



LIBOR TO SOFR Transition

 RiskVal Financial Solutions

EXECUTIVE SUMMARY

The London Inter-bank Offered Rate (LIBOR) was intended to be the rate at which large banks can lend and borrow money from each other. It is also the basis for about \$200 trillion in global financial products. Because of various issues surrounding LIBOR including a manipulation scandal, LIBOR's regulator is likely to discontinue it at the end of 2021.

This document outlines the procedure that the Alternate Reference Rates Committee (ARRC) has recommended and the technical steps that will be taken by the clearing houses CME Clearing and LCH as part of the transition to using the SOFR discounting curve. It also presents solutions that RiskVal believes will help clients in this shift away from LIBOR in line with these proposed changes.

FEATURED POINT

Cleared USD Interest Rate Swaps

Key ARRC and Other Developments

Paced Transition Plan

2016

May - ARRC's Interim Report and Consultation published

2017

Jun. - ARRC selected SOFR as its recommended alternative to USD LIBOR

Jul. - FCA Bailey said panel banks will not be compelled to submit to LIBOR past 2021

Oct. - ARRC Paced Transition Plan adopted

2018

Mar. - ARRC's second report published. ARRC reconstituted with expanded membership

Apr. - New York Fed/OFR began publishing SOFR

May - CME launched SOFR futures

Jul. - LCH began clearing SOFR swaps;

Fannie Mae issued first SOFR-based FRN

Oct. - CME began clearing SOFR swaps using SOFR PAI/discounting

2019

Apr./May. - ARRC releases recommended fallback language for FRNs, business loans, and securitizations as well as a User's Guide to SOFR

Jul. - ARRC releases SOFR ARM Whitepaper

Sep. - ARRC releases practical implementation checklist for SOFR adoption

Nov./Dec. - U.S. Authorities issue accounting, tax, and margin relief proposals

ARRC releases recommended fallback language for residential ARMs

2020

Jan. - ARRC releases recommendations for interdealer cross-currency swap market conventions; ARRC issues vendor survey and buy-side checklist

Mar. - ARRC publishes its Proposed ARRC Draft Legislative Relief; New York Fed/OFR begin publishing SOFR Averages and SOFR Index



Key ARRC and Other Developments

Paced Transition Plan

Apr. - ARRC announces its recommendations for spread adjustment methodology

May. - ARRC releases Best Practices and swaptions recommendations

Jun. 30 - Newly issued FRNs, residential ARMs, and securitizations should include recommended fallback language

Sep. 30 - New business and student loans should include ARRC recommended hardwired fallback language; No new applications of LIBOR ARMs; Business loans and consumer mortgages vendors should be ready to support SOFR; Dealers should offer electronic market making in SOFR derivatives

Nov. - Market participants should adhere to the ISDA Protocol within 4 months of publication

Dec. 31 - no new FRNs using LIBOR and maturing after 2021; securitization vendors should be ready to support SOFR; Dealers should amend interdealer CSAs to use and make markets in SOFR-linked interest rate volatility products

Key Transition Development
(Not Best Practices-related) - Fannie Mae and Freddie Mac no longer purchase LIBOR ARMs

Apr. - ARRC unveils key objectives for 2020

Jun. - ARRC to publish revised hardwired business loan fallback language as well as fallback language and conventions for new student loans

Jul. - ARRC to publish final recommended conventions for SOFR-based floating rate notes, business loans, and securitizations; ISDA expects to publish its protocol and updated definitions

