

**ARRC Consultation on Spread Adjustment Methodologies for Fallbacks in Cash Products  
Referencing USD LIBOR**  
January 21, 2020

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This Consultation seeks views on the appropriate spread adjustment methodology the ARRC should recommend as part of its fallback provision recommendations for cash products referencing LIBOR. The ARRC welcomes responses to the consultation from the widest possible range of stakeholders, including but not limited to, cash market participants in floating rate notes, syndicated loans, business loans, securitizations and retail consumer products referencing LIBOR. Respondents to previous consultations expressed strong support for the ARRC to recommend spread adjustments as part of its fallback provision recommendations, and the ARRC has committed to do so. To that end, the ARRC intends to recommend a static spread adjustment that would be fixed at a specified time at or before LIBOR’s cessation and make the spread-adjusted rate comparable to LIBOR by minimizing the expected change in the value arising from the move to a replacement benchmark based on the Secured Overnight Financing Rate (SOFR).

## **Part I. ARRC Consultation Overview**

### **A. 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.

The [ARRC’s Second Report](#) noted that most contracts for products referencing LIBOR do not appear to have envisioned the permanent or indefinite cessation of LIBOR and have fallbacks inconsistent with their economic intent if this event occurred. The ARRC formed several working groups to focus on various markets and published its [Guiding Principles for More Robust LIBOR Fallback Contract Language](#) to create a framework for fallback language in cash products. The ARRC also established a set of [Guiding Principles](#) that it believes are uniquely applicable for consumer loan products. In furtherance of the principles it has established, the ARRC [consulted on and published recommended fallback language](#) for market participants to consider for new issuances of Floating Rate Notes (FRNs), Syndicated and Bilateral Business Loans, Securitizations, and Residential Closed-end Adjustable Rate Mortgages (ARMs) referencing LIBOR.

These recommendations set forth robust fallback provisions that market participants may elect to voluntarily adopt to define the trigger events<sup>1</sup>, and allow for the selection of a successor rate<sup>2</sup> and a spread adjustment (or in the case of ARMs, a replacement index that would already incorporate a recommended spread adjustment) between LIBOR and the successor rate to account for differences between these two benchmarks. The ARRC has issued voluntary “hardwired” fallback recommendations for each product, which provide specific, pre-determined waterfalls for selecting successor rate and spread adjustments, and also has offered alternative “amendment” language for bilateral and syndicated loans referencing LIBOR, which set out mechanisms for the parties to the loan contract to determine a successor rate and any spread adjustment.

As part of the ARRC’s consultations for the fallback provisions, respondents expressed strong support for the ARRC to recommend spread adjustments for these fallback provisions for cash products, and the ARRC has committed to do so. These adjustments are the subject of the current consultation, and are intended to establish a static spread adjustment that would be fixed at a specified time at or before LIBOR’s cessation and would reflect and adjust for the historical differences between LIBOR and SOFR in order to make the spread-adjusted rate comparable to LIBOR in a fair and reasonable way, thereby minimizing the

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<sup>1</sup> A trigger event is an occurrence that precipitates the conversion from LIBOR to a new reference rate.

<sup>2</sup> The successor rate is the reference rate that would replace LIBOR in contracts. The ARRC has recommended SOFR as the successor rate for U.S. dollar contracts.

impact to borrowers and lenders. Following several consultations, the International Swaps and Derivatives Association (ISDA) has determined that similar spread adjustments to the ones considered in this consultation are appropriate for derivatives contracts.

The extent to which any market participant decides to implement or adopt any suggested contract language is completely voluntary. Each market participant should make its own evaluation and decision about whether or to what extent any suggested contract language, spread adjustment, or spread-adjusted replacement index is adopted. It is important to emphasize that any ARRC-recommended spread adjustments are intended for use in LIBOR contracts that have incorporated the ARRC's recommended hardwired fallback language or for legacy LIBOR contracts in which parties are able to and choose to select an ARRC recommended spread-adjusted rate as a fallback. The recommended spread adjustments would not and are not intended to apply to new contracts referencing SOFR.

## **B. Background on SOFR**

On June 22, 2017, the ARRC [identified](#) SOFR as its recommended alternative to LIBOR after considering a comprehensive list of potential alternatives, including other term unsecured rates, overnight unsecured rates such as the Effective Federal Funds Rate ("EFFR") and the Overnight Bank Funding Rate ("OBFR"), other secured repurchase agreements ("repo") rates, U.S. Treasury bill and bond rates, and overnight index swap rates linked to EFFR. After extensive discussion, the ARRC preliminarily narrowed this list to two rates that it considered to be the strongest potential alternatives: OBFR and some form of overnight Treasury repo rate. The ARRC discussed the merits of and sought feedback on both rates in its 2016 [Interim Report and Consultation](#) and in [a public roundtable](#). The ARRC made its final recommendation of SOFR after evaluating and incorporating feedback from the consultation and from the broad set of end users on its [Advisory Group](#).

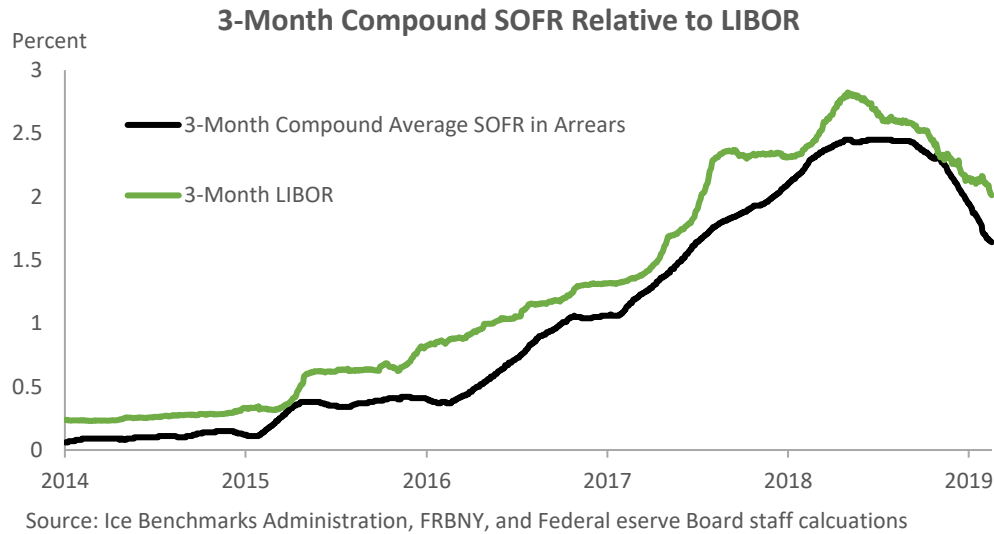
SOFR is a broad measure of the cost of borrowing cash overnight collateralized by U.S. Treasury securities. SOFR is determined based on transaction data composed of: (i) tri-party repo, (ii) General Collateral Finance (GCF) repo, and (iii) bilateral Treasury repo transactions cleared through Fixed Income Clearing Corporation (FICC). SOFR is representative of general funding conditions in the overnight Treasury repo market. As such, it will reflect an economic cost of lending and borrowing relevant to the wide array of market participants active in the financial markets. In terms of the transactions underpinning SOFR, SOFR has the widest coverage of any Treasury repo rate available. Averaging over \$1 trillion of daily trading, transaction volumes underlying SOFR are far larger than the transactions in any other U.S. money market and dwarf the volumes underlying LIBOR.<sup>3</sup>

FRBNY, which administers SOFR in cooperation with the Office of Financial Research ("OFR"), began publishing SOFR on April 3, 2018. SOFR is published on a daily basis by the FRBNY on its [website](#) at approximately 8:00 a.m. eastern time. FRBNY and the OFR have further proposed publishing compound averages of SOFR and a SOFR index that can allow calculation of compound averages of SOFR over any period of business days, with publication expected to begin in the first half of 2020. These kinds of

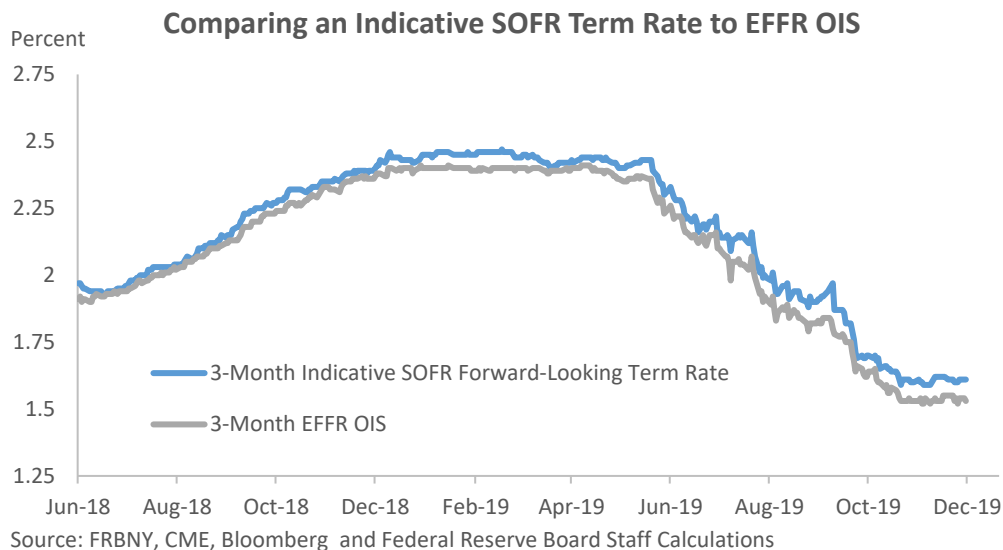
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<sup>3</sup> Additional information about SOFR and other Treasury repo reference rates is available at <https://www.newyorkfed.org/markets/treasury-repo-reference-rates-information>.

averages, which are the forms of SOFR referenced in financial contracts, are generally less volatile than comparable LIBOR rates (as shown in the next Figure).



