

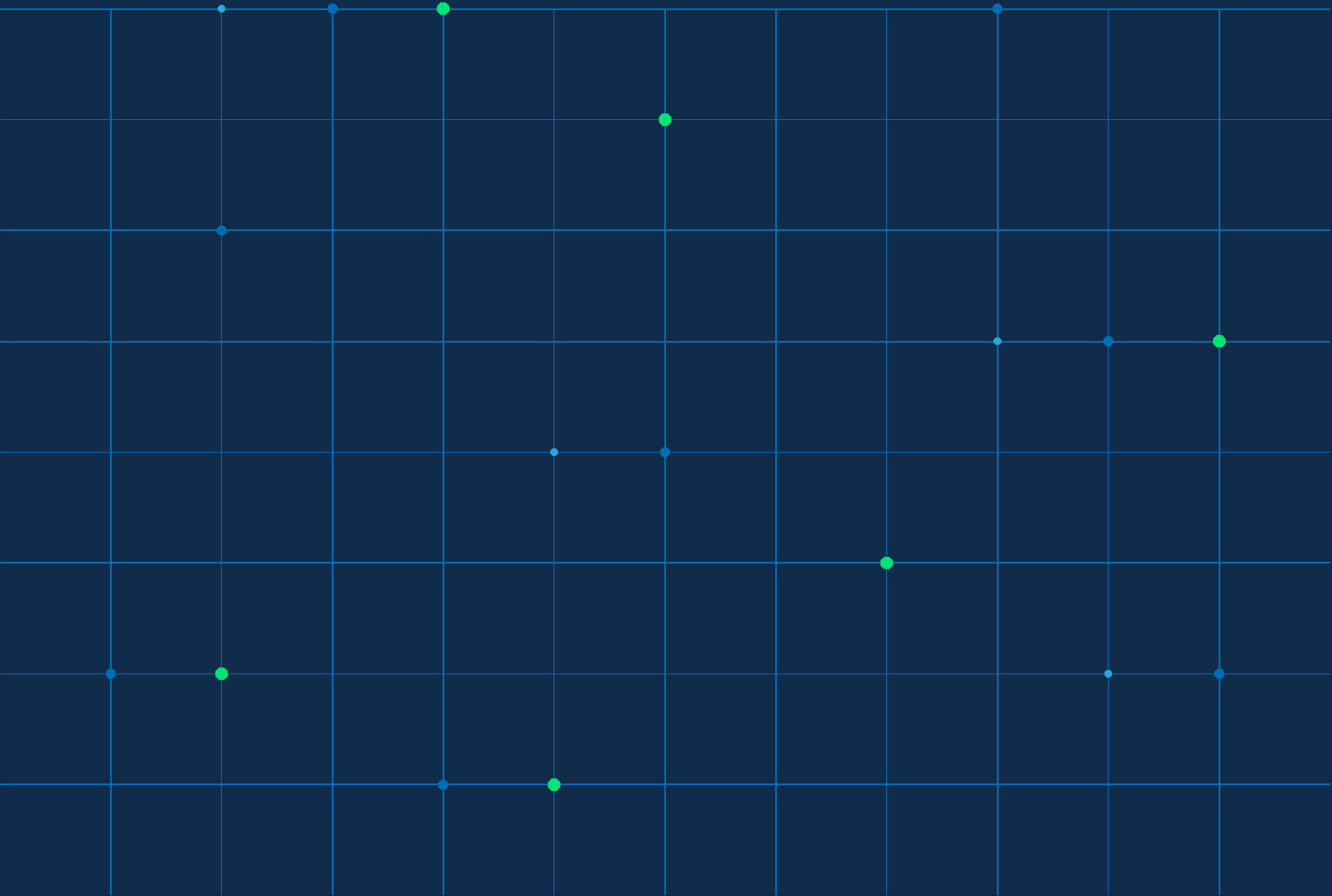
CME Overnight Repo-Backed Benchmark Methodology

RepoFunds Rate Euro “RFR Euro”
RepoFunds Rate Sterling “RFR Sterling”
JBOND Repo Index Rate

CME Group Benchmark Administration Limited

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Version Control

VERSION	KEY CHANGES	APPROVAL DATE
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1. Introduction

CME Overnight Repo-Backed Benchmarks is a suite of benchmarks administered by CME Group Benchmark Administration Limited (“CBA” or the “Administrator”) and intended to measure the cost of secured one-day repo funding of sovereign bonds issued by a sub-set of Eurozone Countries, the United Kingdom and Japan.