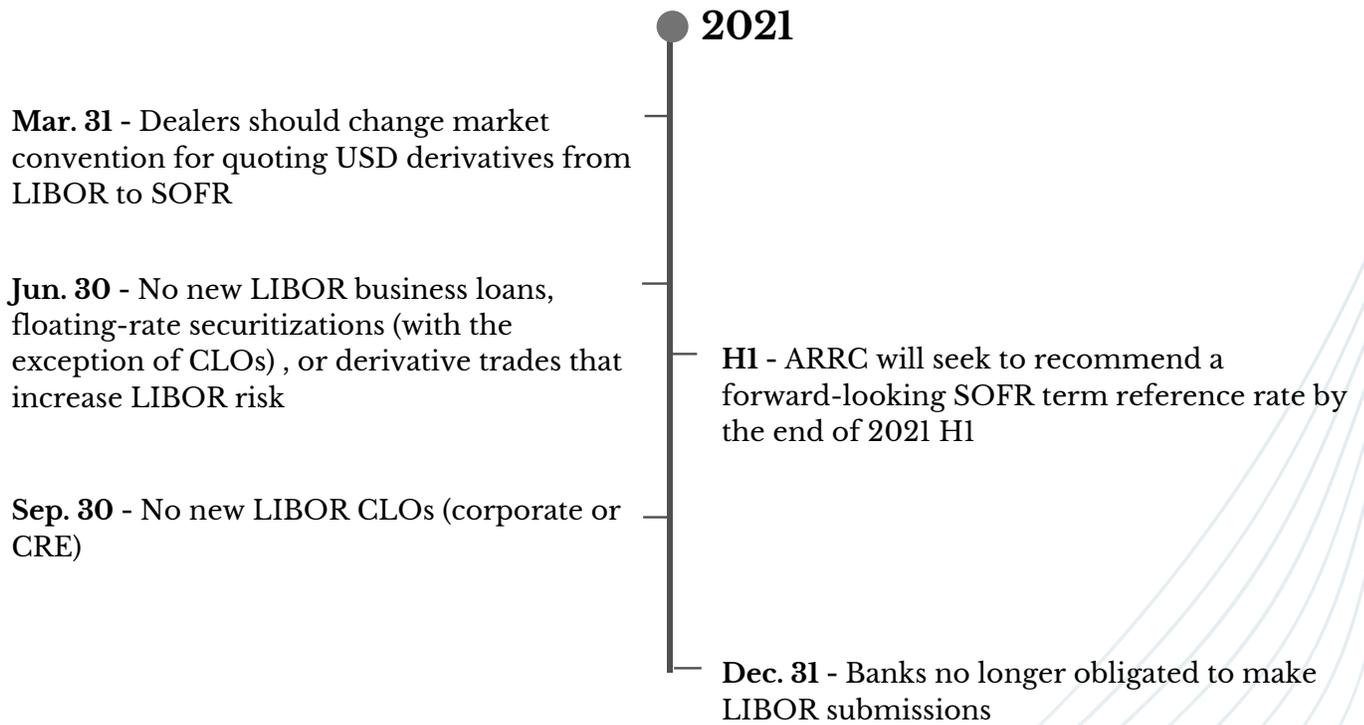
Sep. - ARRC to establish RFP processes to facilitate the eventual publication of (a) forward-looking term SOFR rates and (b) the ARRC's recommended spread adjustment for transition of legacy contracts

Oct. 16 - CME and LCH to move to SOFR PAI and discounting on new and legacy swap



Key ARRC and Other Developments

Paced Transition Plan



I. Transition to SOFR Discounting Plan for Cleared USD Interest Rate Swaps

The ARRC has come up with a Paced Transition Plan to transition cleared USD Interest Rate Swaps (IRS) from being discounted by the daily effective federal funds rate (EFFR) to the secured overnight financing rate (SOFR). The CME Group believes that this plan will create liquidity across the SOFR term structure and that a single-day operation is necessary for this transition.

The CME Group proposes the following plan:

Products: All existing Cleared USD interest rate swaps

- Fixed/Float IRS - Zero Coupon Swaps
- Overnight Index Swaps - Basis Swaps
- Forward Rate Agreements - Swaptions

Timing: Target transition date of October 16, 2020

Procedure: On October 16, 2020 after close of business, Central Time, CME Clearing will conduct an additional special valuation cycle to determine the settlement variation and cash payments on counterparty positions but based on SOFR discounting.

The special valuation cycle will include a cash adjustment that is equal and opposite to the resultant net present value (NPV) of each cleared IRS product ensuring a net cash flow of zero for each transition.

This would move all participant's discounting risk from EFFR to SOFR at October 16, 2020 closing curve levels.

CME will then facilitate a mandatory process to book a series of EFFR/SOFR basis swaps to participants. These basis swaps will restore their positions to their original risk profiles and will also be booked at October 16, 2020 closing curve levels.

Participants will also be able to choose to have such basis swaps booked as float-versus-float basis swaps or as pairs of fixed-versus float swaps with equal and opposite fixed cash flows to facilitate flexibility.