In addition, as described in the Paced Transition Plan, the ARRC has also set the goal of the development of forward-looking term rates based on SOFR derivatives markets, but these are not expected to be produced before 2021 and their production cannot be guaranteed. These forward-looking term SOFR would be available at the beginning of each interest period, similar to LIBOR. Because the term rates would be derived from SOFR derivatives (futures or overnight index swaps (OIS)) markets, it would reflect market expectations of SOFR, rather than SOFR itself or repo markets directly. Staff economists at the Board of Governors of the Federal Reserve are producing [indicative term rates](#) that could help market participants understand how these forward-looking term rates are likely to behave before it is possible to produce a set of robust, IOSCO-compliant term reference rates that could be used in financial contracts. As shown in the figure below, the indicative term rates move closely with EFRR OIS rates.



### C. The ARRC's Fallback Language Recommendations<sup>4</sup>

The ARRC's "hardwired" recommended fallback language for FRNs, Securitizations, Syndicated and Bilateral Business Loans, and ARMs each would replace LIBOR with an alternative (the "Benchmark Replacement", or in the case of ARMs, the "Replacement Index") that encompasses both a SOFR-based successor rate and a spread adjustment recommended by the ARRC as a "Relevant Governmental Body" (defined in the fallback language as the Federal Reserve Board and/or FRBNY, or a committee officially endorsed or convened by the Federal Reserve Board and/or FRBNY). The ARRC's recommended fallback language for ARMs is simpler in structure, but designed to achieve comparable outcomes to the hardwired recommendations for other cash products.

Each set of recommendations sets out specific trigger events that would initiate a move from LIBOR to SOFR. All of the ARRC's fallback recommendations include three triggers related to a permanent or indefinite cessation of LIBOR or public statement by the regulator of LIBOR, the U.K. Financial Conduct Authority, that LIBOR is no longer representative.<sup>4</sup>

While the ARRC's recommendations for ARMs refer directly to a replacement index recommended by the ARRC for use in consumer products, the ARRC's hardwired recommended fallback language for FRNs, Securitizations, and Syndicated and Bilateral Business Loans provide more detailed waterfalls to determine the Benchmark Replacement rate.

The first step in the waterfall is the sum of a forward-looking term SOFR (e.g. 1-month SOFR, 3-month SOFR) and an adjustment that is selected, endorsed or recommended by the Relevant Governmental Body. As noted above, while there are no forward-looking term SOFR rates currently available for use in commercial contracts and their production cannot be guaranteed, the ARRC intends to endorse forward-looking term SOFR rates provided a consensus among its members can be reached that a robust, IOSCO-compliant term<sup>5</sup> benchmark that meets appropriate criteria set by the ARRC can be produced.

If the ARRC has not recommended a forward-looking term SOFR rate, then the second step in the hardwired waterfalls for floating rate notes, securitizations, and syndicated and bilateral business loans is a compounded average of SOFR over the relevant compounding period and an accompanying spread adjustment. FRBNY has recently [proposed](#) daily publication of compounded SOFRs at commonly used maturities. This average of SOFR may be used either "in advance" or "in arrears," depending on the product. The ARRC has also noted that, for certain products such as some business loans, counterparties may choose to fall back to a simple average of SOFR rather than to a compound average. Historically, as noted in [A User's Guide to SOFR](#), the differences between simple and compound averages have been small.

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<sup>4</sup> Fallback recommendations for loans also include an early "opt-in" trigger that allow parties to mutually agree to transition from LIBOR at an earlier date, and the ARRC's securitizations recommendations allow a securitization to transition from LIBOR if a certain percent of the underlying assets has moved to a new rate.

<sup>5</sup> Prior to 2016, global groups focusing on benchmark reform had noted the need for more robust fallback provisions in derivatives and other financial instruments. Principle 13 of the *IOSCO Principles for Financial Benchmarks* provides that users should be encouraged by administrators to "take steps to make sure that contracts or other financial instruments that reference a benchmark have robust fallback provisions in the event of [cessation of] the referenced benchmark." See <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD415.pdf>, page 24.

Even if the ARRC recommends a forward-looking term SOFR, it has recognized that some counterparties in FRN, securitization, or business loan contracts may prefer to eliminate the first step in this waterfall and instead fall back directly to a compound average of SOFR, perhaps because they view it as simpler or because they wish to align with fallbacks in related derivatives, since ISDA's updated LIBOR definitions and protocol for derivatives contracts will fall back to a compound average of SOFR in arrears. The ARRC has indicated that a market participant's choice to eliminate the first step in its waterfall and to fall back directly to a compound average SOFR would be consistent with the ARRC's Guiding Principles for fallbacks.<sup>6</sup>

The spread adjustment (or its methodology) would be selected, endorsed or recommended by the Relevant Governmental Body. Respondents to the ARRC's consultations expressed strong support for the ARRC to recommend spread adjustments and to work to ensure that its recommended rates, spread adjustments, and spread-adjusted rates are published and made publicly available, and the ARRC has committed to do so following this consultation.

#### **D. ISDA's Fallbacks for Derivatives**

ISDA has completed several consultations with market participants on their preferences for fallback methodologies to be used for new and existing derivative contracts referencing LIBOR and other interbank offered rates. Cash market participants should be mindful of the anticipated ISDA fallbacks for derivatives because derivatives are used to hedge interest rate risk of cash products. Alignment of a spread adjustment for fallbacks across products would be in line with the ARRC's principles, would reduce basis risk and may also reduce operational, legal, tax, accounting and similar issues between loans, securitizations and notes and any related hedges. ISDA's methodological choices are also relevant to the ARRC because certain steps of the ARRC's fallback waterfalls refer to ISDA methodologies and because ISDA's process demonstrates that market participants can successfully coalesce around a set of static spread adjustments that in their opinion will fairly compensate for the move from LIBOR to overnight risk-free rates such as SOFR by making the spread-adjusted rate comparable to LIBOR.

Respondents to a [previous ISDA consultation](#) on fallbacks for derivatives referencing U.S. dollar LIBOR supported use of a compound average of SOFR set in arrears. A majority of respondents to ISDA's [recent consultation on parameters for derivatives markets](#) supported a static spread adjustment for derivatives that will be calculated as the median of the historical difference between a given tenor of U.S. dollar LIBOR and a compound average of the SOFR in arrears of corresponding tenor. The median difference will be calculated using the five years of historical data preceding a trigger event.<sup>7</sup> ISDA's spread adjustments for derivatives, which represent roughly 95 percent of all LIBOR exposures, will be static, meaning that they will be set at one point in time and will not be revised after they are determined. In the interim, before

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<sup>6</sup> See [Guiding Principles for More Robust LIBOR Fallback Contract Language](#) (for fallback language in cash products other than consumer loans) and the [Guiding Principles](#) (for consumer loan products).

<sup>7</sup> The consultation sought feedback from market participants on their preferences between a median with a 5-year lookback (supported by 61 percent of respondents) or a trimmed mean with a 10-year lookback (supported by 29 percent of respondents). There were significant differences in geographical preferences, however, with respondents from North America equally split between support for a median 5-year lookback and a trimmed mean of a 10-year lookback.

the spreads are fixed, Bloomberg will publish daily indicative spreads based on ISDA's adopted methodology.

Currently, ISDA's proposed fallback language only includes trigger events related to the cessation of LIBOR. ISDA's spread adjustments would be set as of the business day before a public statement or publication or information by the LIBOR administrator or a regulator supervisor or other official sector body with jurisdiction over LIBOR that LIBOR had or would permanently or indefinitely cease. Although the spread adjustments would be set just prior to the time of such an announcement, the move to the spread adjusted compound average of SOFR would come in to effect only when LIBOR did permanently or indefinitely cease.

As noted above, the ARRC's fallback recommendations also include a pre-cessation trigger, which would move LIBOR contracts to a successor rate if LIBOR's regulator issues a public statement that LIBOR is no longer representative. While ISDA is considering including such a trigger, it has not made any decision to do so and has not specified how inclusion would impact its proposed timing for setting the spread adjustment.

