day after the k-th FOMC policy rate announcement date. A positive θ_k means the overnight SOFR rate jumps up after the k-th FOMC policy rate announcement date M_k; a negative means the overnight SOFR rate jumps down after the k-th FOMC policy rate announcement date M_k;

$f_{t;\theta}$: the overnight SOFR rate as of date t, where $\Theta = (\theta_0, ..., \theta_k)$ and K is the index of the last relevant FOMC policy rate announcement date;

$1\{\cdot\}$: binary function returning 1 if the statement in the parenthesis is true and 0 otherwise.

The overnight SOFR rate for date t can be computed as:

[7] *One-Month SOFR Futures Contract Specs*
[8] *Three-Month SOFR Futures Contract Specs*

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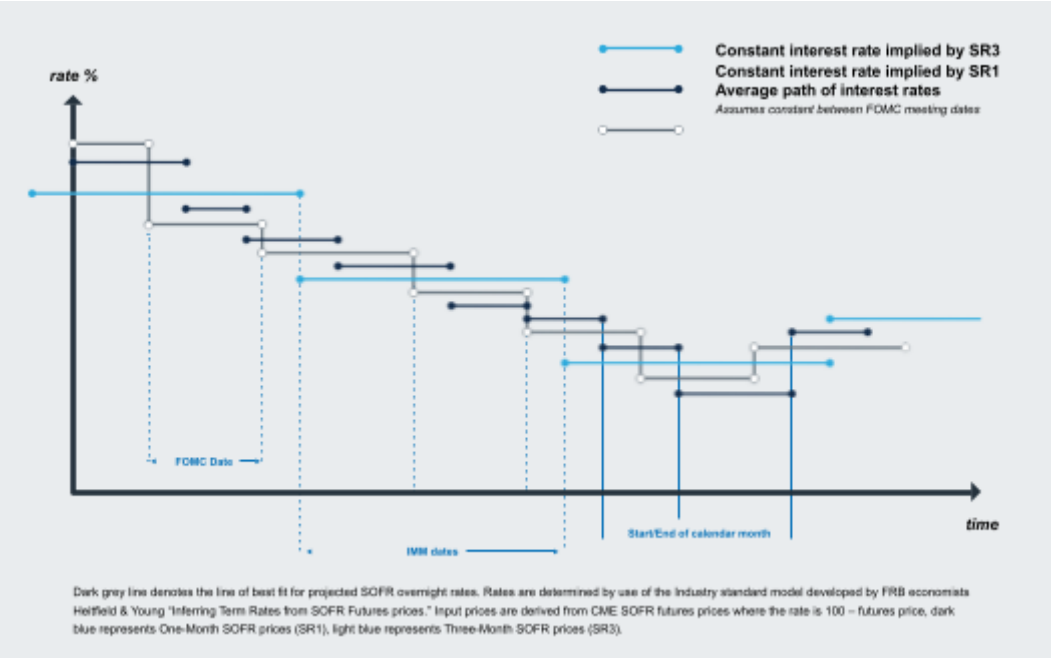
$$f(t;\ \Theta) = \theta_0 + \sum_k \theta_k * 1\{t > M_k\}$$

CME is solving for the unknown parameter set $\Theta = (\theta_0, ..., \theta_k)$ such that the projected path of overnight SOFR rates results in the smallest mismatches for SR1 and SR3 prices as determined from the sections below.

The example in ***Graph 1***, illustrates the piecewise constant step function followed by the overnight SOFR rates and the corresponding average overnight SOFR rates implied by each SR1 and SR3 contract.

Graph 1



Dark grey line denotes the line of best fit for projected SOFR overnight rates. Rates are determined by use of the industry standard model developed by FRB economists Heitfield & Young "Inferring Term Rates from SOFR Futures prices." Input prices are derived from CME SOFR futures prices where the rate is 100 – futures price, dark blue represents One-Month SOFR prices (SR1), light blue represents Three-Month SOFR prices (SR3).