LCH proposes the following plan:

Products: All USD-discounted positions in swapClear, including non-deliverable currencies

Timing: Target transition date on or around October 17, 2020

Procedure: LCH proposes using both a cash payment to provide compensation and basis swaps to provide risk compensation.

A centralized auction process will be used to determine two-way quotes on the LIBOR/SOFR basis and mids will be used to build a curve. The curve will be used to facilitate the cash-only election and the cash compensating amount for the cash and swap booking.

The compensating EFR/SOFR basis swaps booked would be at the market cleared level with a spread on the SOFR leg calibrated to ensure a zero PV. The swap booking should mitigate any short-term market distortions while the cash element would ensure a net flat valuation.

LCH intends to allow participants to elect cash-only compensation as some buy-side entities are unable or unwilling to accept compensation in the form of swaps due to trading or operational mandates. For these instances, LCH's auction aims to source for the price of the off-setting swaps and establish the market value of these positions, payable through the cash compensating process.

RiskVal's proprietary pricing tool allows you to price both CME and LCH swaps as seen below

The screenshot displays a financial software interface with a 'Market View' menu. It features a 'Summary' table and a 'Swap (2/2)' table. The 'Clearing House' column in the swap table is highlighted with a red box, showing 'CME' and 'LCH' entries.

Tab Name	DV01 USD	PV01 USD	Daily P&L USD	Cum P&L USD	Prev Cum P&L	Prev Cum P&L USD	PV	\$Delta N USD	\$Gamma N USD	\$Vega N USD	\$Theta N USD	PV USD	DV01	PV01	Daily P&L	Cum P&L	\$Delta N	\$Gamma N	\$Vega N	\$Theta N
1 Total	93,223	99,...	330,568	13,643,...	0	0	14,...	0	0	0	0	14,...	93,223	93,...	330,...	13,...	0	0	0	0
2 Swap	93,223	99,...	330,568	13,643,...	0	0	14,...	0	0	0	0	14,...	93,223	93,...	330,...	13,...	0	0	0	0
3 Basis Swap	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X	Ccy	MM Fixed Notional	Trade Date	Fixed Start	Fixed Mty	Fixed Cpn	Fixed Pay/Rec	Fixed DC	Fixed Pmt Freq	Float Index	Clearing House	Float Pmt Freq	Float DC	NPV	Index	Daily P&L
1	USD	100	01-Jan-2020	03-Jan-2020	03-Jan-2025	2.00000%	REC	30/360	SA	LIB3M	CME	QUARTERLY	ACT/360	7,302,178	1.90838%	164,709 U
2	USD	100	01-Jan-2020	03-Jan-2020	03-Jan-2025	2.00000%	REC	30/360	SA	LIB3M	LCH	QUARTERLY	ACT/360	7,306,542	1.90838%	165,859 U
3	USD	0	09-Apr-2020	15-Apr-2020	15-Apr-2020	0.00000%	REC	30/360	SA	LIB3M		QUARTERLY	ACT/360	0	0.00000%	0

II. RiskVal Example

OIS VS SOFR Discounted Swap

In the below screenshot, we use RiskVal's Trade Blotter Sheet to value two identical 5 year swaps starting 1/3/2020 into 1/3/2020. The first is discounted using the fed funds curve, while the second is using the SOFR curve.

Tab Name	DV01 USD	PV01 USD	Daily P&L USD	Cum P&L USD	Prev Cum P&L	Prev Cum P&L USD	PV	\$Delta N USD	\$Gamma N USD	\$Vega N USD	\$Theta N USD	PV USD	DV01	PV01	Daily P&L	Cum P&L	\$Delta N	\$Gamma N
1 Total	46,612	49,...	167,613	6,826,012	0	0	7,3...	0	0	0	0	7,3...	46,612	49,...	167,...	6,8...	0	0
2 Swap	46,612	49,...	165,863	6,824,261	0	0	7,3...	0	0	0	0	7,3...	46,612	49,...	165,...	6,8...	0	0
3 Basis Swap	(0)	0	1,751	1,751	0	0	1,751	0	0	0	0	1,751	(0)	0	1,751	1,751	0	0