These benchmarks, consisting of the RepoFunds Rate Euro Benchmarks (“RFR Euro Benchmarks”), RepoFunds Rate Sterling (“RFR Sterling”) and the JBOND Repo Index Rate, are registered as a “Benchmark Family” under EU Benchmark Regulation (“BMR”) 2016/1011, 8th June 2016 Title I Art 3 (4).

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 offers futures trading through the CME Globex® electronic trading platform (“Globex”), fixed income trading via BrokerTec, foreign exchange trading on the EBS platform, and central counterparty clearing services at CME Clearing, a division of CME. CBA capitalizes on CME Group’s wealth of electronic transaction-based data in the calculation of its indices and benchmarks. CBA is registered under EU BMR and is authorized and supervised by the UK Financial Conduct Authority (“FCA”). CBA is the administrator CME Overnight Repo-Backed Family of Benchmarks, with Chicago Mercantile Exchange Group Inc. providing calculation agent and distribution services.

1.2. Regulatory and IOSCO Compliance

CME Overnight Repo-Backed Benchmark is a family of benchmarks, designed on the basis of industry best practices and the IOSCO Principles for Financial Benchmarks. This will include but is not limited to the creation of an oversight committee and a published methodology. The Index is also subject to an audit process. Material changes to the methodology will be announced via public consultation and any changes would be announced with a notice period of at least one (1) month.

2. Description of benchmarks

2.1. RepoFunds Rate Euro Benchmarks (“RFR Euro Benchmarks”)

RFR Euro Benchmarks are overnight, secured Euro repo benchmarks, created with the intent to measure the effective cost of overnight funding of sovereign collateral. Benchmarks are calculated from repo trades that use Euro area sovereign government bonds denominated in EUR as the underlying collateral and are executed on the BrokerTec Regulated Market operated by CME Amsterdam B.V.¹ and BondVision multilateral trading facility (“MTF”)² EuroMTS Limited³.

RFR Euro is calculated on an Act/360 day-count convention and its publication follow the ECB TARGET Calendar.⁴

The RFR Euro Benchmarks consists of the following benchmarks:

- RepoFunds Rate Austria (“RFR Austria”)
- RepoFunds Rate Belgium (“RFR Belgium”)
- RepoFunds Rate Finland (“RFR Finland”)
- RepoFunds Rate France (“RFR France”)
- RepoFunds Rate Germany (“RFR Germany”)
- RepoFunds Rate Italy (“RFR Italy”)
- RepoFunds Rate Ireland (“RFR Ireland”)
- RepoFunds Rate Netherlands (“RFR Netherlands”)
- RepoFunds Rate Portugal (“RFR Portugal”)
- RepoFunds Rate Spain (“RFR Spain”)
- RepoFunds Rate Euro (“RFR Euro”): based on the combination of the above ten (10) individual countries.

2.2. RepoFunds Rate Sterling (“RFR Sterling”)

RepoFunds Rate Sterling (“RFR Sterling”) is an overnight, secured Sterling repo index. The index is calculated from repo trades that use UK sovereign government bonds denominated in Sterling as the underlying collateral, executed on the BrokerTec operated by BrokerTec Europe Limited⁵ and centrally cleared. Underlying collateral includes DBV⁶, general collateral and specific collateral trades.

RFR Sterling is reported on an ACT/ACT day-count convention and its publication follows the UK settlement calendar⁷.

¹ <https://www.cmegroup.com/trading/market-tech-and-data-services/brokertec/regdocs.html#all-documentation>

² Article 4(1)(22) of MiFID

³ <https://www.mtsmarkets.com/products/mts-bondvision>

⁴ Long-term calendar for TARGET closing days: (https://www.ecb.europa.eu/press/pr/date/2000/html/pr001214_4.en.html)

⁵ <https://www.cmegroup.com/trading/market-tech-and-data-services/brokertec.html>

⁶ Delivery by Value

⁷ <https://www.gov.uk/bank-holidays>

2.3. JBOND Repo Index Rate (“JBOND RIR”)

JBOND Repo Index Rate is a tomorrow-next, secured Japanese Yen repo index, calculated from eligible repo trades that use Japanese sovereign government bonds denominated in Japanese Yen as the underlying collateral, executed on the JBOND Repo Trading System⁸ electronic trading platform, and centrally cleared through the Japan Securities Clearing Corporation.⁹ JBond Totan Securities Co., Ltd. is headquartered in Tokyo, Japan and operates the JBOND Repo System under the relevant PTS license.¹⁰

The Japanese one-day repo market is predominantly traded on tomorrow-next value date; rarely are repo on Japanese sovereign bonds executed on overnight dates (today-tomorrow). Consequently, the JBOND Repo Index rate measures the cost of funding Japanese sovereign securities for one-day, for value date tomorrow-next.