5.2. Optimization

In order to determine the optimal path for the overnight SOFR rates, CME implemented the Broyden-Fletcher-Goldfarb-Shanno algorithm that solves for the unknown parameter set $\Theta = (\theta_0, ..., \theta_k)$ and utilizes 13 SR1 and 5 SR3 contracts to cover the SOFR term rates computation period up to 12-month tenor.

The optimization function is designed to solve the following minimization problem:

$$min_\Theta \left\{ \left[\sum_{m=0}^{12} w_m^1 \times \left(P_m^1 - \hat{P}_m^1(\Theta) \right)^2 + \sum_{q=0}^{4} w_q^3 \times \left(P_q^3 - \hat{P}_q^3(\Theta) \right)^2 \right]^{\frac{1}{2}} + \lambda \times \left[\sum_k \left(\theta_k \right)^2 \right]^{\frac{1}{2}} \right\}$$

Where:

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- P_m^1 and P_q^3: the observed blended prices of SR1 and SR3 contract with reference month m and reference quarter q, respectively;
- $\hat{P}_m^1(\Theta)$ and $\hat{P}_q^3(\Theta)$: the implied value of SR1 and SR3 contract with reference month m and reference quarter q, respectively;
- w_m^1 and w_q^3: weighting parameters for pricing errors of SR1 and SR3 with reference month m and reference quarter q, respectively;
- λ: weighting parameter for penalty function. $\lambda = \frac{0.1}{\sqrt{K}}$ where K is the number of scheduled FOMC meetings in the period.

For SR1 contracts, whose reference month is not the current month ($m > 0$), the implied value only depends on projected overnight SOFR rates:

$$\hat{P}_m^1(\Theta) = 100 \times \left(1 - \frac{1}{N_m^1} \sum_{t \epsilon T_m^1} f(t;\Theta)\right)$$

Where:

- T_m^1: set of calendar days for the m-th month;
- N_m^1: total number of calendar days in m-th month.

For the SR1 contract, whose reference month is the current month ($m = 0$), the implied value can be calculated using published SOFR fixings and projected overnight SOFR rates:

$$\hat{P}_0^1(\Theta) = 100 \times \left[1 - \frac{1}{N_0^1}\left(\sum_{t \epsilon T_0^{1-}} r_t + \sum_{t \epsilon T_0^{1+}} f(t;\Theta)\right)\right]$$

Where:

- $T_0^{1+} = \{t \epsilon T_0^1 | t \geq t_0\}$;
- $T_0^{1-} = \{t \epsilon T_0^1 | t < t_0\}$;
- r_t: published SOFR fixing for date t.

For SR3 contracts, whose reference quarter is not the current quarter ($q > 0$), the implied value only depends on projected overnight SOFR rates:

$$\hat{P}_q^3(\Theta) = 100 \times \left[1 - \frac{360}{N_q^3}\left(\prod_{t \epsilon T_q^3} \left(1 + \frac{f(t;\Theta) \times d_t}{360}\right) - 1\right)\right]$$

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Where:

- T_q^3: set of Business Days for the q-th quarter;
- N_q^3: total number of calendar days in q-th quarter;
- d_t: the number of calendar days from date t to its next Business Day following the SIFMA US Holiday Schedule[9], if the next Business Day is no later than the end date of the q-th quarter; otherwise, d_t equals to the number of days from date t to the end date of the q-th quarter.

For the SR3 contract, whose reference quarter is the current quarter ($q = 0$), the implied value can be calculated using published SOFR fixings and projected overnight SOFR rates:

$$\hat{P}_0^3(\Theta) = 100\times\left[1 - \frac{360}{N_0^3}\left(\prod_{t\epsilon T_q^{3-}}(1 + \frac{r_t\times d_t}{360})\times \prod_{t\epsilon T_q^{3+}}(1 + \frac{f(t;\Theta)\times d_t}{360}) - 1\right)\right]$$

Where:

- $T_q^{3+} = \{t\epsilon T_q^3 | t \geq t_0\}$;
- $T_q^{3-} = \{t\epsilon T_q^3 | t < t_0\}$;
- r_t: published SOFR fixing for date t.