#### **E. Why a Spread Adjustment is Required**

Although SOFR is far more robust than LIBOR, it also has certain distinguishing features from LIBOR. SOFR is an overnight, secured nearly risk-free rate, while LIBOR is an unsecured rate published with several different maturities (overnight/spot next, one week, one month, two months, three months, six months and one year). Because LIBOR is unsecured and therefore includes an element of bank credit risk, it may be higher than SOFR. LIBOR may also include term premia and reflect supply and demand conditions in wholesale unsecured funding markets that also could lead to differences with SOFR.<sup>8</sup> The ARRC is seeking views of market participants on spread adjustments in response to the views provided by respondents for the components of the fallback provisions before making recommendations to address these differences.

As will be discussed further in the following sections, the ARRC is consulting on specific methodologies for calculating its recommended spread adjustments. This spread is intended to support the recommended fallback language for the successor rate at the trigger event. Although the methodology would be the same across different tenors of LIBOR, it would be applied to each LIBOR tenor separately, so that there will be a separate recommended spread adjustment calculated for 1-month, 2-month, 3-month, 6-month and 1-year LIBOR. The calculated spread adjustment would generally differ for each tenor of LIBOR, even if the methodology used to calculate each is the same. Because 1-week and overnight LIBOR are relatively little used in financial contracts, the ARRC is consulting here on whether recommended spread adjustments are necessary for these LIBOR tenors.

The ARRC's spread recommendations for the fallback provisions at the trigger event, like ISDA's, will be static – that is, fixed at a point in time upon the occurrence of a trigger event. The ARRC is not considering

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<sup>8</sup> While forward looking term SOFR rates may also have several different maturities, these rates would not include the type of bank credit risk included in LIBOR, and they would also require a spread adjustment when used as fallback rates for LIBOR.

dynamic spread adjustments because these would need to be based on the same wholesale unsecured funding markets that underpin LIBOR and that have now grown to be so thin.<sup>9</sup> As noted in the [ARRC's Interim Report and Consultation](#), the ARRC considered term unsecured lending rates as it sought alternatives to LIBOR, but did not recommend them for the following reasons:

- Limited Transactions. Even in normal times, short-term wholesale unsecured transactions are now relatively sparse.
- Not Robust to Stress. Term wholesale unsecured borrowing is substantially less frequent during periods of stress, particularly at longer maturities. For example, the Federal Reserve was able to compute three-month AA-rated financial CP rates for only 10 of the 40 trading days over November and December 2008.
- Unstable Sample. The sample of firms that borrow in short-term unsecured wholesale markets is not stable over time because firms access these markets intermittently. This will create fluctuations in observed rates unless daily changes in the credit quality of the firms accessing these markets is controlled for, something that is technically difficult to do without changing the basic nature of the benchmark. The sample of firms is also not stable across maturities, as weaker (stronger) firms typically borrow more at shorter (longer) tenors. This difference is heightened during times of stress.

In the table below, we show the mean absolute error over 1999-2019 that would have been incurred on a loan that moved from LIBOR to the effective federal funds rate<sup>10</sup> plus a static spread. In addition, we compare that to the mean absolute error for a LIBOR loan that moved to the Federal Reserve's financial CP series, which is used here as a proxy for a dynamic spread adjusted rate. The table demonstrates that a static spread of the type that ISDA will use for derivatives and that the ARRC is considering here can produce results that are as accurate as a potentially dynamic spread. The financial CP series measures rates in the same unsecured funding markets that are reflected by LIBOR, but despite that, as shown, historically, a static spread adjustment would have produced similarly sized errors.<sup>11</sup>

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<sup>9</sup> These views were recently echoed by Andrew Bailey, Chief Executive of the U.K. Financial Conduct Authority and Co-Chair of the Financial Stability Board's Official Sector Steering Group on benchmark reform: "we see no prospect of the administrator being able to continue with a dynamic credit spread – the likely choice would be between a risk-free rate plus fixed spread, or nothing." (see [LIBOR: Preparing for the End](#), July,15, 2019).

<sup>10</sup> We use EFFR because there is data for a much longer historical period than for SOFR.

<sup>11</sup> The comparable mean absolute error measuring the difference between 3-month LIBOR and the 3-month financial CP rate is 0.14, which is again similar to the errors found for static spread adjustments shown in Part III.



*Table 1: Historical Errors Between Returns on a LIBOR Loan and Spread-Adjusted Rates*

<i>Loan with 1-year remaining maturity</i>		Mean Absolute Error
	Static Spread Based on 5-Year Median Spread to SOFR In Advance	0.10
	Dynamic Spread Using 1-Month Financial CP Series	0.11
<i>Loan with 5-years remaining maturity</i>		Mean Absolute Error
	Static Spread Based on 5-Year Median Spread to SOFR In Advance	0.08
	Dynamic Spread Using 1-Month Financial CP Series	0.11

Data sources: FRBNY, Federal Reserve Board, Refinitiv, and Federal Reserve Board staff calculations. Annualized differences in returns (in percentage points) in a loan based on 1-month LIBOR and a loan based on a spread-adjusted rate. Mean Absolute Errors calculated over 1999-2019 and reported in percentage points.

## **Part II. Analysis of Parameter Choices for Spread Adjustments**

### **A. Overview**

Once LIBOR stops publication or has been found to no longer be representative, it will no longer be possible to know how a representative LIBOR rate would have behaved. Therefore, after the fact, it will not be possible to know whether any spread adjustment was effective. Because the spread adjustment methodologies need to be set and in place before LIBOR stops or is no longer representative, they must be judged by whether they are expected to minimize changes to the value of contracts. In this consultation document, we attempt to shed light on how one could evaluate spreads by showing how various methodological choices would have affected the historical accuracy of spread adjustments had the transition from LIBOR occurred in the past.

The analysis builds on the alternatives presented to participants in ISDA's recent consultations but also considers other potential approaches.<sup>12</sup> The ARRC's [Guiding Principles](#) recommended consistency between asset classes where feasible and appropriate, and some respondents may wish to align with ISDA's methodologies. There are several good reasons to do so, including that alignment with ISDA would minimize any basis in hedges, risk and may also reduce operational, legal, tax, accounting and similar issues between loans, securitizations and notes and any related hedges. Respondents may also have the general view that having multiple spread adjustments across different instruments may be confusing to market participants. The ARRC's Guiding Principles also acknowledged, however, that other considerations may lead to differences in approach for specific products, and some respondents may find that other methodologies are more appropriate for certain cash products.

We find that many of the ISDA spread adjustment parameters appear to also work well in cash markets. One area of difference that respondents may wish to consider is how to transition from the last reliable published value of LIBOR to the long-run spread-adjusted rate. One possibility, to be adopted by ISDA for derivatives, is that the switch to the long-run spread would occur immediately at the next reset date. Depending on rate differences, however, an immediate jump to a long-run spread adjustment could be undesirably abrupt for participants in some cash markets, and could also be inconsistent with the historical behavior of LIBOR spreads. With this concern in mind, we also consider transition periods that would more gradually adjust from the last value of LIBOR to a SOFR-based rate.

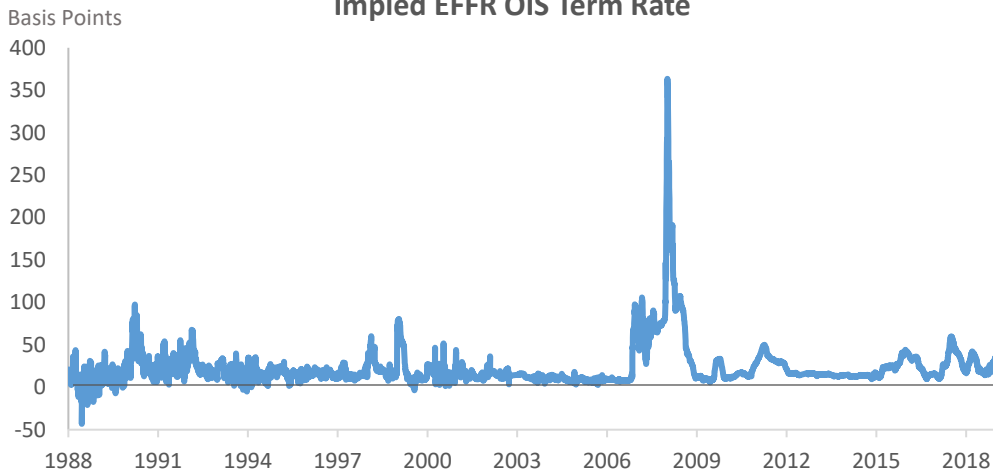
### **B. Parameter Choices**

ISDA's spread adjustments, and the spread adjustments discussed in this consultation, all rely on a measure of a long-run historical difference between LIBOR and SOFR-based rates. Historically, when LIBOR spreads have moved up or down, they have eventually reverted to long-run values as can be seen in the chart below.

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<sup>12</sup> Previous work relevant to the construction of SOFR references includes: [A User's Guide to SOFR](#), April 2019. [ISDA Consultation](#), November 2019. [ISDA Consultation](#), December 2018.