JBOND Repo Index Rate is reported on an ACT/365 day-count convention and its publication follow the Japanese settlement calendar¹¹.

2.4. Input data

The Benchmarks are calculated on transactions executed on regulated trading venues and no discretion is exercised by the Administrator in the determination process, as explained in section [Calculation Methodology](#).

2.5. Trading Venues

The trading venues of BrokerTec Europe Limited and EuroMTS Limited are MTFs and are regulated in accordance with the laws applicable in the UK or EEA.

The trading venue of CME Amsterdam B.V. is a Regulated Market, authorised by the Dutch Minister of Finance.¹²

The trading venue of JBond Totan Securities Co., Ltd. is regulated in accordance with the laws of Japan.

2.6. Administrator and Calculation Agent

CBA is the Benchmark Administrator, registered under EU Benchmark Regulation (EU Regulation 2016/1011), authorized and supervised by the UK Financial Conduct Authority (FCA).

The Calculation Agent for the family of benchmarks is Chicago Mercantile Exchange Inc.

⁸ https://jbond.co.jp/_us/index.html

⁹ <https://www.jpx.co.jp/jsc/en/>

¹⁰ https://www.jbond.co.jp/_us/profile.html

¹¹ <https://www.boj.or.jp/en/about/outline/holi.htm/>

¹² https://www.cmegroup.com/media-room/press-releases/2019/3/12/cme_group_receivesapprovalfromthedutchministeroffinancetooperate.html

3. Calculation Methodology

The Calculation Methodology has been designed to measure the cost of secured one-day repo funding of sovereign bonds, including considerations about the size and liquidity of the market as well as its dynamics.

3.1. Eligible Repo Transactions

Repo transactions deemed eligible for inclusion in the calculation of the Benchmarks must meet the following criteria:

- Must be executed on one of the regulated trading venues relevant to their respective markets (BrokerTec Europe Limited, CME Amsterdam B.V., EuroMTS Limited and JBOND Repo System) within nominated market hours, defined as follows:
 - Spot-Next and Tom-Next trades:
 - BrokerTec Europe Limited, CME Amsterdam B.V. and EuroMTS Limited: 6:45am to 5:15pm (GMT/BST)
 - JBOND Repo System: 7:30am to 6:00pm (JST)
 - Overnight trades
 - All trades executed from market opening until the relevant clearing house deadline.
- Quotes must be available to all dealers on the relevant market prior to being executed (no bilateral or off-platform trades);
- Trades must be centrally cleared;
- Repo term (from settlement date to maturity date) of one business day;
- Settle on the day for which the Benchmark is being calculated (“Common Settlement”);
- Repo collateral to be any bill, bond, floating-rate note, or inflation-linked bond issued by the sovereign government of the relevant country or, in the case of RFR Euro, by the sovereign government of the Eurozone countries listed in [RepoFunds Rate Euro \(“RFR Euro”\)](#);
- Collateral must be denominated in the respective domestic currencies;
- Repo trade must be DBV, general collateral or specific collateral; however, specific collateral trades are filtered out as per the [Filtering Algorithm](#) presented below.

3.2. Specific Collateral Trade Filtering Algorithm

Repo markets execute a mix of trades types, usually described as “general collateral” or “specific collateral”.

Unlike “general collateral”, specific collateral trades (special trades) precisely identify the ISIN of the security to be used as collateral. Normally it happens when a specific security is in high demand and the transacted repo rate tends to be below typical market levels, often by a significant spread.

Hence, the calculation algorithm is designed to remove “special trades” from the set of trades used for benchmark calculation. Special trades are not clearly labelled at the time of execution and only the magnitude of their trading spread versus the median value of the eligible set can provide guidance.

To provide the most accurate estimation of “special trades” to be removed, an iterative process is applied, as follows:

- All repo trades for the same settlement date and the same benchmark are sorted by descending rate;
- The volume-weighted average rate (VWAR) of all trades is calculated;
- The absolute furthest trade in rate terms from the VWAR is removed (if there is more than one repo trade with the same rate, the smallest trade is deleted);
- A new VWAR of the remaining set is calculated and the process is iterated until 25% (twenty five percent) of the original number of trades is removed;

The filtering process is designed to remove outliers symmetrically from both sides of the distribution, while the 25% threshold has been estimated as a suitable threshold for the identification of special trades to be removed.

The same iterative filtering process is also applied to the calculation of RFR Euro; the entire set of repo trades executed in the ten (10) individual Eurozone countries listed above, is aggregated in a single set and the filtering algorithm described above is applied.