X	Ccy	MM Fixed Notional	Trade Date	Fixed Start	Fixed Mty	Fixed Cpn	Fixed Pay/Rec	Fixed DC	Fixed Pmt Freq	Float Index	Float Pmt Freq	Float DC	Discount Crv	NPV
1	USD	100	01-Jan-2020	03-Jan-2020	03-Jan-2025	2.000000%	REC	30/360	SA	LIB3M	QUARTERLY	ACT/360	USD OIS CURVE	7,306,542
2	USD	100	01-Jan-2020	03-Jan-2020	03-Jan-2025	2.000000%	REC	30/360	SA	LIB3M	QUARTERLY	ACT/360	SOFR CURVE	7,306,657

Risking the same aged swap against two different discounting curves gives rise to the two different risk profiles below. The left, using OIS discounting and the right using SOFR discounting.

USD		Swap		Swap OIS	
1	Total	49,208	1	Total	1,999
2	Stub	(1,702)	2	Stub	49
3	EDM0	(725)	3	EDM0	54
4	EDU0	41	4	EDU0	41
5	EDZ0	35	5	EDZ0	35
6	EDH1	24	6	EDH1	24
7	EDM1	18	7	EDM1	18
8	EDU1	6	8	EDU1	6
9	2Y	222	9	2Y	222
10	3Y	432	10	3Y	432
11	4Y	576	11	4Y	576
12	5Y	50,281	12	5Y	542
13	6Y	0	13	6Y	0
14	7Y	0	14	7Y	0
15	8Y	0	15	8Y	0
16	9Y	0	16	9Y	0
17	10Y	0	17	10Y	0
18	12Y	0	18	12Y	0
19	15Y	0	19	15Y	0
20	20Y	0	20	20Y	0
21	25Y	0	21	25Y	0
22	30Y	0	22	30Y	0
23	40Y	0	23	40Y	0
24	50Y	0	24	50Y	0

USD		Swap		Swap SOFR	
1	Total	49,208	1	Total	1,983
2	Stub	(1,702)	2	SERJ0	35
3	EDM0	(725)	3	SERK0	19
4	EDU0	41	4	SERM0	6
5	EDZ0	35	5	SERN0	(1)
6	EDH1	24	6	SFRH0	0
7	EDM1	18	7	SFRM0	62
8	EDU1	6	8	SFRU0	44
9	2Y	222	9	SFRZ0	41
10	3Y	432	10	SFRH1	24
11	4Y	576	11	SFRM1	20
12	5Y	50,281	12	SFRU1	4
13	6Y	0	13	2Y	276
14	7Y	0	14	3Y	445
15	8Y	0	15	4Y	514
16	9Y	0	16	5Y	493
17	10Y	0	17	6Y	0
18	12Y	0	18	7Y	0
19	15Y	0	19	8Y	0
20	20Y	0	20	9Y	0
21	25Y	0	21	10Y	0
22	30Y	0	22	12Y	0
23	40Y	0	23	15Y	0
24	50Y	0	24	20Y	0
			25	30Y	0

This functionality in the Trade Blotter can be used to check the NPV and risk of the original and replacement swaps booked by CME and LCH.

Additionally, there are multiple hedging options for these swaps under “Calculation” like against fed fund futures (Calc FF Hedge) or against 3-month SOFR futures (Calc 3m SOFR Hedge) and 1-month SOFR futures (Calc 1m SOFR Hedge) that traders can use to hedge single or multiple trade portfolios of either type of swaps.

FF Hedge

	FFH0	FFJ0	FFK0	FFM0	FFN0	FFQ0	FFU0	FFV0	FFX0	FFZ0	FFF1	FFG1	FFH1	FFJ1	FFK1	FFM1	FFN1	FFQ1	FFU1	FFV1	FFX1	FFZ1	FFF2	FFG2
FuturePx	99.3	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
FF Hedge	(42.0)	(40.0)	(42.0)	(40.0)	(42.0)	(42.0)	(40.0)	(42.0)	(40.0)	(42.0)	(42.0)	(38.0)	(42.0)	(40.0)	(42.0)	(40.0)	(42.0)	(42.0)	(40.0)	(42.0)	(40.0)	(42.0)	(42.0)	(1,422.0)