### Spread between 3-Month LIBOR and a 3-Month Futures Implied EFRR OIS Term Rate



Source: Ice Benchmarks Administration, Refinitiv, Federal Reserve Board Staff Calculations

Formal statistical tests confirm that this is the case: whenever LIBOR spreads have moved away from their long-run values, they have reverted back to the long-run value over time, on average within a year.<sup>13</sup> Forward curves from longer-dated LIBOR and EFRR OIS swaps data also indicate that market participants have generally expected LIBOR spreads to revert toward longer-run levels, even at the height of the financial crisis.

There is thus a sound basis for ISDA's methodology, and the methodologies considered in this consultation, in that LIBOR spreads should be expected to revert to long-run levels, but there are still a number of choices that need to be considered in selecting a recommended spread adjustment methodology:

- Should the same methodology and parameter choices be used to calculate recommended spread adjustments to a compound average in arrears, a compound average in advance, and a forward looking term rate?
- How should the long-run level of the difference between LIBOR and SOFR be measured?
- How far back in time should data be reviewed to estimate the long-run level?
- How quickly should the spread adjustment move to the long-run historical level?

We provide an overview of each of these considerations before turning to a more in depth examination in latter sections.

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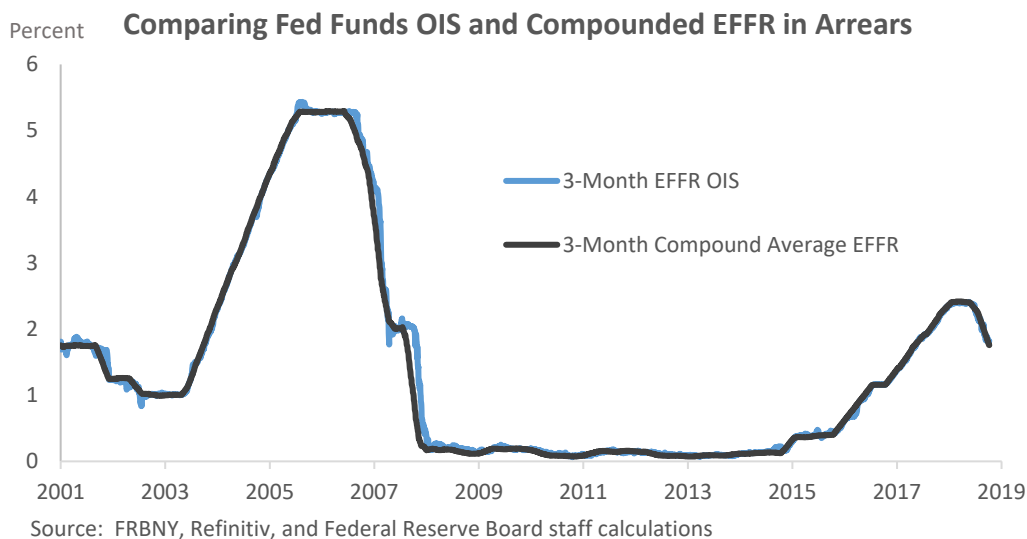
<sup>13</sup> Formally, Augmented Dickey-Fuller tests, Phillips-Perron tests, and Elliot, Rothenberg and Stock tests all strongly reject the presence of a unit root in the LIBOR-OIS spread using the data available from 1988-2019. Estimating an autoregressive process for the spread indicates that after one year, the spread will tend to have reverted to within very near (about 98.5 percent) the long-run level.

(i) *Should the same methodology be used to calculate spread adjustments to a compound average of SOFR in arrears, a compound average of SOFR in advance, and a forward looking the term SOFR rate?*

As noted in section I.C, the ARRC’s hardwired fallback recommendations for floating rate notes, securitizations, and syndicated and bilateral business loans would fall back to a forward-looking term SOFR rate if the ARRC has recommended one, or a compound average of SOFR either in arrears or in advance, depending on the choices made by the parties adopting the language, if a term rate has not been recommended or if the parties prefer to fall back to a compound average SOFR.

The ARRC thus may make recommendations for spread adjustments to three types of SOFR: a forward-looking term SOFR, a compound average of SOFR in arrears, and a compound average of SOFR in advance. In addition, if respondents believe it is helpful, the ARRC could also consider recommended spread adjustments for simple averages of SOFR.

In theory, different methodologies and parameter choices could be used for each version of SOFR. In practice, in the results below, we find that the same parameter choices appear to work well across the different versions of SOFR. This is perhaps not surprising, since the different versions are all closely linked. An average of SOFR in advance is simply a lagged version of an average in arrears, and the term rate will likely represent the market expectation of compound SOFR in arrears. As shown below, a term rate based on fed funds futures has historically moved very closely with a compound average of EFR. While there were some differences during the financial crisis, when monetary policy rates were unexpectedly and very sharply cut, the difference between a EFR term rate and EFR compound average has averaged less than a basis point both before and since the financial crisis.



(ii) *How should the long-run level of differences between LIBOR and SOFR be measured?*

In ISDA’s most recent market consultation about the adjustment, it asked market participants to express preferences between two specific statistics; a median of the historical differences between LIBOR and a compound average of SOFR in arrears, which was ultimately preferred by most respondents to ISDA’s

consultation, and a trimmed mean of the differences. In this analysis we widen the potential range of statistics to include a broader set of unweighted means, medians, and trimmed means. Other options were also explored, such as an exponentially weighted mean, but the results were not strong enough to justify the additional complexity of the calculations.

In the results shown in detail for different cash products in latter sections, we generally find that a median or trimmed mean would have historically performed a bit better than a simple average.

*(iii) How far back in time should the data be used to estimate the long-run level?*

As discussed in section 1.D, ISDA's spread adjustment will be based on a 5-year period of historical differences between LIBOR and a compound average of SOFR set in arrears available at the time of an announcement by LIBOR's administrator or regulator or official sector body with jurisdiction over LIBOR that LIBOR has or will permanently or indefinitely stop publication. Because the ARRC's recommendations include a pre-cessation trigger, it is proposed that the ARRC's recommended spread be set at the earlier of any date upon which it is announced that LIBOR has or will stop publication or has it is announced by the U.K. Financial Conduct Authority that LIBOR is no longer representative. Although LIBOR may continue publication after a judgement that it is no longer representative, the ARRC believes that it would not be appropriate to include such data, because at that stage LIBOR would have been officially declared to be no longer reliably accurate.

In the results shown in detail for different cash products in latter sections, we consider shorter and longer historically periods. We generally find that a 5- or 10-year lookback period would have historically performed a bit better than a shorter period.

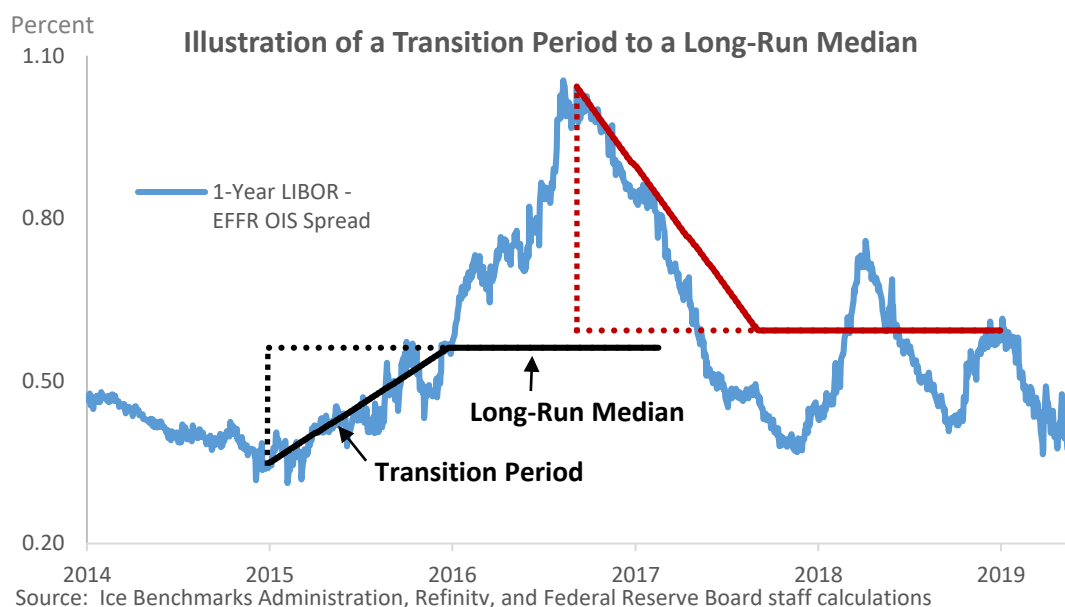
One issue that will not affect ISDA's considerations, because there should be sufficient data to estimate the historical difference between LIBOR and compound averages of SOFR, is how the historical difference between LIBOR and a forward-looking term SOFR rate could be calculated. As discussed, there is currently no forward-looking term SOFR rate recommended by the ARRC and such a rate may not exist before 2021, although there are indicative forward-looking SOFR term rate data going back to June 2018. As a consequence, there may be at most one-year or so of actual term rate data and about 3 and a half years of indicative term rate data available by the end of 2021, which would not be sufficient to match ISDA's 5-year historical lookback period. Further, if LIBOR's cessation were announced before 2021, there would be less data than that. There are a few ways to address this:

- One option would be to use a shorter sample to estimate a recommended spread for the forward-looking term SOFR rate.
- Another would be to use other sources of data. As noted above, the forward-looking term rate should be tightly linked to compound averages of SOFR in arrears (the average difference has been less than a basis point over the last five years). The recommended term-rate spread could be based on the historical difference between LIBOR and these compound averages during periods of time for which historical data on a term SOFR rate is unavailable.
- A third option would be to base the spread adjustment on the difference between LIBOR and EFR term OIS rates, on the grounds that SOFR term rates should move closely with EFR OIS rates as shown in Section 1.B.

