ARRC White Paper

Suggested Fallback Formula for the USD LIBOR ICE Swap Rate

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Part I. Background

The Board of Governors of the Federal Reserve System and the Federal Reserve Bank of New York ("FRBNY") convened the Alternative Reference Rates Committee ("ARRC") in 2014 to identify alternative reference rates for U.S. dollar (USD) LIBOR ("LIBOR"), identify best practices for contract robustness in the interest rate market, and create an implementation plan to support an orderly adoption of new reference rates. After accomplishing its initial set of objectives by selecting an alternative reference rate (which is the Secured Overnight Financing Rate or "SOFR") and setting out a Paced Transition Plan with respect to derivatives, the ARRC was reconstituted in 2018 with an expanded membership to help ensure the successful implementation of the Paced Transition Plan and to serve as a forum for cash and derivatives market participants to address the risks of severe market disruption that could result from the cessation of LIBOR and develop and support liquidity in SOFR-based products across cash and derivatives markets.

Significant progress has been made in establishing industry standard fallback language for financial contracts directly linked to USD LIBOR:

- In October 2020, the International Swaps and Derivatives Association ("ISDA") finalized Supplement 70 to the 2006 ISDA definitions – which took effect on January 25, 2021 – and launched the 2020 IBOR Fallbacks Protocol. Both the Supplement and the Protocol provide fallback language intended to be used in derivative contracts directly linked to a LIBOR rate (including USD LIBOR) as well as some other IBOR rates.
- Since 2018, the ARRC has published recommended fallback language for various products in the cash market directly linked to USD LIBOR (floating rate notes, loans, mortgages and securitizations)

However, contracts that are linked to USD LIBOR in an indirect manner through reference to USD ICE Swap Rate are not covered by either ISDA Supplement 70 or by the ARRC-recommended fallback language.

The same challenge exists in British Pound Sterling (GBP) for contracts referencing the GBP LIBOR ICE Swap Rate. The Working Group on Sterling Risk-Free Rates ("Sterling Working Group") has recently published a paper outlining a formula that can be used as fallback for the GBP LIBOR ICE Swap Rate. It consists in a spread-adjusted version of the GBP SONIA ICE Swap Rate – with the spread tied to the spread adjustment for the corresponding GBP LIBOR tenor in ISDA Supplement 70– and incorporates technical adjustments to account for differences in conventions of the underlying swaps. In this paper, we show how to derive a similar formula that could be used for a fallback from the USD LIBOR ICE Swap Rate to a spread-adjusted SOFR Swap Rate.

A. ICE Swap Rate

The ICE Swap Rates, formerly known as ISDAFIX and sometimes referred to as the CMS (constant-maturity swap) rates, represents the mid-market fixed rate for fixed/float interest rate swaps for a set of tenors at a specified time of the day.

They are published by the ICE Benchmark Administration (IBA), using a waterfall methodology:

- Level 1: Executable levels on electronic trading venues
- Level 2: Indicative dealer-to-client levels on electronic trading venues
- Level 3: Movement interpolation[1]
- If none of these steps succeeds, no rate is published

[1] *Movement interpolation is the linear interpolation of the daily rate movement between adjacent tenors and the preceding day's rate if they have been calculated based on the Level 1 or Level 2 methodologies*

These rates are primarily used to:

- Compute the settlement amount for cash-settled swaptions that use Collateralized Cash Price
- Compute the cashflows / payouts of CMS-linked derivatives (e.g. curve options)
- Compute the cashflows / payouts of CMS-linked debt instruments (e.g. structured notes)

For U.S. dollar (USD), the most commonly used version of the ICE Swap Rates is calculated around 11am Eastern time and references a standard fixed/float cleared interest rate swap with the floating leg referencing 3m USD LIBOR and paying quarterly with an ACT/360 day count convention and with the fixed leg paying semi-annually with a 30/360 day count convention. The ICE Swap Rate is therefore dependent on transactions and/or quotations referencing USD LIBOR and therefore on the availability of a representative USD LIBOR.

