CALCULATION METHODOLOGY

Overview

The ICE Term Reference Rates (each an "ICE TRR") are designed to measure average expected (i.e. forward-looking) rates over specified tenor periods for certain Risk Free Rates (RFRs). Currently these include the ICE Term SONIA Reference Rate ("ICE TSRR") for SONIA[1] and the ICE Term SOFR Reference Rate[2] ("ICE Term SOFR") for SOFR[3].

Each published ICE Term Reference Rate setting is calculated using eligible prices and volumes for specified interest rate derivative products linked to the relevant RFR, provided by trading venues. The ICE TRR settings are calculated using the data in accordance with a "Waterfall" Methodology.

The first level of the Waterfall ("Level 1") uses as its inputs eligible, executable prices and volumes for relevant and eligible overnight interest rate swaps referencing the relevant RFR, provided by regulated, electronic trading venues.

If there is insufficient eligible input data to derive the applicable ICE TRR setting in accordance with Level 1 of the Methodology, then the second level of the Waterfall ("Level 2") uses eligible dealer-to-client prices and volumes subject to central clearing, displayed electronically by trading venues, to derive the applicable ICE TRR setting.

If there is insufficient eligible input data to calculate the applicable ICE TRR setting in accordance with Level 2 of the Methodology, then the third level of the Waterfall ("Level 3") derives the applicable ICE TRR setting using:

- the previous trading day's futures settlement prices in respect of designated contracts referencing the relevant RFR, published on an electronic trading venue;
- the relevant RFR as published by its administrator; and
- scheduled monetary policy potential rate change effective dates[4].

Where it is not possible to calculate an ICE TRR setting at Level 1, Level 2 or Level 3 of the Waterfall, then the ICE TRR Insufficient Data Policy will apply, and the previous day's setting would be re-published for that ICE TRR until the applicable ICE TRR setting could again be calculated using the Waterfall.

This document describes the "Methodology" used to calculate and determine the published values for the ICE TRR settings.

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[1] SONIA is the Sterling Overnight Index Average rate, administered and published by the Bank of England

[2] At present, ICE Term SOFR settings are expected to be calculated using input data at Level 2 or Level 3 of the Waterfall (i.e. eligible dealer-to-client prices and volumes for eligible SOFR-linked interest rate swaps displayed electronically by trading venues where available, and otherwise futures settlement prices in respect of designated contracts referencing SOFR, published on an electronic trading venue). IBA expects to use Level 1 input data (i.e. eligible, executable prices and volumes for eligible SOFR-linked interest rate swaps, provided by regulated, electronic, trading venues) to derive ICE Term SOFR when this is available in the future.

[3] SOFR is the U.S. dollar Secured Overnight Financing Rate, administered and published by the New York Fed.

[4] For Term SONIA Reference Rates, the rate change dates are UK Monetary Policy Committee meeting dates; for Term SOFR Reference Rates, they are the effective dates immediately following scheduled Federal Open Market Committee meetings. These dates may be estimated dates where official schedules have yet to be announced.

The ICE TRRs are administered by ICE Benchmark Administration Limited (“IBA”), which is authorised and regulated by the Financial Conduct Authority for the regulated activity of administering a benchmark.

The "SONIA" mark is used under licence from the Bank of England (the benchmark administrator of SONIA), and the use of such mark does not imply or express any approval or endorsement by the Bank of England. "Bank of England" and "SONIA" are registered trademarks of the Bank of England.

IBA is not affiliated with the New York Fed. The New York Fed does not sanction, endorse, or recommend any products or services offered by IBA.

This Methodology is reviewed at least annually by the ICE Swap Rate & Term Reference Rates Oversight Committee, as documented in its Terms of Reference.

Calculation steps

The calculation of each ICE TRR setting involves the following steps:

Waterfall Level 1

1. IBA collects tradeable bid and offer prices and volumes for relevant, eligible overnight interest rate swaps referencing the relevant RFR available on the central limit order books of regulated, electronic trading venues in respect of a two-hour window before the applicable ICE TRR calculation.