3-Month SOFR Hedge

	SFRH0	SFRM0	SFRU0	SFRZ0	SFRH1	SFRM1	SFRU1	SFRZ1	SFRH2	SFRM2	SFRU2	SFRZ2	SFRH3	SFRM3	SFRU3	SFRZ3	SFRH4	SFRM4	SFRU4	SFRZ4
FuturePx	99.9	100.0	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.7	99.7	99.7	99.7
SOFR Hedge	(206.0)	(206.0)	(206.0)	(204.0)	(204.0)	(204.0)	(204.0)	(204.0)	(204.0)	(218.0)	(204.0)	(188.0)	(218.0)	(202.0)	(202.0)	(202.0)	(202.0)	(202.0)	(200.0)	(36.0)

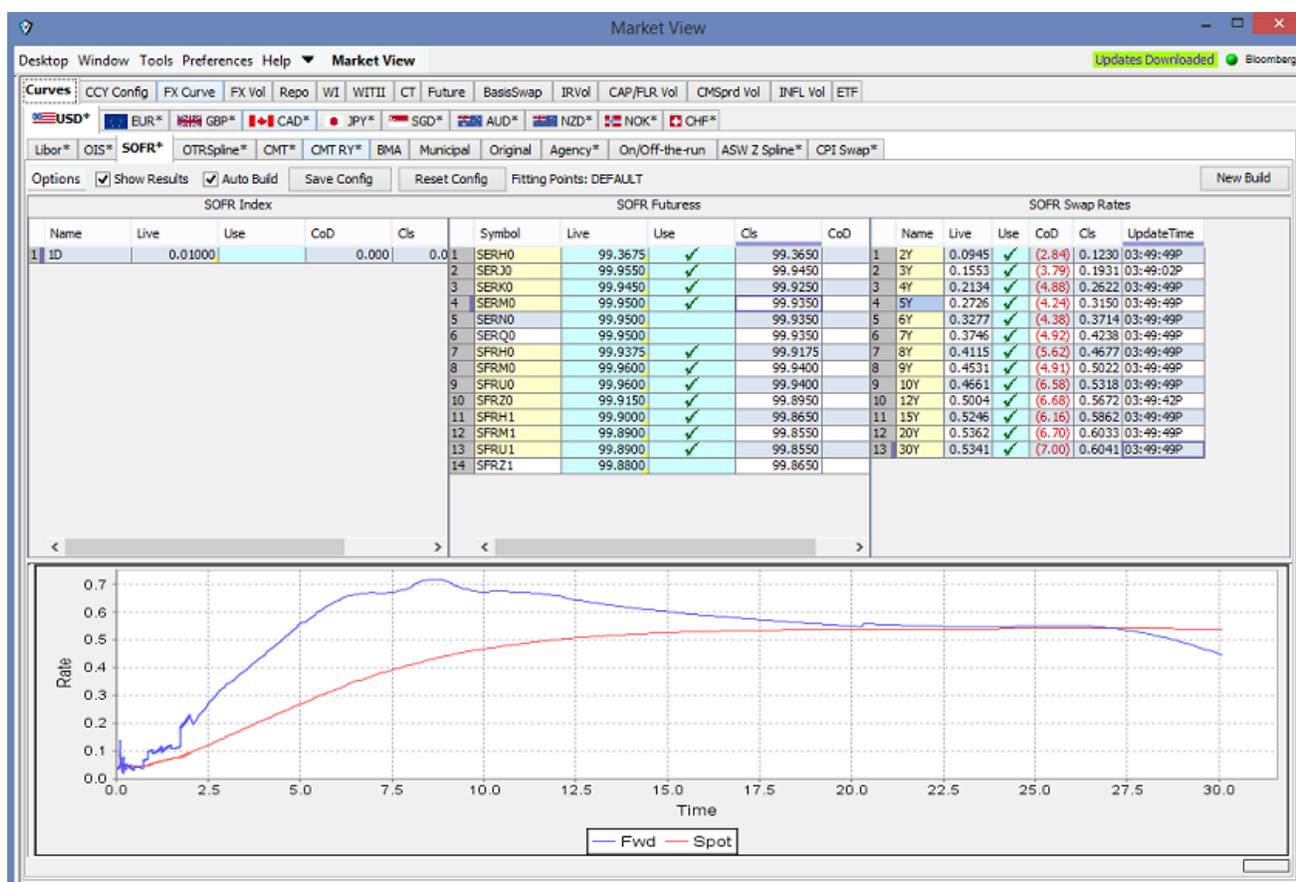
1-Month SOFR Hedge

	SERH0	SERJ0	SERK0	SERM0	SERN0	SERQ0	SFRM0	SFRU0	SFRZ0	SFRH1	SFRM1	SFRU1	SFRZ1	SFRH2	SFRM2	SFRU2	SFRZ2	SFRH3	SFRM3	SFRU3	SFRZ3	SFRH4	SFRM4	SFRU4	SFRZ4
FuturePx	99.4	99.9	99.9	99.9	99.9	99.9	100.0	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.7	99.7	99.7	99.7