IBA has published a consultation proposing that the publication of key tenors of USD LIBOR end as of June 30, 2023 and that the publication of LIBOR in other currencies end as of December 31, 2021. For ICE Swap Rates based on LIBOR swaps, IBA has further noted that there can be no certainty or guarantee that those ICE Swap Rate settings in respect of which LIBOR serves as the floating leg for the relevant interest rate swaps will be able to be published after December 31, 2021.

It is expected that once SOFR swap liquidity increases on electronic trading venues, the IBA or other vendors will start publishing a SOFR version of these Swap Rates.[2]

In this paper, we will refer to the 1100 USD LIBOR ICE Swap Rate as the "LIBOR ISR" and to the expected SOFR Swap Rate as the "SOFR SR".

We will also make the following assumptions in laying out the suggested formula below:

- The SOFR SR will be published as a 'live' benchmark prior to 3m USD LIBOR being discontinued or becoming non-representative
- The SOFR SR will be calculated at the same time as the LIBOR ISR (around 11am Eastern time)
- The SOFR SR will be published for all thirteen tenors for which the LIBOR ISR is published
- The convention for the swaps whose levels are used to compute the SOFR SR will be annual payment with an ACT/360 day count convention on both the fixed and the floating leg

B. Impact of LIBOR Cessation

It is likely that there will be no available cleared USD LIBOR swap data that can be used to compute and publish the LIBOR ISR after June 30, 2023:

- On December 15, 2020, LCH published a consultation on its intention to convert all cleared LIBOR swaps into cleared SOFR swaps on or shortly prior to the cessation date and to no longer accept LIBOR swaps for clearing after that date. On February 16, 2021, LCH provided an update after reviewing responses to the consultation and confirmed that they intended to move forward with this approach, with the exact date of the conversion and technical details to be communicated at a later date.
- On January 14, 2021, CME published a discussion document on a proposed conversion of all cleared LIBOR swaps into cleared SOFR swaps prior to the cessation date.

As a result, market participants will likely need to use LIBOR ISR contractual fallbacks after that date for LIBOR swaptions that are settled using Collateralized Cash Price settlement as well as CMS-linked derivatives and debt instruments.

In addition, if the clearinghouses no longer allow USD LIBOR swaps for clearing after that date (including if they are the result of the physical settlement of a swaption), then swaptions using Physical Cleared

[2] *In GBP, the IBA started publishing the GBP SONIA ICE Swap Rate as a 'beta' rate on October 2, 2020 and as a 'live' benchmark on December 14, 2020.*

settlement would fall back to Collateralized Cash Price settlement and be impacted as well by a cessation of the LIBOR ISR.

In almost all cases, existing contractual LIBOR ISR fallbacks consist in conducting a dealer poll and/or in relying on calculation agent determination. Neither of those would be practical or desirable in the context of a cessation of the LIBOR ISR.

Note that neither ISDA Supplement 70 nor ARRC-recommended fallback language for debt instruments have addressed the discontinuation of the LIBOR ISR. In the case of ISDA Supplement 70, this is because the LIBOR ISR is a different benchmark than USD LIBOR and therefore represented by a different 'Rate Option' in the ISDA definitions. Therefore, new LIBOR swaptions and CMS-linked derivatives and debt instruments continue to be issued with dealer poll and/or calculation agent determination as fallbacks.

To avoid disruption to these contracts that could result from the cessation of LIBOR, the ARRC Market Structure and Paced Transition Working Group has developed a suggested fallback formula for the LIBOR ISR that is presented below.

C. Impact of Supervisory Restrictions After Year-End 2021

On November 30, 2020, the Federal Reserve, the FDIC and the OCC issued a statement encouraging "banks to cease entering into new contracts that use USD LIBOR as a reference rate as soon as practicable and in any event by December 31, 2021".