(iv) *How quickly should the spread adjustment move back to its historical long-run level?*

In ISDA’s methodology for derivatives, the implementation of a spread based on the median long-run historical differences between LIBOR and compounded SOFR would occur immediately at the next reset date. Advantages of this approach are that there will be only one static spread adjustment for each LIBOR tenor and these spreads will be known on the trigger date (which is not possible with a transition period as discussed further below). Depending on rate differences, however, an immediate jump to a long-run spread adjustment could be undesirably abrupt for participants in some cash markets, and could also be inconsistent with the historical behavior of LIBOR spreads. Historically, LIBOR spreads have reverted to long-run levels within a period of about a year or so; a transition period would account for this at the time of a trigger event by starting at the recent level of the spread to LIBOR and then smoothly converging to the long-run spread level over the following year.

In the figure below, we demonstrate the potential difference between switching immediately to a long-run spread and more gradually moving toward that spread, using a 1-year transition period in which the recommended spread adjustment would move linearly to the long-run spread. We show two examples of the differences had the switch to the SOFR proxy occurred at different points in the post-crisis period when LIBOR was further away from a long-run median. Had LIBOR ceased to be representative in early 2015, without a transition period (the dashed black line), the spread adjustment (and the rate paid by the borrower) would have jumped up immediately by about 30 basis points. In reality, spreads did eventually move up, although not immediately. A 1-year linear transition from an unusually wide spread to the average (shown by the solid black line) would have avoided the sudden jump in rates and would have more accurately matched the subsequent moves in LIBOR. Had LIBOR instead ceased to be representative in mid-2016 when spreads were unusually high (shown by the red lines), without a transition period the spread adjustment (and the rate paid by the borrower) would have jumped down immediately by roughly 60 basis points. In reality, spreads moved down more gradually, and a 1-year linear transition would have more closely mimicked the actual behavior of LIBOR. Appendix 1 provides some further details describing exactly how a transition period could be implemented.

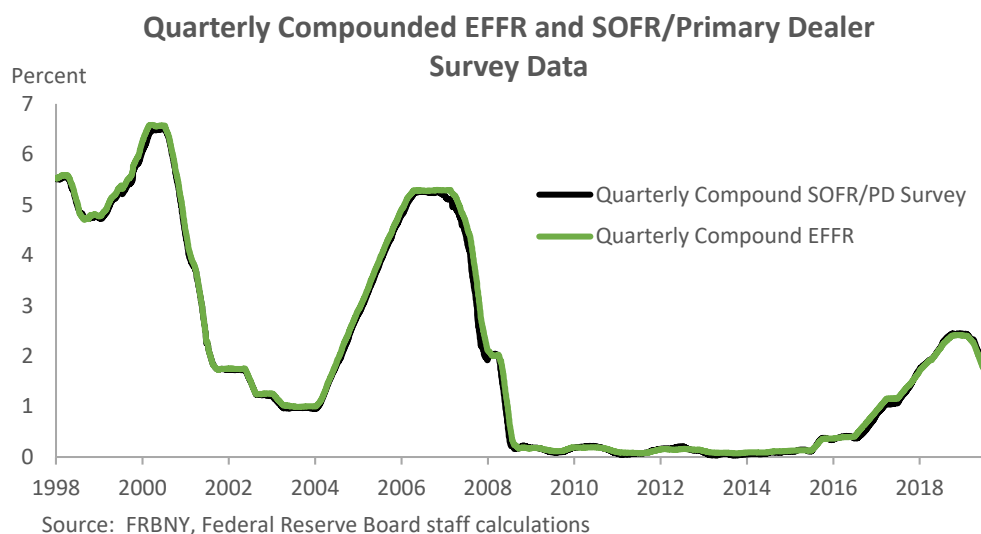


With these issues in mind, we also consider transition periods that would more gradually adjust from the last value of LIBOR to a SOFR-based rate. While adding a transition period does not have a large effect on the historical accuracy averaged over longer periods of time, it does have some positive impact on the short-run accuracy, and also can avoid a sudden jump up in rates paid by borrowers upon a transition to LIBOR. While ISDA’s methodology, which has no transition period, may be appropriate for some cash products, respondents may wish to consider whether there are some products, for example consumer products or bilateral business loans, for which a transition period could be a positive feature. One consideration to bear in mind is that the inclusion of a transition period would create some basis relative to the fallbacks for derivatives that may be used to hedge these cash products. Because the inclusion of a transition period would mean that the spread adjustments would not be known until the fallback is activated (and the spot spread is known) it could be potentially more difficult to model and hedge.

### C. Data and Methodology

To assess a variety of potential parameter choices, we use historical data to examine how accurate a given set of choices would have been if the transition away from LIBOR had occurred in the past. Given that it will not be possible to examine how an accurate LIBOR would have behaved after it has stopped publication or it has been announced that it is no longer representative, looking at past data may be a useful guide as respondents consider their preferences.

Although SOFR began production in April, 2018, as discussed in a recent [FEDS Note](#), pre-production and proxy data are available back to 1998. However, with parameter choices that could involve up to 10-years of data to compute a long-run spread and considering contracts that have 5 or more years remaining maturity, even this data sample is not long enough to consider some historical analysis, for example, how certain parameter choices would have behaved during the crisis or pre-crisis periods. Further, indicative SOFR forward-looking term rate data only begin in 2018. To examine a longer period than is available with this data, we take advantage of the long history of daily publication of EFFR to compare different methodologies over a variety of economic conditions. As shown in the chart, averages of EFFR move quite closely with averages of overnight repo rates like SOFR.



We proxy a forward-looking term rate using Fed Funds futures data and using the method outlined in Park and Heitfield (2019) to infer implied EFRR OIS rates, in the same way that indicative SOFR term rates are currently calculated. These data are available back to 1988, which, allowing for up to 10 years of data to calculate a historical long-run spread, provides a sample from 1999-2019 to examine how various spread adjustments would have behaved in the past. That sample period includes two full monetary policy and tightening cycles and covers the financial crisis.

To assess the historical accuracy of any set of parameter choices, we report mean absolute errors (MAEs) as summary statistics of the difference, over time, between realized LIBOR rates and the spread-adjusted rates for different hypothetical contracts. These statistics measure the size of differences between LIBOR and the spread-adjusted rate. Smaller values mean that the size of differences are smaller. Assuming that market participants would prefer a spread adjustment that minimizes the difference between LIBOR and the spread-adjusted successor rate, the ideal spread adjustment is one that historically would have produced a MAE of zero. In reality, any spread adjustment will have some difference with LIBOR, so the MAE will be larger than zero, but adjustments that historically would have produced smaller MAEs may be preferred.

We consider statistics for our observation period (1999-2019) as well as the post-crisis period. We generally illustrate the comparisons with medians of adjustable rate products with five years remaining to maturity at the time that LIBOR is deemed unrepresentative of market conditions but we also consider shorter and longer periods of remaining maturity.



### **Part III. Analysis of Spread Methodologies for Floating Rate Notes, Securitizations, and Business Loans**

In this section, we provide background analysis for a security or loan that pays LIBOR to help inform respondents as they answer the questions posed in Part V. We consider possible fallbacks to a spread-adjusted term rate or compounded averages, both in advance and in arrears. As a baseline, we initially assume that the security or loan has five years remaining maturity at the time LIBOR hypothetically became unrepresentative of market rates (or following an announcement that it will be discontinued) and compare historical results for different potential spread methodologies.

As discussed in Part II, one baseline consideration is whether the same methodology and parameter choices should be used to calculate recommended spread adjustments for the different potential versions of SOFR-based fallback rates. In we show historical mean absolute errors (MAEs) for a hypothetical 1-month LIBOR loan or security using several different variants of potential spread methodologies (a 5-year median and a 10-year trimmed mean, which were both considered in ISDA’s consultations, as well as a 2-year average for comparison) and the different potential versions of spread-adjusted rates (a spread-adjusted compound average in advance, a spread-adjusted compound average in arrears, and a spread-adjusted forward-looking term rate) using each methodology.