2. The two-hour window is divided into 24 blocks of five minutes each and a random snapshot time is selected for each of these five-minute blocks (i.e. 24 snapshots).

3. A synthetic order book is created at each snapshot time by combining and ranking (by price) the eligible bids and offers from each trading venue. So long as the best bid price is less than the best offer price, these prices (and the associated volumes) are used to calculate the volume weighted bid ("VWB") and the volume weighted offer ("VWO") of the prices that would result from filling a hypothetical trade of Standard Market Size ("SMS") on each side of the market. A volume weighted average mid-price ("VWAMP") is then calculated from the VWB and the VWO.

4. Snapshots with insufficient tradable volume to fill the SMS, or that contain crossed or zero-spread bid and offer prices, are not included in the calculation. In order to calculate a level 1 rate, a minimum of 6 snapshots is required. The snapshots are then ranked in order of their VWAMPs and the snapshots with a VWAMP above the 75th percentile or below the 25th percentile are discarded.

5. The VWAMPs from the remaining snapshots are quality-weighted based on the difference between the VWB and the VWO and averaged, in order to determine the applicable ICE TRR setting.

Waterfall Level 2

6. If fewer than six snapshots remain after Level 1, IBA will use:

    a. Dealer to client bid and offer prices and volumes displayed electronically by trading venues in respect of the same two-hour window to calculate the applicable ICE TRR setting.

    b. The two-hour window is again divided into 24 blocks of five minutes each and a random snapshot time is selected for each block.

    c. Where a trading venue provides prices from dealers for multiple categories of clients within a snapshot, IBA will select the prices from a single client category per dealer, based on the tightest spread and largest volume for each client category within the snapshot.

    d. The selected, eligible bids and offers from each dealer from each trading venue are combined and ranked (by price) to create a synthetic order book at each snapshot time, and any crossed bid and offer volume within the orderbook is uncrossed. The remaining prices and associated volumes are used to calculate the VWB and the VWO of the prices that would result from filling a hypothetical trade of SMS in the same manner as for Level 1, with the VWAMP also calculated in the same way.

e. Illiquid snapshots are excluded in the same manner as for Level 1 and again at least 6 snapshots are required for a level 2 rate. The snapshots are ranked in order of their VWAMPs and the snapshots with a VWAMP above the 75th percentile or below the 25th percentile are discarded.

f. The applicable ICE TRR setting is determined as the quality weighted average of the remaining VWAMPs in the same manner as for Level 1.

Waterfall Level 3

7. If fewer than six snapshots remain after Level 2, IBA will use:

   a) Futures' settlement prices in respect of designated contracts referencing the relevant RFR maturing within each calendar month spanned by the relevant tenor period, published on the preceding trading day on an electronic trading venue;

   b) Overnight settings for the relevant RFR on the date the term rate is being derived and from the beginning of the current calendar month; and

   c) Scheduled monetary policy potential rate change effective dates during the tenors of the relevant futures contracts (being dates that might be expected to result in rate changes over the relevant period)[5],

8. A step function model is then used to determine, from these input values, the implied average daily RFR settings. This is done from the date the applicable ICE TRR setting is being derived until the end of the last calendar month spanned by the relevant tenor, ascribing implied rate changes for each month to the relevant potential rate change effective date (or the first business day of the month if there is no scheduled potential rate change effective date in that month).

9. The implied average daily RFR settings are then compounded over the relevant tenor period to produce the applicable ICE TRR setting.

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[5] These dates may be estimated dates where official schedules have yet to be announced.

APPENDIX

ICE Term Rate Calculation Illustration

This illustration shows the calculation for a 3 Month ICE Term SOFR Reference Rate tenor on a single day. Input data is available at Level 2 of the waterfall. 24 snapshots of the dealer-to-client prices and volumes are taken, during a 2 hour period.

Note: For readability, throughout this calculation illustration, intermediate results are shown rounded to 5 decimal places. In the actual calculation, rounding is not applied until the end of the calculation.