While the agencies noted that "there may be limited circumstances when it would be appropriate for a bank to enter into new USD LIBOR contracts after December 31, 2021", for example risk-reducing transactions, it is possible that there will not be sufficient executable or indicative levels quoted on electronic trading venues for the IBA to publish the LIBOR ISR after December 31, 2021 even if LIBOR is still published as a representative fixing until June 30, 2023.

To the extent that the LIBOR ISR is not published for an extended period of time or is discontinued altogether between December 31, 2021 and June 30, 2023, market participants would need to rely on existing contractual fallbacks such as dealer polls and/or calculation agent determination.

While this would be suboptimal from a practical standpoint, it would be difficult to get counterparties to agree to use the suggested fallback formula for LIBOR ISR fixings prior to LIBOR cessation.

For example, doing so would result in a bifurcation between physically-settled swaptions (that would still settle into a LIBOR swap) and cash-settled swaptions (that would reference a SOFR swap using a fixed spread adjustment that will likely differ from the market-implied basis between SOFR and LIBOR at the time).

To avoid such a bifurcation and encourage widespread adoption, the suggested fallback formula is only intended to be used for LIBOR ISR fixings after 3m LIBOR has been discontinued or become non-representative, even if the LIBOR ISR has been discontinued prior to that date.

D. Proposed Fallback Formula for the GBP LIBOR ICE Swap Rate

Addressing the impact of LIBOR cessation on contracts referencing the LIBOR ICE Swap Rates (or similar rates published by other administrators) is necessary in currencies other than USD, for example GBP and JPY.

The Sterling Working Group, through its Non-Linear Derivatives Task Force ("NLTF") has been focused on the topic and on February 12, 2021, it published a paper suggesting a fallback formula for the GBP LIBOR ISR.

The Market Structure and Paced Transition Working Group, on behalf of the ARRC, and the NLTF, on behalf of the Sterling Working Group, have engaged in an international collaboration aimed at addressing this topic.

The fallback formula suggested for the GBP LIBOR ISR in the Sterling Working Group paper was derived in a similar way than the formula suggested herein for the USD LIBOR ISR. The differences in the formulas come from USD and GBP LIBOR swaps having different day count conventions payment frequencies and therefore requiring different adjustments.

			USD	GBP (Tenor >1Y)	GBP (Tenor = 1Y)
Day Count Convention	LIBOR Swap	Fixed Leg	30/360	ACT/365	ACT/365
		Floating Leg	ACT/360	ACT/365	ACT/365
	RFR Swap	Fixed Leg	ACT/360	ACT/365	
		Floating Leg	ACT/360	ACT/365	
Payment Frequency	LIBOR Swap	Fixed Leg	Semi-annual	Semi-annual	Annual
		Floating Leg	Quarterly	Semi-annual	Quarterly
	RFR Swap	Fixed Leg	Annual	Annual	
		Floating Leg	Annual	Annual	

Part II. Developing a Fallback Formula for the LIBOR ISR

In developing a fallback formula for the LIBOR ISR, the ARRC Market Structure and Paced Transition Working Group relied on the following key principles:

1. Consistency with the fallback for 3m LIBOR used in ISDA Supplement 70
2. Avoidance of value transfers and of disincentives to adopt this fallback formula
3. Simplicity and transparency by using a closed-form formula with the SOFR SR as the only variable input

Given that the LIBOR ISR is the fixed rate of a fixed/float interest rate swap with 3m LIBOR as the floating rate and that the fallback for 3m LIBOR in ISDA Supplement 70 is SOFR compounded in arrears plus a fixed spread adjustment, it might appear that applying the ISDA spread adjustment for 3m LIBOR directly to the SOFR SR would ensure consistency with ISDA Supplement 70.

However, such an approach would result in potential value transfer and potential disincentives for market participants to adopt this fallback formula.