*Table 2: Comparing MAEs for Different Spread Methodologies Relative to 1-Month LIBOR\**

Spread Methodology	1-month term rate	1-month Compound Average in advance	1-Month Compound Average in arrears
2-year average	0.13	0.12	0.15
5-year median	0.07	0.08	0.09
10-year trimmed mean	0.07	0.06	0.08

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with monthly rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

As seen in the table, while there are differences across potential methodologies, the results of each methodological choice are similar across the different versions of fallback rate. The same basic result is found for other LIBOR tenors, including the results for 3-month LIBOR shown in Table 3.

*Table 3: Comparing MAEs for Different Spread Methodologies Relative to 3-Month LIBOR\**

Spread Methodology	3-month term rate	3-month Compound Average in advance	3-Month Compound Average in arrears
2-year average	0.20	0.21	0.26
5-year median	0.14	0.16	0.17
10-year trimmed mean	0.14	0.08	0.13

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with quarterly rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

While most respondents to the ARRC’s consultations preferred to fall back to a forward-looking SOFR term rate if the ARRC has recommended one, the result is these tables suggest that even falling back to a spread-adjusted compound average in advance would not have resulted in larger errors; and in fact, in some cases, might have resulted in smaller errors than a spread-adjusted term rate.

Tables 2 and 3 show historical results for the full period from 1999 to 2019 that compound average and term rate proxy data is available. Importantly, the results in these tables include the financial crisis, which created larger errors than might be anticipated in more stable economic settings. Table 4 shows that errors would have been markedly smaller in the post-crisis period, while still reinforcing the finding that each method works fairly similarly across the different potential versions of fallback rates.

*Table 4: Comparing Post-Crisis MAEs for Different Spread Methodologies Relative to 3-Month LIBOR\**

Spread Methodology	3-month term rate	3-month Compound Average in advance	3-Month Compound Average in arrears
2-year average	0.20	0.12	0.16
5-year median	0.08	0.10	0.06
10-year trimmed mean	0.06	0.04	0.02

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with quarterly rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 2010-May 2019.*

The finding that errors would have been notably smaller in the post-crisis period, when money market rates in general have exhibited much lower volatility than during the financial crisis, is probably not surprising. Nonetheless, the results suggest that if economic conditions remain relatively calm, the spread adjustments to be recommended by the ARRC could have very little associated error.

Average annualized errors are also likely to be smaller the longer the remaining maturity of the loan or security being referenced at the time that LIBOR stops, because any larger errors are more likely to “average out” over the remaining life of the instrument. Table 5 (which is based on the full period, including the financial crisis) shows that the annualized difference in returns between LIBOR and the potential spread-adjusted fallback rates tend to decline as the remaining maturity increases. Because the relationships between LIBOR and other money market rates have historically been fairly stable over long-periods of time, any deviations between LIBOR and the potential spread adjusted rates, when they occur, have washed out over time.

*Table 5: The Effects of Different Remaining Maturities on MAEs*

Spread-Adjusted rate	1 year	2 years	5 years	10 years
3 months in advance	0.32	0.26	0.16	0.15
3 months in arrears	0.35	0.31	0.17	0.20
3-month term	0.27	0.23	0.14	0.14

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with quarterly rate resets and with 1, 2, 4, or 10 years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019. Spread adjustments are calculated based on a 5-year median*

A second baseline consideration discussed in Part II that the ARRC is seeking views on how to measure historical differences between LIBOR and SOFR (e.g. a mean, a trimmed mean, or a median difference). As shown in Table 6, which compares historical results for a 5-year median (the method to be used by ISDA), a 5-year trimmed mean, and a 5-year average on a 1-month LIBOR loan or security. The results we show in the Table were generally found in all of the analysis: using a simple average would historically have generated larger errors than using either a median or trimmed mean, and the errors generated using a median or trimmed mean would generally have been similar.<sup>14</sup>

<sup>14</sup> We also considered other potential methodologies, such as an exponentially weighted mean, but the historical results were notably less accurate than the options shown in Table 6.

*Table 6: Comparing MAEs for Alternative Spread Methodologies*

Spread Methodology	3-month term	3 months in advance	3 months in arrears
Median	0.07	0.08	0.09
Trimmed Mean	0.07	0.06	0.08
Average	0.10	0.11	0.14

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with quarterly rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019. Spread adjustments are calculated based on a five-year lookback period.*

The third baseline consideration discussed in Part II is how far back should data be used to calculate a long-run average, median, or trimmed mean. This length of time, which could range anywhere from 2 to 10 years, or longer, is sometimes called the “Lookback Period.” Looking at historical data, we found that a very short lookback, of 2 years or less, tended to be less accurate, and that ISDA’s choice of a 5-year lookback seemed reasonable. Going beyond 5 years did not improve results appreciably in most cases.

*Table 7: Comparing MAEs for Different Lookback Periods*

Spread Methodology	3-month term	3 months in advance	3 months in arrears
2-year median	0.19	0.21	0.23
3.5-year median	0.14	0.15	0.20
5-year median	0.14	0.16	0.17
10-year median	0.15	0.11	0.15

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with quarterly rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

As noted in Part II, there will only be about 3.5 years of indicative SOFR term rate data available by the end of 2021. If the ARRCs fallbacks were triggered at that time, it would not be possible to directly use a 5-year lookback for the term rate, although it would still be possible to do so for fallbacks to averages of SOFR. Table 7 indicates that there may not be much loss in precision if the lookback period for a term rate were only 3.5 years rather than 5 years, and similar results (not shown) were found for 1-month LIBOR. So, one possibility would be to take the longest window available (up to 5 years, if respondents wished to match ISDA) at the time of a trigger event. As noted in Part II, another option would be to use

a 5-year spread based on the difference between LIBOR and the in arrears rate, given the tight connections between the term rate and SOFR in arrears. Table 8 shows that, historically, this would have also have produced reasonable results.

*Table 8: Comparing MAEs for Different Spread-Adjusted Term Rate Calculation Methods*

Spread Methodology	3-month term
3.5-year median term spread	0.14
5-year median arrears spread	0.11

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with quarterly rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

Transition Period

The final baseline consideration discussed in Part III was how quickly the spread adjustment should move to its long-run level. The historical long-term spread adjustment could be used immediately at the next interest rest or it could be implemented at the end of a one-year transition period after the fallback is activated. During the potential transition period, the spread to be used would be calculated using linear interpolation between the spot LIBOR/SOFR spread around the time the fallback applies and the historical long-term spread that would apply after the end of the transition period. The one-year transition period would help mitigate against a “cliff effect” at the time the fallback applies if the spot LIBOR/SOFR spread at that time differs from the historical level. The progression from spot spread to the spread adjustment calculated in accordance with the final ARRC-recommended approach that would apply going forward would be gradual over the transition period.

Historically, LIBOR-OIS spreads have reverted to long-run levels within a period of about a year or so; a transition period would account for this at the time of a trigger event by starting at the recent level of the spread to LIBOR and then smoothly converging to the long-run spread level over the following year. Without a transition period, the spread adjustment would jump immediately to its long-run level.

Respondents to ISDA’s recent consultation generally did not support a transition period with some citing the costs of the additional complexity outweighing the benefits, despite the potential for short term interest rate shocks.

While a one year or two year transition period would not have had significant effects on the difference between LIBOR and a SOFR-based reference rate (see Table 9), a transition period could be valuable if the last reliable LIBOR rates were at historically wide spreads to other money market rates. Although, without a transition period, it would be possible that the spread-adjusted rate would be appreciably lower than the last LIBOR, which could be welcomed by borrowers, it is also possible that the spread-adjusted rate would be appreciably higher, if the last LIBOR spread was well below the long-run level.

Table 9: The Effects of Including a Transition Period on Historical MAEs

Spread-Adjusted Rate	1 Year Remaining Maturity		5 Years Remaining Maturity	
	No Transition Period	1-Year Transition Period	No Transition Period	1-Year Transition Period
3 months in advance	0.24	0.18	0.16	0.16
3 months in arrears	0.18	0.14	0.17	0.16
3-month term	0.14	0.13	0.14	0.13

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical security with quarterly rate resets and one or five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

Overall, Table 9 indicates that in most instances there would not have been much gain in average accuracy over the course of an instrument with a longer remaining maturity, but there is some gain in accuracy for a short-lived instrument. For products where there would be concerns about avoiding a potential jump in rates to borrowers, a transition period could be useful. Although such instances were infrequent over the historical sample, without a transition period, there would have been instances in which the rate paid would have increased by as much as [40] basis points.

#### Summary

The similarities of these statistics suggests that the ARRC has some flexibility in making its recommendations on fallback methodologies for legacy contract language. This flexibility may allow choices to be influenced by other factors, such as simplicity of implementation or consistency across instruments (ISDA respondents to consultation questions, for example, preferred medians over trimmed means, largely on the basis of simplicity).

One clear conclusion from our analysis is that SOFR-based reference rates based on a lookback period of at least five years would have been closer to the underlying LIBOR references than rates based on a 2-year lookback. The slight gains from moving from a 5-year to a 10-year lookback, where they exist, may be outweighed by a desire for consistency with ISDA's final recommendations.