The framework of the optimization method is guided by the following principles:

- **Reflect Market Expectations**. The first term of the optimization function is the weighted average squared error between implied values and observed prices of the 13 SR1 and 5 SR3 contracts. The optimization algorithm is trying to minimize the root mean squared errors of the deviations from market expectations.
- **Equivalent importance of inputs**. CME assigns each input price the same level of importance with respect to the contribution to the error function in the optimization. The weight for each future contract is $0.\overline{05}$ for all 13 (thirteen) SR1 contracts and all 5 (five) SR3 contracts.
- **Eighteen Month Jump Window**. CME assumes that no jumps will occur more than eighteen months after the as of date.
- **Policy Gradualism**. The second term of the optimization function is a penalty function which will impose punishment on large jump size. This regularization term in the optimization function ensures that the optimization prefers "gradual jump patterns" of the overnight SOFR rates rather than "extreme jump patterns" if the two patterns leads to the same contract prices. For example, suppose two or more FOMC meetings occurred during the lifespan of a single SR3 contract (multiple jump patterns), with a big jump at one FOMC policy rate announcement date and no jumps at other meetings or equal jump at each FOMC policy rate announcement date, may have the same implied contract price. In this case, the penalty function will select the equal jump pattern to minimize the absolute value of the largest individual jump size such that the path for overnight SOFR rates will be smoother. A small positive number will be assigned to λ and hence it will not materially affect the parameter estimates.

[9] *https://www.sifma.org/resources/general/holiday-schedule/*

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5.3. Computing Term Rates from Projected Overnight Rates

Term Rates are derived by compounding the overnight SOFR rates over one, three, six and twelve months. The compounding follows conventions listed as below:

$$h(T) = \frac{360}{T} \times \left[\prod_{t \in \widetilde{T}(T)} \left(1 + \frac{f(t;\Theta) \times d_t}{360} \right) - 1 \right]$$

- $\widetilde{T}(T)$: the set of Business Days from the term start date to date T days in the future. Each term tenor will start on (and include) two Business Days following the publication day, based on Following convention. The term rate will span the corresponding tenor (e.g., 1-month, 3-month, 6-month, 12-month which is represented by T days in the formula) in accordance with Modified Following conventions.
- t: a Business Day in set $\widetilde{T}(T)$
- d_t: the number of calendar days from date t to its next Business Day following the SIFMA US Holiday Schedule, if the next Business Day is no later than the end date of SOFR term rate; otherwise, d_t is equal to the number of days from date t to the end date of SOFR term rate.
- $f(t, \Theta)$: the overnight SOFR rate as of date t.

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6. Eligibility of SOFR OIS

In addition to futures markets, the Over the Counter (OTC) market for SOFR Overnight Indexed Swaps (OIS) may provide an indication of CME Term SOFR Reference Rates values.

SOFR OIS will be considered for inclusion in the benchmark's calculation when their transacted monthly volumes exceed 25% of SOFR Futures volumes for a consecutive 6 (six) month rolling period. SOFR OIS executed volumes are observed based on available CCP cleared OIS data with a tenor shorter than 1 (one) year. Where SOFR OIS data is not available from third parties for tenors less than 1 year, the available tenor data will be adjusted. The adjustment will be based on a rolling 6-month average ratio of 1 year vs the available tenor data as reported by CME Group.

The Administrator will monitor the monthly SOFR OIS volumes and report its findings to the Oversight Committees. The Oversight Committees are responsible for approving the inclusion of SOFR OIS data into the CME Term SOFR Reference Rate calculation.

There are currently no OTC OIS data sources used in the calculation of the CME Term SOFR Reference Rates.