It does not account for the difference in day count convention between:

- The fixed leg of a LIBOR fixed/float swap (on which the LIBOR ISR is quoted), which is 30/360
- The fixed leg of a SOFR fixed/float swap (on which the SOFR SR will be quoted), which we assume to be ACT/360
- The floating leg of a LIBOR swap (on which the ISDA fallback spread will apply), which is ACT/360

It also does not account for the difference in payment frequency between:

- The fixed leg of a LIBOR fixed/float swap (on which the LIBOR ISR is quoted), which is semi-annual
- The fixed leg of a SOFR fixed/float swap (on which the SOFR SR will be quoted), which we assume to be annual
- The floating leg of a LIBOR swap (on which the ISDA fallback spread will apply), which is quarterly

To account for both of these differences, the approach could be improved by using the following formula:

$$(1)\ Fallback\ LIBOR\ ISR = SOFR\ SR * \frac{AV_{SOFR\ Swap,Fixed\ Leg}}{AV_{LIBOR\ Swap,Fixed\ Leg}} + ISDA\ Spread(3m\ LIBOR) * \frac{AV_{LIBOR\ Swap,Floating\ Leg}}{AV_{LIBOR\ Swap,Fixed\ Leg}}$$

Where:

- $AV_{LIBOR\ Swap,Fixed\ Leg}$ is the annuity value of the fixed leg of a LIBOR swap
- $AV_{SOFR\ Swap,Fixed\ Leg}$ is the annuity value of the fixed leg of a SOFR swap
- $AV_{LIBOR\ Swap,Floating\ Leg}$ is the annuity value of the floating leg of a LIBOR swap

The main drawback of this formula is that there is no official benchmark or index that can be used for the annuity values.

Subject to some simplifying assumptions, it can be transformed into the following closed-form formula with the SOFR SR as the only variable input. This is the suggested fallback formula.

$$(2)\ Fallback\ LIBOR\ ISR = \frac{365.25}{360} * \left[2 * \left(\sqrt{1 + SOFR\ SR} - 1\right) + ISDA\ Spread\ (3m\ LIBOR) * \frac{1}{2} * \left(\sqrt[4]{1 + SOFR\ SR} + 1\right)\right]$$

The ratio of $\frac{365.25}{360}$ is intended to correct for the difference in the numerator of the day count convention between the fixed leg of a SOFR fixed/float swap and the floating leg of a LIBOR fixed/float swap on one hand (actual number of calendar days, for a total of 365.25 days per year on average after accounting for leap years) and the fixed leg of a LIBOR fixed/float swap on the other hand (every month assumed to have 30 days, for a total of 360 days per year).

The other adjustments are intended to correct for the difference in payment frequency as described above. The Appendix describes in more detail how this approximation was derived.

As mentioned above, the suggested fallback formula was derived under the assumption that the SOFR SR used is computed as the mid-level fixed rate around 11am Eastern Time of a fixed/float interest rate swap with SOFR as the floating rate and with annual payment frequency and ACT/360 day count convention on both the fixed and the floating legs.

This formula is not intended to be used if the SOFR SR is computed at a different time or is based on a swap with a different day count convention or a different payment frequency than assumed in this document.

Appendix. Derivation of the Suggested Fallback Formula

Let's assume that formula (1) below properly adjusts for the difference in payment frequency and day count conventions between the fixed leg of the LIBOR swap (on which the LIBOR ISR is quoted), the fixed leg of the SOFR swap (on which the SOFR SR will be quoted) and the floating leg of the LIBOR swap (on which the ISDA spread adjustment will be applied).

(1) $Fallback\ LIBOR\ ISR$

$$= SOFR\ SR * \frac{AV_{SOFR\ Swap,Fixed\ Leg}}{AV_{LIBOR\ Swap,Fixed\ Leg}} + ISDA\ Spread(3m\ LIBOR) * \frac{AV_{LIBOR\ Swap,Floating\ Leg}}{AV_{LIBOR\ Swap,Fixed\ Leg}}$$

For both annuity value ratios, the numerator uses an ACT/360 day count fraction while the denominator uses a 30/360 day count fraction. As a result, the formula can be transformed into:

$$Fallback\ LIBOR\ ISR = \frac{ACT}{360} * \left[SOFR\ SR * \frac{AV_{1y}}{AV_{6m}} + ISDA\ Spread(3m\ LIBOR) * \frac{AV_{3m}}{AV_{6m}}\right]$$