3.3. Calculation Algorithm

Each benchmark is the volume-weighted average rate of the defined set of eligible repo trades, and is calculated as follows:

$$RFR = \frac{\sum_i \text{rate}(i) \times \text{quantity}(i)}{\sum_i \text{quantity}(i)}$$

where $\text{rate}(i)$ and $\text{quantity}(i)$ are the repo rate and nominal size of repo trade i , and the sum is the total of all repo trades in the defined set of eligible repo trades for that day's benchmark.

Benchmark values are calculated and published with a precision of up to three (3) decimal places.

Normally one-day repo trades are executed at a fixed rate; if transacted at a spread over a reference rate, the resulting rate will be assumed to be fixed and used for the calculation of the benchmarks.

No expert judgement is applied to the determination of the Benchmarks; input data are transactions only, as contributed entirely and directly from the relevant trading venues.

3.4. Data Sufficiency and Integrity

Each Benchmark will be calculated and published as long as there is at least one (1) eligible transaction in the observation period. If there are no eligible transactions available to calculate that specific benchmark, the benchmark value for that day will not be generated.

The input data used for the calculation of the benchmarks are checked by the Calculation Agent for anomalies once received from each Trading Venue.

The Administrator regularly reviews the underlying markets and reports to the Oversight Committee any concern caused by persistent lack of transactional activity in a specific benchmark.

In the case of a severe market disruption or technical failure where no input data is received by the Administrator from contributing trading venues, the Administrator will publish the previous day's benchmark levels.

3.5. Publication

The Calculation Agent performs calculations and post-calculation checks immediately after input data have been received; Benchmarks are published shortly after calculation and checks, according to the following schedule:

Times GMT/BST unless specified	SFTP	Bloomberg	Administrator Website
EUR	4:15pm same day	4:30pm same day	5:00pm next day
GBP	4:15pm same day	4:30pm next day	5:00pm next day
JPY	9:30am (6:30pm JST)	9:30am (6:30pm JST)	9:30am (6:30pm JST)

3.6. Error Policy

If the Administrator finds that there is an incorrect Benchmark publication resulting from miscalculation or inaccurate data inputs within 24 hours from publication, the benchmark will be republished if the error is greater than 1bp (0.01%). Alternatively, if the difference is smaller than 1bp, there will be no re-publication.

4. 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.

The over-arching governance is ensured by the Oversight Committee, formed and operating under the CBA Terms of Reference for Oversight Committees. The Oversight Committees can escalate to the CBA Board if required.

4.1. Oversight Committee

An Oversight Committee is appointed by the Administrator to review the integrity of the benchmark, in accordance with the Oversight Committee Terms of Reference.

The Oversight Committee will provide independent oversight of, and challenge to the Administrator on all aspects of the Benchmark determination process. The Oversight Committee approves proposed 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.

4.2. Review of the Methodology

The Administrator constantly monitors the Benchmark Methodology and its consistency with the stated objectives. All changes to the Methodology are reviewed by the Oversight Committee including, but not limited to, changes in input data and calculation parameters used in the calculation of the benchmark.

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

4.3. Review of the Methodology - Consultation Process

The Administrator will engage relevant stakeholders and end users on material changes to the benchmark, or where the Oversight Committee requests such consultation.

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 Committee for its consideration.

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

4.4. 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 Committee at the earliest opportunity. These cessation arrangements are designed to mitigate cessation and transition risks.

The Oversight Committee may direct the Administrator to consult with Stakeholders as in [Review of the Methodology - Consultation Process](#).

As a last resort, if no alternative arrangements are feasible, the Oversight Committee 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 and 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.

4.5. Records Retention

Administrator to discontinue the Benchmark, providing Stakeholders at least 6 (six) months notice and assistance to explore alternative reference instruments.

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.

4.6. Auditing

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

External audits can be requested at any time by the Administrator's board, the Oversight Committee or the internal audit function (including if it is dissatisfied with any aspects of its conduct).

4.7. 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: benchmark@cmegroup.com

4.8. Complaints Procedures

CME Group has publicly available Complaints Procedures, applicable to the Administrator, that sets out the procedure according to which a complaint 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 up to 5 (five) years following the date when the complaint was first lodged. Complaints can be submitted at internationalcompliance@cmegroup.com

5. Appendix I – Key Terms & Definitions

TERM	DESCRIPTION
Administrator	CME Group Benchmark Administration Limited
BMR	EU Benchmark Regulation (Regulation (EU) 2016/1011)
bp	Basis Point (1 basis point = 0.01%)
CBA	CME Group Benchmark Administration Limited
OC	Oversight Committee