SOFR Hedge	(42.0)	(40.0)	(42.0)	(40.0)	(42.0)	(42.0)	(34.0)	(206.0)	(204.0)	(204.0)	(204.0)	(204.0)	(204.0)	(204.0)	(218.0)	(202.0)	(186.0)	(218.0)	(202.0)	(202.0)	(202.0)	(202.0)	(202.0)	(200.0)	(36.0)

OIS-SOFR Basis Swap

In the below screenshot, we use RiskVal’s Trade Blotter Sheet to risk a 5 year OIS-SOFR Basis Swap starting 03/01/2020 into 03/01/2025 which represents the swap CME or LCH will book to counterparties to ensure flat risk. The left riskstrip shows the OIS risk, while the right risk strip shows the SOFR risk.





To build the SOFR curve, RiskVal uses the following fitting points:

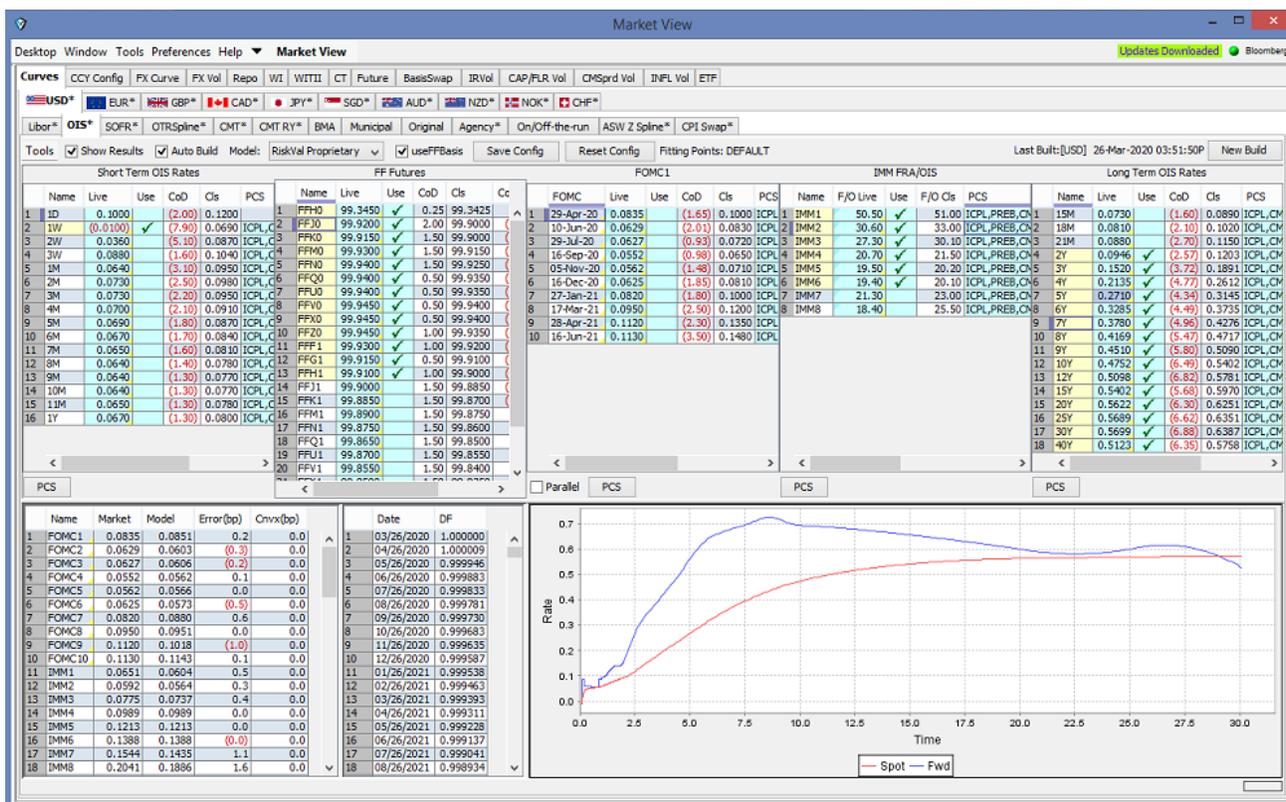
- 1-Day SOFR index
- First four monthly SOFR future contracts and seven 3-month future contracts
- 2Y, 3Y, 4Y, 5Y, 6Y, 7Y, 8Y, 9Y, 10Y, 12Y, 15Y, 20Y and 30Y derivation from SOFR vs FF basis