Where:

- AV_{1y} is the annuity value assuming annual cashflows and an ACT/360 day count convention
- AV_{6m} is the annuity value assuming semi-annual cashflows and an ACT/360 day count convention
- AV_{3m} is the annuity value assuming quarterly cashflows and an ACT/360 day count convention

Let's define $SOFR\ Rate_{3m\ Fixed}$ and $SOFR\ Rate_{6m\ Fixed}$ as the SOFR swap rates with a quarterly and semi-annual payment frequency on the fixed leg (respectively) but otherwise retaining an annual payment on the floating leg and an ACT/360 day count convention on both legs.

By definition:

$$SOFR\ SR * AV_{1y} = SOFR\ Rate_{6m} * AV_{6m} = SOFR\ Rate_{3m} * AV_{3m} = PV\ of\ the\ Floating\ Leg$$

The fallback formula can therefore be rewritten as:

$$Fallback\ LIBOR\ ISR = \frac{ACT}{360} * \left[SOFR\ Rate_{6m} + ISDA\ Spread(3m\ LIBOR) * \frac{SOFR\ Rate_{6m}}{SOFR\ Rate_{3m}}\right]$$

The following approximations are made:

$(1 + SOFR\ SR) \approx \left(1 + \frac{SOFR\ Rate_{6m}}{2}\right)^2$ and therefore $SOFR\ Rate_{6m} \approx 2 * (\sqrt{1 + SOFR\ SR} - 1)$

$(1 + SOFR\ SR) \approx \left(1 + \frac{SOFR\ Rate_{3m}}{4}\right)^4$ and therefore $\frac{SOFR\ Rate_{6m}}{SOFR\ Rate_{3m}} \approx \frac{2*(\sqrt{1+SOFR\ SR}-1)}{4*(\sqrt[4]{1+SOFR\ SR}-1)}$

This can be simplified further to:

$$\frac{SOFR\ Rate_{6m}}{SOFR\ Rate_{3m}} \approx \frac{1}{2} * \frac{\left(\sqrt{1 + SOFR\ SR} - 1\right) * \left(\sqrt[4]{1 + SOFR\ SR} + 1\right)}{\left(\sqrt[4]{1 + SOFR\ SR} - 1\right) * \left(\sqrt[4]{1 + SOFR\ SR} + 1\right)}$$

$$\frac{SOFR\ Rate_{6m}}{SOFR\ Rate_{3m}} \approx \frac{1}{2} * \frac{\left(\sqrt{1 + SOFR\ SR} - 1\right) * \left(\sqrt[4]{1 + SOFR\ SR} + 1\right)}{\left(\sqrt{1 + SOFR\ SR} - 1\right)}$$

$$\frac{SOFR\ Rate_{6m}}{SOFR\ Rate_{3m}} \approx = \frac{1}{2} * \left(\sqrt[4]{1 + SOFR\ SR} + 1\right)$$

Such that the fallback formula can be approximated as:

$$Fallback\ LIBOR\ ISR \approx \frac{ACT}{360} * \left[2 * \left(\sqrt{1 + SOFR\ SR} - 1\right) + ISDA\ Spread(3m\ LIBOR) * \frac{1}{2} * \left(\sqrt[4]{1 + SOFR\ SR} + 1\right)\right]$$

Finally, the "actual" number of days for a calendar year can be approximated as 365.25 (to account for leap years) such that we reach the suggested fallback formula:

(2) $$Fallback\ LIBOR\ ISR = \frac{365.25}{360} * \left[2 * \left(\sqrt{1 + SOFR\ SR} - 1\right) + ISDA\ Spread\ (3m\ LIBOR) * \frac{1}{2} * \left(\sqrt[4]{1 + SOFR\ SR} + 1\right)\right]$$