Determination of Volume Weighted Midpoint for a Snapshot : Snapshot 1

The first snapshot, taken at approx. 09:02:26 ET, contains bid and offer volume at multiple price levels. For the purposes of this illustration, we show the top 4 price levels on each side:

DIRECTION	PRICE	VOLUME
BID	4.7345	960000000
BID	4.717	40000000
BID	4.715	1000000000
BID	4.712	1000000000

DIRECTION	PRICE	VOLUME
ASK	4.6595	1000000000
ASK	4.72	1000000000
ASK	4.723	40000000
ASK	4.7245	1000000000

In this snapshot, the price of the best Ask is lower than the best Bids, so matching volume is removed ("uncrossed"). The Bid at 4.7345 and the Asks at 4.6595 and 4.72 can be matched and are eliminated (shown as struck through in the table below). This leaves the best prices as 4.715 Bid - 4.72 Ask.

The Standard Market Size for the 3 Month tenor is $750,000,000. In this case we have sufficient volume available to fill SMS at the best price on each side:

BID PRICE	BID VOLUME	Volume After Uncrossing	Volume Used for SMS
~~4.7345~~	~~960000000~~	~~0~~	~~0~~
~~4.717~~	~~40000000~~	~~0~~	~~0~~
4.715	**1000000000**	**1000000000**	**750000000**
4.712	1000000000	1000000000	0

ASK PRICE	ASK VOLUME	Volume After Uncrossing	Volume Used for SMS
~~4.6595~~	~~1000000000~~	~~0~~	~~0~~
4.72	**1000000000**	**1000000000**	**750000000**
4.723	40000000	40000000	0
4.7245	1000000000	1000000000	0

The Volume Weighted Bid and Ask are calculated using the volume required at each level to fill SMS - in this case since the volume is not split between price levels, these are simply equal to the best bid and ask prices:

- **Volume Weighted Bid (VWB) =** (750000000*4.715)/750000000= 4.715
- **Volume Weighted Ask (VWA) =** (750000000*4.72)/750000000 = 4.72
- **Volume Weighted Midpoint (VWAMP)** for this snapshot is (VWB+VWA)/2 =4.7175

Determination of Volume Weighted Midpoint for a Snapshot : Snapshot 2

In the second snapshot, taken at approx. 09:07:01 ET, the same process is followed. Note that the Bid at 4.684 has its volume reduced but not eliminated by uncrossing. The SMS fill on the Ask side is split between the best two remaining price levels:

BID PRICE	VOLUME	Volume After Uncrossing	Volume Used for SMS
~~4.6995~~	~~960000000~~	~~0~~	~~0~~
4.684	**1000000000**	**920000000**	**750000000**
4.6765	40000000	40000000	0
4.6725	500000000	500000000	0

ASK PRICE	VOLUME	Volume After Uncrossing	Volume Used for SMS
~~4.54~~	~~1000000000~~	~~0~~	~~0~~
~~4.683~~	~~40000000~~	~~0~~	~~0~~
4.6885	**500000000**	**500000000**	**500000000**
4.689	1000000000	1000000000	250000000

The Volume Weighted Bid and Ask are again calculated using the volume required at each level to fill SMS:

- **VWB** = (750000000*4.684)/750000000= 4.684
- **VWA** = (500000000*4.6885 + 250000000*4.689)/750000000 = 4.68867
- **VWAMP** = (VWB+VWA)/2 = 4.68633

Summary of snapshot results

The same process is applied to the remaining 22 snapshots with the following results:

Snapshot	VWB	VWO	VWAMP
Snapshot 1	4.71500	4.72000	4.71750
Snapshot 2	4.68400	4.68867	4.68633
Snapshot 3	4.67450	4.68384	4.67917
Snapshot 4	4.64650	4.65687	4.65168
Snapshot 5	4.64200	4.64834	4.64517
Snapshot 6	4.67703	4.69129	4.68416
Snapshot 7	4.71144	4.73039	4.72092
Snapshot 8	4.71263	4.72825	4.72044
Snapshot 9	4.73350	4.74346	4.73848
Snapshot 10	4.72319	4.73841	4.73080
Snapshot 11	4.69019	4.70541	4.69780
Snapshot 12	4.68133	4.69771	4.68952
Snapshot 13	4.68100	4.69323	4.68712
Snapshot 14	4.67361	4.68913	4.68137
Snapshot 15	4.69132	4.71055	4.70093
Snapshot 16	4.70419	4.71841	4.71130
Snapshot 17	4.71374	4.73095	4.72235
Snapshot 18	4.73737	4.75161	4.74449
Snapshot 19	4.70650	4.71900	4.71275
Snapshot 20	4.71650	4.73154	4.72402
Snapshot 21	4.72400	4.73590	4.72995
Snapshot 22	4.73371	4.74921	4.74146

Snapshot 23	4.72107	4.73995	4.73051
Snapshot 24	4.71263	4.72495	4.71879

At this point, any snapshot which did not have sufficient volume to fill SMS on both sides would not have a Volume Weighted Midprice and would be excluded from the remainder of the calculation; however, in this case all snapshots have sufficient volume.

Outlier Trimming and Quality Weighting

The Outlier Thresholds are calculated as the 25th and 75th percentile of the available Volume Weighted Midpoints:

- Low threshold, 25th Percentile:4.68692
- High threshold, 75th Percentile: 4.72550

For snapshots falling at or within these thresholds, a Quality Weighting is calculated as 1/(VWA-VWB); for excluded snapshots, this weighting is zero.

Snapshot	VWB	VWO	VWAMP	Within 25-75Pct	QW
Snapshot 1	4.71500	4.72000	4.71750	**Yes**	**200.0**
Snapshot 2	4.68400	4.68867	4.68633	No	0
Snapshot 3	4.67450	4.68384	4.67917	No	0
Snapshot 4	4.64650	4.65687	4.65168	No	0
Snapshot 5	4.64200	4.64834	4.64517	No	0
Snapshot 6	4.67703	4.69129	4.68416	No	0
Snapshot 7	4.71144	4.73039	4.72092	**Yes**	**52.8**
Snapshot 8	4.71263	4.72825	4.72044	**Yes**	**64.0**
Snapshot 9	4.73350	4.74346	4.73848	No	0
Snapshot 10	4.72319	4.73841	4.73080	No	0
Snapshot 11	4.69019	4.70541	4.69780	**Yes**	**65.7**
Snapshot 12	4.68133	4.69771	4.68952	**Yes**	**61.1**
Snapshot 13	4.68100	4.69323	4.68712	**Yes**	**81.7**
Snapshot 14	4.67361	4.68913	4.68137	No	0
Snapshot 15	4.69132	4.71055	4.70093	**Yes**	**52.0**
Snapshot 16	4.70419	4.71841	4.71130	**Yes**	**70.3**
Snapshot 17	4.71374	4.73095	4.72235	**Yes**	**58.1**
Snapshot 18	4.73737	4.75161	4.74449	No	0
Snapshot 19	4.70650	4.71900	4.71275	**Yes**	**80.0**
Snapshot 20	4.71650	4.73154	4.72402	**Yes**	**66.5**
Snapshot 21	4.72400	4.73590	4.72995	No	0
Snapshot 22	4.73371	4.74921	4.74146	No	0
Snapshot 23	4.72107	4.73995	4.73051	No	0

Snapshot 24	4.71263	4.72495	4.71879	**Yes**	**81.2**

So long as there are at least 6 snapshots remaining in the calculation (*i.e.* with non-zero weightings), we can calculate the rate at this level of the waterfall. In this case there are 12 snapshots remaining, so the rate is calculated as the quality-weighted average of the 24 midpoints:

$$ICE\ Term\ SOFR\ Reference\ Rate = \frac{\sum_{i=1}^{24}(VWAMP_i \times QW_i)}{\sum_{i=1}^{24} QW_i} = 4.71110$$