#### **Part IV. Analysis of Spread Methodologies for Consumer Products**

The ARRC has estimated that there are roughly \$1.2 trillion in consumer exposures to U.S. dollar LIBOR. The majority of these exposures (\$1.1 trillion) are through adjustable rate mortgages, which tend to reference 1-year LIBOR. There are also some exposures through student loans (an estimated \$80 billion) which tend to reference 1- or sometimes 3-month LIBOR.

To aid respondents as they consider the questions in Part V on spread adjustments for consumer products, we present some historical results indicating how different methods would have worked in the past. We consider a hypothetical adjustable rate mortgage indexed to 1-year LIBOR, facing an annual reset, and with five years remaining until maturity at the time that the contract stops referencing LIBOR. As discussed in the ARRC’s [Whitepaper](#) on adjustable rate mortgages, consumers need to be notified about their payments in advance, and so the ARRC would only consider fall backs to either a SOFR-based term rate, or, if the ARRC has not recommended a forward-looking term rate, to an average of SOFR set in advance. Although the ARRC may recommend a one-year forward-looking SOFR term rate, we do not have enough historical data to present results for a 1-year term rate, but we do have enough data to present results for a 1-month or 6-month term rate.

Table 10 shows the historical mean absolute error (MAE) measuring the difference between what the annualized rate of interest on an ARM would be based on using LIBOR and what it would have been based on had the index switched to a spread-adjusted term or compound average rate at some date since 1999. In the table, we follow the ISDA methodology of using a median of the historical spread to LIBOR, looking at different potential periods over which the median could be calculated – over the two years before a trigger event, over 3.5 years, 5 years, or 10. The length of time is called the “lookback period.” Looking down the columns it is clear that a 5-year or 10-year lookback would have resulted in smaller differences from LIBOR than the 2-year lookback. ISDA’s choice of a 5-year lookback appears to do well.

*Table 10: Comparing MAEs for Alternative Spread Methodologies*

Spread Methodology	1-month term	6-month term	1-month in advance
2-year median	0.25	0.26	0.29
3.5-year median	0.20	0.23	0.20
5-year median	0.18	0.22	0.17
10-year median	0.21	0.28	0.18

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical adjustable-rate mortgage with annual rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

Perhaps surprisingly, using a longer term rate does not produce better results, and falling back to a compound average in advance does as well as, or in some cases better than, falling back to a forward-looking term rate over the historical sample.<sup>15</sup>

In Table 11, we hold the lookback period fixed at 5 years, and consider different statistical measures to calculate the long-run spread: the median used in ISDA’s methodology, a trimmed mean, and a simple average. Although a trimmed mean does slightly better in relation to a spread-adjusted average in advance, there is generally little difference across results, again indicating that ISDA’s choice of a 5-year median can be a reasonable one for cash products.

*Table 11: Comparing MAEs for Alternative Spread Methodologies*

Spread Methodology	1-month term	6-month term	1-month in advance
5-year median	0.18	0.22	0.17
5-year trimmed mean	0.17	0.21	0.15
5-year average	0.18	0.19	0.19

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical adjustable-rate mortgage with annual rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

The results in Tables 10 and 11 include the period of the financial crisis, when errors were larger. In Table 12, we show results for the post-crisis period, which have much smaller errors. If economic conditions remain relatively calm, there is good reason to expect that the spread-adjusted fallbacks could be very accurate.

*Table 12: Post-Crisis MAEs*

Spread Methodology	1-month term	6-month term	1-month in advance
5-year median	0.05	0.12	0.09

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical adjustable-rate mortgage with annual rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

<sup>15</sup> Results, not shown, indicate that falling back to a 1- or 3-month average would have tended to historically do better than falling back to a longer 6-month or 1-year average in advance.



Unlike ARMs, student loans tend to reference 1-month LIBOR rather than 1-year LIBOR. In table 13, we show historical results relative to 1-month LIBOR

*Table 13: Comparing MAEs for Alternative Spread Methodologies*

Spread Methodology	1-month term	1-month in advance
5-year median	0.07	0.08
5-year trimmed mean	0.07	0.06
5-year average	0.10	0.11

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical adjustable-rate mortgage with annual rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

#### *Proposed publication of replacement index for consumer products*

For the major consumer products, the ARRC is contemplating the publication of a replacement index that has been recommended by the Federal Reserve Board, the Federal Reserve Bank of New York, or a committee endorsed or convened by the Federal Reserve Board or the Federal Reserve Bank of New York. The ARRC believes that the publication of a recommended replacement index for the major consumer products will make it easier for consumers to arrive at the index without having to calculate it using the spread adjustment methodology that will be adopted by the ARRC. The recommended [fallback language](#) for new Adjustable Rate Mortgages based on LIBOR envisages the publication of such a replacement index.

#### *Transition Period*

One baseline consideration discussed in Part III was how quickly the spread adjustment should be expected to move back toward its long-run level. As described above, the spread adjustment calculated in accordance with the long-term historical differences between LIBOR and SOFR could be used only from the end of a transition period after the fallback applies. During the potential transition period, the spread to be used would be calculated using linear interpolation between the spot LIBOR/SOFR spread around the time the fallback applies and the historical mean/median spread that would apply after the end of the transition period. The one-year transition period would help mitigate against a “cliff effect” at the time the fallback applies if the LIBOR/SOFR spread at that time differs from the long-term historical spread. The progression from spot spread to the spread adjustment calculated in accordance with the final ARRC-recommended approach that would apply going forward would be gradual over the one-year transition period.

Historically, LIBOR-OIS spreads have reverted to long-run levels within a period of about a year or so; a transition period would account for this at the time of a trigger event by starting at the recent level of the spread to LIBOR and then smoothly converging to the long-run spread level over the following year. Without a transition period, the spread adjustment would jump immediately to its long-run level. Although, without a transition period, it would be possible that the spread-adjusted rate would be appreciably lower than the last LIBOR, which could be welcomed by borrowers, it is also possible that the spread-adjusted rate would be appreciably higher, if the last LIBOR spread was well below the long-run level, which could result in a sudden jump up in rates paid by borrowers. Over the period examined, without a transition period, we could have seen jumps of more than 50 basis points for a compound average in arrears at some times, and much more for a compound average in advance.

Respondents to ISDA’s recent consultation generally did not support a transition period with some citing the costs of the additional complexity outweighing the benefits. ISDA respondents, however, may be better positioned to absorb interest rate shocks than retail borrowers.

If the remaining maturity of the ARM is long enough, then adding a transition period may have little overall impact, as shown in Table 14, which reports historical results for an ARM with 5 years remaining maturity at the time of a trigger to the spread-adjusted rate. If the remaining maturity is long enough, then any short-term errors are essentially averaged out. However, a transition period can substantially improve short-run accuracy, as shown in Table 15, which reports historical results for an ARM with just one year remaining maturity. In that case, adding a 1-year transition period yields substantially better results. Increasing the transition from one year to two years offers little to no benefit in reducing the fitting error.

*Table 14: The Effects of Including a Transition Period on Historical MAEs for an ARM with 5 Years Remaining Maturity*

Spread-Adjusted Rate	No Transition Period	1-Year Transition Period	2-Year Transition Period
1-month term	0.18	0.16	0.16
6-month term	0.22	0.22	0.19
1-month in advance	0.17	0.17	0.17

*\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical adjustable-rate mortgage with annual rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.*

Table 15: The Effects of Including a Transition Period on Historical MAEs for an ARM with 1 Year Remaining Maturity

Spread-Adjusted Rate	No Transition Period	1-Year Transition Period	2-Year Transition Period
1-month term	0.31	0.12	0.13
6-month term	0.25	0.08	0.08
1-month in advance	0.36	0.12	0.13

\* Data Sources: FRBNY, Refinitiv, and Federal Reserve Board staff calculations. Compound averages and term rates are based on EFR and EFR futures prices. Statistics are reported in percentage points and are based on a hypothetical adjustable-rate mortgage with annual rate resets and five years of remaining maturity at the time of the move from LIBOR to the spread-adjusted rate over the sample period Jan 1999-May 2019.

## **Part V: Consultation Questions**

Questions 1- 7 refer to Floating Rate Notes, Securitizations, and Business Loans

**Question 1.** Do you agree that using the ISDA methodology of a 5-year median of the historical difference between LIBOR and the SOFR fallback rate is the best choice for the following cash products, or would you prefer an alternative method?