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7. Pre-publication Reliability Checks

Pre-publication reliability checks are performed daily, to validate that the calculated CME Term SOFR Reference Rates are within acceptable tolerances and to identify and remediate any potential error in the calculation process.

7.1. Market Volatility Checks

For each CME Term SOFR Reference Rates tenor, changes (in interest rate terms) from the previous day are calculated and stored; 70 days rolling average and standard deviation are calculated.

The daily changes described above, are then compared for consistency, as follow:

- whether daily changes are within 2 (two) standard deviations from their historical 70 days average;
- whether daily changes are within a tolerance of 150% of the corresponding changes of the input prices (in interest rate terms).

If at least one of the above validation tests is passed, CME Term SOFR Reference rates are published.

In the occurrence of both validation tests failing, the Calculation Agent consults with the Administrator to assess consistency of CME Term SOFR Reference Rates changes with the underlying market and approve for publication.

In the occurrence that the day-on-day changes are not consistent with the movement in the underlying market, the previous day CME Term SOFR Reference Rates are re-used.

7.2. Technical Failure – IT System

If there is a technical failure in the calculation of CME Term SOFR Reference Rates, the average change of input data, converted into interest rate, is calculated and applied equally to the previous day CME Term SOFR Reference Rates, for all tenors.

7.3. Unavailability of Input Data

If SOFR Futures input data are unavailable, the prior day inputs are entered into the projection model (Section 5) to calculate the CME Term SOFR Reference Rates.

If the NY Fed Overnight SOFR rate is unavailable for a day where the CME Term SOFR Reference Rates are calculated, the previous published Overnight SOFR rate will be used in the calculation of the day's CME Term SOFR Reference Rates.

If there is a technical failure in the projection model and the SOFR Futures input data are unavailable, preventing the calculation of changes over the previous day as described above, the CME Term SOFR Reference Rates from the previous day are re-published.

In the event that the previous day CME Term SOFR Reference Rates are republished for more than 3 (three) consecutive Business Days, the Administrator must promptly convene the Oversight Committees to assess available remedial actions.

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8. Publication and Error Policy

8.1. Benchmark Publication

The CME Term SOFR Reference Rates Publication will be on the next Business Day following the Business Day during which futures data sampling takes place.

CME Term SOFR Reference rates are calculated and published to 5 (five) decimal places.

CME Term SOFR Reference Rates are computed based on a reference period that begins two Business Days (T+2) after the Publication Date settlement, where publication occurs on the Business Day following the sampling date.

CME Term SOFR Reference Rates is calculated each Business Day, in accordance with the recommended SIFMA US Holiday Schedule. Publication will occur at 5.00am CT (6.00am ET, typically 11.00am GMT/BST). Please refer to Appendix II for further details.

In addition, CBA may, with notification to the market, choose not to publish the CME Term SOFR Reference Rates on any given business day.

The CME Term SOFR Reference Rates are published on the CME Group website and on licensed data vendor platforms.

8.2. Error Policy

The Administrator takes the utmost care to ensure that input data and calculations are accurate; during the calculation process and prior to publication, the Administrator performs additional validation checks (as in Pre-publication Reliability Checks) to identify possible errors, and swiftly recalculate and revalidate CME Term SOFR Reference Rates prior to publication.

If the Administrator identifies an incorrect publication the same day, prior to 2pm CT, the CME Term SOFR Reference Rates will be republished if the error is greater than 1 basis point. In the event that there is an error in the publication that requires a re-publication of the rate, users will be informed via the CME Globex system utilizing the GCC System Alerts.

8.3. Publication Alerts

In the event of disruptions to the standard CME Term SOFR Reference Rates publication process, publication alerts will be issued if and when publication disruptions have not been resolved: a publication alert will be issued by 7:00am CT (8.00am ET,13.00pm GMT/BST) at the latest.

Publication alerts will be made available via the CME Globex system utilizing the GCC System Alerts.