The industry tends to use the OIS swap rates for the 2Y to 7Y sector and LIBOR swap rates from 10Y to 30Y. We do not believe that this is a good representation of the SOFR curve and instead derive the SOFR curve 2Y and onwards from the SOFR vs FF basis.

To build the OIS curve, the industry mainly uses the following fitting points:

- 1-Day Fed Funds Effective Rate (FEDL01)
- 1-Week to 10Y OIS Swap rates





To build the OIS curve, RiskVal uses the following fitting points:

- 1-Week OIS swap rate
- First 13 Fed Fund futures
- First 6 IMM FRA-OIS basis swaps
- 2Y to 40Y OIS swap rates

The short end of the OIS curve is important and requires a reasonable amount of nuance to construct. We believe in using the Fed Funds future rate implied by the forward federal funds effective rate and assume a step function interpolation. The Fed Funds futures has historically been a good representation of expectation of forward fed funds rates.

We incorporate a hybrid interpolation method, with the short end utilizing these Fed Fund futures and IMM FRA-OIS basis swaps and the longer end using a quadratic spline as the interpolation method.



To select the various instruments used to build the curves, it is important to not only understand what the instrument represents, but also the liquidity profile of the instruments. A good gauge of this is from the number and quality of dealers who quote each instrument.

RiskVal is currently working on building a comprehensive tool that our clients can use to value their positions in real time and to transition smoothly. We are also excited to work with several of our clients who have already expressed interest to utilize our new LIBOR-SOFR migration tool.

IV. Case Study - LIBOR VS SOFR in a Pandemic

Since late February 2020, the global coronavirus pandemic has hit global markets hard. Both demand and supply have deteriorated along with producer and consumer sentiment. Global growth has come to a standstill.

Since then, governments and central banks around the world have intervened, in a bid to provide liquidity in the markets and reduce the damage. In the US, the Federal Reserve has lowered rates to near zero and pledged unlimited quantitative easing to tide the economy over, purchasing US Treasuries, MBS, corporate bonds, High Yield indexes and assets backed by credit card, auto and student loans.

Since intervening, both the LIBOR and SOFR plunged. LIBOR has recovered some, while SOFR continued to fall to close to 0.

1) Since LIBOR is the rate at which banks borrow and lend to each other, it is a proxy of the health of the financial system - LIBOR recovered because it is sensitive to risks faced by borrowers other than the FED

2) SOFR, on the other hand is the average repo rate in the treasury market - SOFR continued to fall and remains near 0 as the FED flushed the treasury markets with cash and is expected to continue to do so



This pandemic has shown that SOFR is extremely sensitive to FED policy, has no risk premium, and is too low and stable to accurately measure credit risk in the markets, like LIBOR used to. It brings to the forefront one of the biggest issues in using SOFR as a LIBOR replacement and is concerning for an index that may potentially be used to price trillions of dollars of derivatives.

Indeed it is also interesting to note that the \$600bn Main Street lending facility initiated by the Fed to get cash to small and medium sized businesses to combat the effects of the pandemic will also use LIBOR instead of SOFR as originally planned as the FED believes that pushing banks to use SOFR would be too time consuming and delay the program. As these are also 4 year loans, and LIBOR will stop being published in Dec 2021, they will have to include ARRC's recommended fallback language.