Floating Rate Notes       5-year median is preferred       Other method is preferred

Securitizations       5-year median is preferred       Other method is preferred

Syndicated Loans       5-year median is preferred       Other method is preferred

Bilateral Business Loans       5-year median is preferred       Other method is preferred

**Question 2.** If “Other Method” was specified for any product, please provide additional feedback on your institution’s preferences, noting whether your alternative is strongly or mildly preferred and why you prefer the alternative method:

- |                         |                           |
|-------------------------|---------------------------|
| a. 5-year trimmed mean  | f. 3.5-year median        |
| b. 5-year average       | g. 3.5-year trimmed mean  |
| c. 10-year median       | h. 3.5 year average       |
| d. 10-year trimmed mean | i. Other (please specify) |
| e. 10-year average      |                           |

**Question 3.** If there are fewer than 5 years of available data to use in calculating a spread adjustment for a forward-looking term rate, which method would you prefer to calculate the associated spread adjustment:

- Use the longest span of indicative term rate data available
- Use the spread adjustment associated with the difference between LIBOR and a compound average of SOFR in arrears as an appropriate spread adjustment for the forward-looking term rate.
- Use the spread between LIBOR and EFRR OIS rates, adjusted for the mean difference between compound averages of EFRR and SOFR

**Question 4.** Do you believe that a 1-year transition period should be included for any of these cash products? If yes, please specify which products. (If you believe that a transition period should be included, but that it should be longer or shorter than 1 year, please note this and explain why.)

**Question 5.** Should the ARRC recommend spread adjustments for 1-week or overnight LIBOR?

**Question 6.** Should the ARRC recommend spread adjustments based on the differences between LIBOR simple averages of SOFR in addition to compound averages?

**Question 7.** *Would it be problematic to use different approaches to calculate the spread adjustment across products and currencies? Please comment specifically on the implications of any differences in the recommended spread adjustment methodologies.*

Questions 8- 11 refer to Consumer Products

**Question 8.** *Do you agree that using the ISDA methodology of a 5-year median of the historical difference between LIBOR and the SOFR fallback rate is an acceptable choice for consumer products, or would you prefer an alternative method? (If another method is preferred, please specify which and note whether your alternative is strongly or mildly preferred and why you prefer the alternative method).*

**Question 9.** *Do you believe that a 1-year transition period should be included for consumer products? (If you believe that a transition period should be included, but that it should be longer or shorter than 1 year, please note this and explain why).*

**Question 10.** *If a 1-year or 6-month term rate has not been recommended by the ARRC, would you prefer that a consumer ARM referencing 1-year or 6-month LIBOR fall back to a spread adjusted rate based on:*

- a. *the next longest tenor of term rate recommended by the ARRC*
- b. *a compound average of SOFR in advance*

*(Note that in these instances, the rate would still reset annually or semiannually and spreads would be calculated relative to 1-year or 6-month LIBOR).*

**Question 11.** *If there is less than 5 years of available data to use in calculating a spread adjustment for a forward-looking term rate, which method would you prefer to calculate the associated spread adjustment:*

- a. *Use the longest span of indicative term rate data available*
- b. *Use the spread adjustment associated with the difference between LIBOR and a compound average of SOFR in arrears as an appropriate spread adjustment for the forward-looking term rate*
- c. *Use the spread between LIBOR and EFRR OIS rates, adjusted for the mean difference between compound averages of EFRR and SOFR*

Question 12 applies to all products

**Question 12.** *Please provide any additional feedback on any aspect of the proposals.*

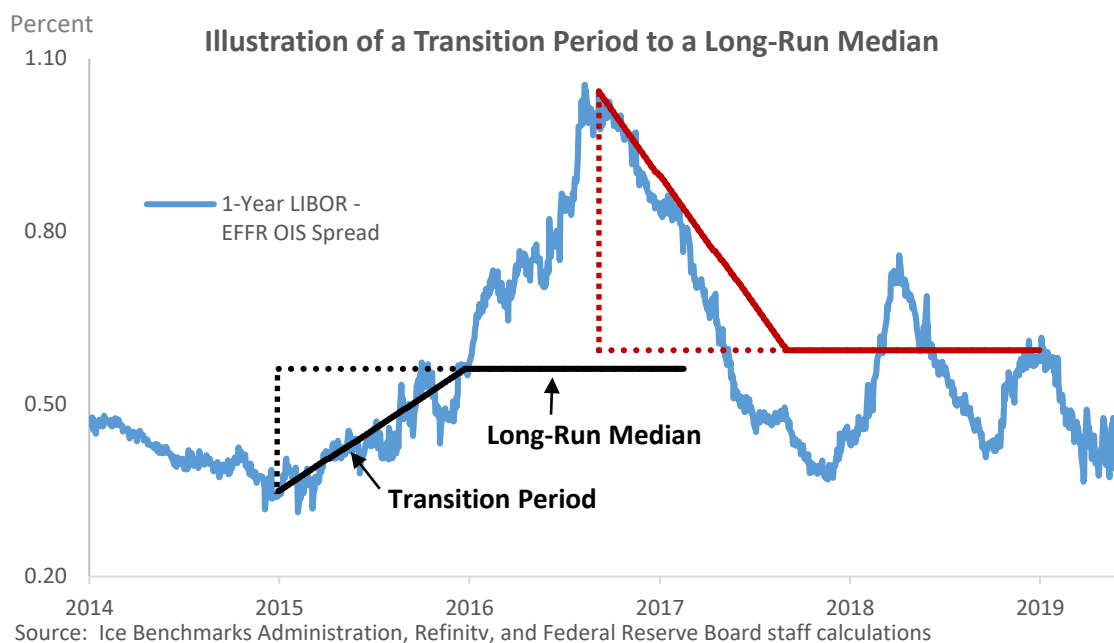
## **Part VI. Response Procedures / Next Steps**

Market participants may submit responses to the consultation questions by email to the ARRC Secretariat ([arcc@ny.frb.org](mailto:arcc@ny.frb.org)) no later than March 6, 2020. Please coordinate internally and provide only one response per institution. Please attach your responses in a PDF document and clearly indicate “Consultation Response” in the subject line of your email. Comments will be posted on the ARRC’s website as they are received without alteration except when necessary for technical reasons. Comments will be posted with attribution unless respondents request anonymity. If your institution is requesting anonymity, please clearly indicate this in the body of your email and please ensure that the PDF document you submit is anonymized. Questions regarding the consultations should be sent to the ARRC Secretariat ([arcc@ny.frb.org](mailto:arcc@ny.frb.org)) and will not be posted for attribution.

Following this market-wide consultation, the ARRC plans to recommend spread adjustments that would apply to its fallback recommendations.

## Appendix 1. Further Technical Details on a Transition Period

Because the concept of a transition period may be new to some, we provide further technical details about how a transition period could be implemented, using an example to illustrate how a one-year transition period would have worked if LIBOR had stopped publication on December 31, 2014 and 1-year LIBOR had fallen back to a 1-year term rate as shown in the figure.



On December 31, 2014, 1-year LIBOR was 0.63 percent and an EFRR OIS term rate (using term EFRR OIS rates as a proxy, since we do not have term SOFR rates before 2019) was 0.28 percent, so the LIBOR-EFRR OIS spread (the blue line in the figure) was 35 basis points at that time. However, a measure of the long-run spread (the black dashed line) was 60 basis points, 25 basis points higher than the spread on December 31. In the absence of a transition period, the spread on January 2, 2015 would be set equal to the long-run value of 60 basis points and remain at that level, and the corresponding spread-adjusted term rate would have been 0.88 percent on January 2, 25 basis points higher than the last LIBOR rate on December 31 (the 1-year OIS rate itself was unchanged between December 31 and January 2).

With a transition period, the spread adjustment would have gradually increased over the following year from the 35 basis points at the time of the stop to 60 basis points at the end of the year (the solid black line). There were 253 business days over the following year, (there are generally around 252 business days per year, but this can vary), so the spread would have increased by roughly 1 basis point every two weeks until it reached and remained at 60 basis points at the end of 2015. Because OIS rates did not change between December 31 and January 2, the spread adjusted term rate would have been essentially unchanged (a tenth of a basis point higher) between December 31 and January 2 if a transition period was included.

The spread adjustment (with or without a transition period) would only be applied on reset dates. So, for example, if the reset date on an ARM had happened to have occurred on January 2, 2015 then the

next reset would not occur until January 2, 2016, and the rate paid by the borrower would be fixed at the spread-adjusted rate for January 2, 2015 and would remain fixed at that rate for the following year.

To calculate a spread adjustment with a transition period that would be applied on a given reset date, the party calculating and publishing the spread adjustment would interpolate between a measure of the spread at the time of the trigger event and the long-run spread. To provide an example of how this interpolation would be calculated, if there were  $N$  business days in a given year and the move away from LIBOR is triggered on date 0, then on any reset date  $i$  (where  $i$  is a business day ranging from 1 to  $N$ ) over the next year, the spread adjustment that interpolates between the spread on date 0 and the long-run spread level would be:

$$Spread(i) = Spread(0) \frac{N - i}{N} + LongRunSpread \frac{i}{N}$$

In principle, the initial spread could literally be based on the last value of LIBOR before the trigger away, or it could be based on, for example, an average of the spread over the last 5 days before the trigger event. If responses to the consultation indicated that incorporating a transition period was appropriate for certain cash products, the ARRC would work with the vendors who might publish these spreads and spread adjusted rates to determine these kinds of details, including how it would be applied to a compound average of SOFR in arrears or term SOFR.