8.4. Consultations and Notices

CBA will inform the users and stakeholders of any announcements relating to republication, restatements or consultations via the CBA Notice Page.

In addition, CBA may, at its discretion, release information notices with respect to issues impacting the availability of the CME Term SOFR Reference Rates, via the CBA Notice Page.

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9. Governance

The Administrator operates under a comprehensive Risk and Control Framework, providing clear policies on Governance, Oversight, Benchmark Design and Calculation, Outsourcing, Operations, Reporting of Infringements and Business Continuity.

CBA has in place a "Three Lines of Defence" model, enabling close cross-monitoring of the governance process - this being business, compliance and audit who all have a key role in ensuring that CBA meets its regulatory requirements.

9.1. Oversight Committees

The Administrator has implemented a tiered oversight committee structure, which in combination, performs the overall duties of the Oversight Function, as defined under Article 5 UK and EU BMR (collectively, the "BMR"). The purpose of the Oversight Function is to review the accuracy, reliability and integrity of benchmarks provided by CBA by providing independent oversight and challenge to the Administrator.

Please see a description of these Oversight Committees below:

• The BMR Joint Oversight Committee ("JOC") is responsible for the overall direction and coordination of the Oversight Function and for interaction with the management body of CBA. The JOC is supported by and is an escalation point for the CME Term SOFR Product Advisory Committee. Please refer to the JOC Terms of Reference for full details of the responsibilities of the JOC. They are available on the CME Term SOFR website.

• The CME Term SOFR Product Advisory Committee ("PAC") presides over major methodology developments and changes relating to specific index families as well as cessation and/or consultation decisions. The PAC provides technical oversight of the operation of the benchmarks as well as the underlying market and how changes could impact the continued representativeness and integrity of the benchmarks. The PAC provides its views and recommendations to both the JOC and the CBA Management. Please see the Terms of Reference for the Product Advisory Committees for further information. They are available on the CME Term SOFR website.

9.2. Review of the Methodology

The Administrator monitors the Benchmark Methodology and its consistency with the stated objectives. The Benchmark Methodology is reviewed and approved annually by the Administrator and reviewed annually by the Oversight Committees.

The Oversight Committees review proposed material changes to the Calculation Methodology including, but not limited to, the structure of the Benchmark, input data used and all aspects of the Calculation Methodology.

The Oversight Committees may request the Administrator to consult on any changes to the methodology with Stakeholders and the wider market.

9.3. Consultation Process

The Administrator will engage relevant stakeholders and end users on material changes to the Benchmark Methodology, if required by regulation or where the Oversight Committees request such consultation.

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Changes to the Methodology are deemed material on the basis of an assessment conducted by the Administrator and submitted to the Oversight Committees for advice and feedback.

The Administrator will publish notice of the consultation on its website, inviting feedback from stakeholders and the wider market. Notice of a consultation will be posted at least 1 (one) month prior to the deadline for responses. The notice will include the details of the proposed material change, the timeline and the rationale for the change.

Findings of the consultation process and proposed changes to the Benchmark Methodology, recommended as a result of the consultation, will be presented by the Administrator to the Oversight Committees for their consideration.

Feedback to a consultation is considered confidential, however the Administrator will publish an anonymized summary with its conclusions, as soon as it is practical, but before implementation of any changes.

9.4. Cessation

The Administrator constantly monitors the representativeness of the Benchmark. If the Benchmark is deemed to be unrepresentative of the underlying economic reality due to paucity of input data or systemic changes in the related markets, the Administrator will engage the Oversight Committees at the earliest opportunity. These cessation arrangements are designed to mitigate cessation and transition risks.

The Oversight Committees may direct the Administrator to consult with Stakeholders as described in the Consultation Process section.

As a last resort, if no alternative arrangements are feasible, the Oversight Committees may advise the Administrator to discontinue the Benchmark, providing Stakeholders at least 6 (six) months' notice and assistance to explore alternative reference instruments.

The Administrator will endeavour to identify alternative benchmarks; however, this might not always be possible due to regulations, market conditions or suitable alternatives.

Users of the Benchmark are recommended to ensure that they have adequate fallback policies and procedures in the event of the Benchmark becoming unrepresentative of its economic interest.

9.5. Record Retention

The Administrator has in place policies for the retention of any relevant evidence and documentation related to the determination and dissemination of the Benchmark, either in paper or in electronic format, for at least the mandatory term of 5 (five) years.

9.6. Auditing

An internal audit process will be undertaken regularly, to ensure adherence to the stated Methodology, the IOSCO principles and regulatory requirements.

An external audit will be carried out at least every two years. External audits can be requested at any time by the Administrator's board, the JOC or the internal audit function.

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9.7. Data Licensing and Distribution

The Benchmark is made available subject to execution of an Information License Agreement (ILA) together with the appropriate Schedules. Market participants that intend to subscribe to the Benchmark should contact the Administrator at the following email address: CMEDataSales@cmegroup.com.

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9.8. Complaints Procedures

The CBA Complaints Procedures set out details on the management of customer complaints to ensure that they are handled fairly and effectively, in a prompt and transparent manner and in accordance with applicable regulatory requirements.

Complaints will be dealt with by a senior member of staff not directly involved with the benchmark calculation and dissemination. Information related to complaints will be stored in a restricted access area and kept for a period of at least 5 (five) years following the date when the complaint was first lodged. Complaints can be submitted at internationalcompliance@cmegroup.com

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Appendix I – Key Terms & Definitions

TERM	DESCRIPTION
Administrator	CME Group Benchmark Administration Limited
ARRC	Alternative Reference Rates Committee
BMR	UK Benchmark Regulation
Business Day	US Government Securities Business Day
CBA	CME Group Benchmark Administration Limited
DCM	Designated Contract Market
FCA UK	Financial Conduct Authority (UK)
FED	Federal Reserve System
FOMC	Federal Open Market Committee
IMM	International Money Market day-count convention
IOSCO	International Organization of Securities Commissions
NY FED	Federal Reserve Bank of New York
JOC	BMR Joint Oversight Committee
PAC	Product Advisory Committee
OIS	Overnight Indexed Swaps
OTC	Over the Counter
SIFMA	Securities Industry and Financial Markets Association
SOFR	Secured Overnight Financing Rate
SR1	One-month SOFR Futures
SR3	Three-month SOFR Futures
VWAP	Volume Weighted Average Price

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Appendix II – CME Term SOFR Reference Rates Early Close Calendar

2024 Early Close Calendar

DATE	SIFMA CALENDAR/ MARKET CLOSE TIME	CME TERM SOFR OBSERVATION WINDOW
28-Mar-2024	2:00pm ET	7:00am CT - 12:00pm CT
24-May-2024	2:00pm ET	7:00am CT - 12:00pm CT
03-Jul-2024	2:00pm ET	7:00am CT - 12:00pm CT
29-Nov-2024	2:00pm ET	7:00am CT - 12:00pm CT
24-Dec-2024	2:00pm ET	7:00am CT - 12:00pm CT
31-Dec-2024	2:00pm ET	7:00am CT - 12:00pm CT

2025 Early Close Calendar

DATE	SIFMA CALENDAR/ MARKET CLOSE TIME	CME TERM SOFR OBSERVATION WINDOW
09-Jan-2025	1:15pm ET	7:00am CT - 11:00pm CT
17-Apr-2025	2:00pm ET	7:00am CT - 12:00pm CT
23-May-2025	2:00pm ET	7:00am CT - 12:00pm CT
03-Jul-2025	2:00pm ET	7:00am CT - 12:00pm CT
28-Nov-2025	2:00pm ET	7:00am CT - 12:00pm CT
24-Dec-2025	2:00pm ET	7:00am CT - 12:00pm CT
31-Dec-2025	2:00pm ET	7:00am CT - 12:00pm CT

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