Weaning Ourselves off LIBOR

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(virtually)

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Prologue

"Evidence that bankers were manipulating Libor for their own profit first came to light in 2008, leading to about ==$10 billion in fines== and the decision to phase it out by the end of 2021.

"Only ==one in five== derivatives users have a plan to transition away from Libor.

"The task is Herculean: Libor is embedded in almost every corner of the financial markets.

"Sixty-three percent of derivatives users said the Libor transition was their No. 1 concern. For all users in the market, including banks and brokers, it was the second-biggest issue, just behind the impact on the industry of capital requirements."

Bloomberg, March 11th, 2020.

Talk Outline: Main Content

1. What is LIBOR?
2. LIBOR in Practice (Trillions)
3. The LIBOR Scandal
4. Development of Alternative Rates (ARs) esp. overnight vs 1M/3M etc. tenor)
5. Legacy LIBOR Products
6. New LIBOR-like Products
7. Discounting/price alignment interest (PAI) with ARs
8. Building a SOFR Curve
9. Roadmap

Talk Outline: Appendices

Appendix A: View from Standpoint of Child Development ("Weaning" etc.)

Appendix B: Glossary

Appendix C: Methodologies for ARs

Appendix D: Ameribor

1. History of LIBOR

Includes: Methodology, data contributors

How did we get here?

- LIBOR (the London Interbank Offered Rate) started in 1986
- Originated by the British Bankers' Association, it's now owned by the Intercontinental Exchange (ICE; in Atlanta; owned by NYSE)
- Computed by polling a panel of banks (details below)
- Published at 11:55 AM London time on every London business day

- Definition:

The rate at which an individual Contributor Panel bank could borrow funds, were it to do so by asking for and then accepting inter-bank offers in reasonable market size, just prior to 11.00 [AM] London time.

How LIBOR is calculated

- A panel of banks is defined for each of the five currencies in scope:

USD	GBP	EUR	CHF	JPY

- Each member of the panel contributes a value based on expert judgment for all seven standard maturities (Actual/360):

Overnight /Spot Next	One Week	One Month	Two Months	Three Months	Six Months	Twelve Months
ON	1W	1M	2M	3M	6M	12M

Panel Banks*

BANK/CCY	USD	GBP	EUR	CHF	JPY
Bank of America N.A. (London Branch)	●				
Barclays Bank plc	●	●	●	●	●
BNP Paribas SA (London Branch)		●			
Citibank N.A. (London Branch)	●	●	●	●	
Cooperatieve Rabobank U.A.	●	●	●		
Crédit Agricole Corporate & Investment Bank	●	●			
Credit Suisse AG (London Branch)	●		●	●	
Deutsche Bank AG (London Branch)	●	●	●	●	●
HSBC Bank plc	●	●	●	●	●
JPMorgan Chase Bank, N.A. (London Branch)	●	●	●	●	●
Lloyds Bank plc	●	●	●	●	●
Mizuho Bank, Ltd.		●	●	●	
MUFG Bank, Ltd	●	●	●	●	●
National Westminster Bank plc	●	●	●	●	●
Royal Bank of Canada	●	●			
Santander UK Plc		●	●		
Société Générale (London Branch)		●	●	●	●
Sumitomo Mitsui Banking Corporation Europe Limited	●				●
The Norinchukin Bank	●				●
UBS AG	●	●	●	●	●

* As of 3/6/2020; source: ICE.

Trimmed Mean Methodology

NUMBER OF CONTRIBUTORS	NUMBER OF TRIMMED VALUES (HIGHEST AND LOWEST)*	NUMBER OF CONTRIBUTOR RATES AVERAGED	TRIM PERCENTAGE
16	4	8	25%
15	4	7	27%
14	3	8	21%
13	3	7	23%
12	3	6	25%
11	3	5	27%

* For example, in the case of 16 contributors, the 4 highest and lowest values are dropped.   See ICE documentation for further details.

Other Common IBORs in Major Currencies

- Local
- Less Liquid
- Mainly available after end of LIBOR

Flag	Country/Region	Currency	IBOR Name	Will outlive LIBOR?
	Europe	Euro	Euribor (Europe IBOR)	YES
	Japan	Yen	TIBOR (Tokyo IBOR)	MAYBE
	India	Rupee	MIBOR (Mumbai IBOR)	YES
	Canada	Dollar	CDOR (Canadian Dollar IBOR)	YES
	Australia	Dollar	BBSW (Bank Bill Swap Rate)	YES
	New Zealand	Dollar	NZD LIBOR [not NZD BBA LIBOR]	YES

2. LIBOR in Practice

Includes: LIBOR is pervasive, but its positives and negatives must be understood

The Trillion Dollar LIBOR Market

EUR
> $152-182 tn

USD
> $150-160 tn

JPY
> $35 tn

GBP
> $30 tn

CHF
> $6.5 tn
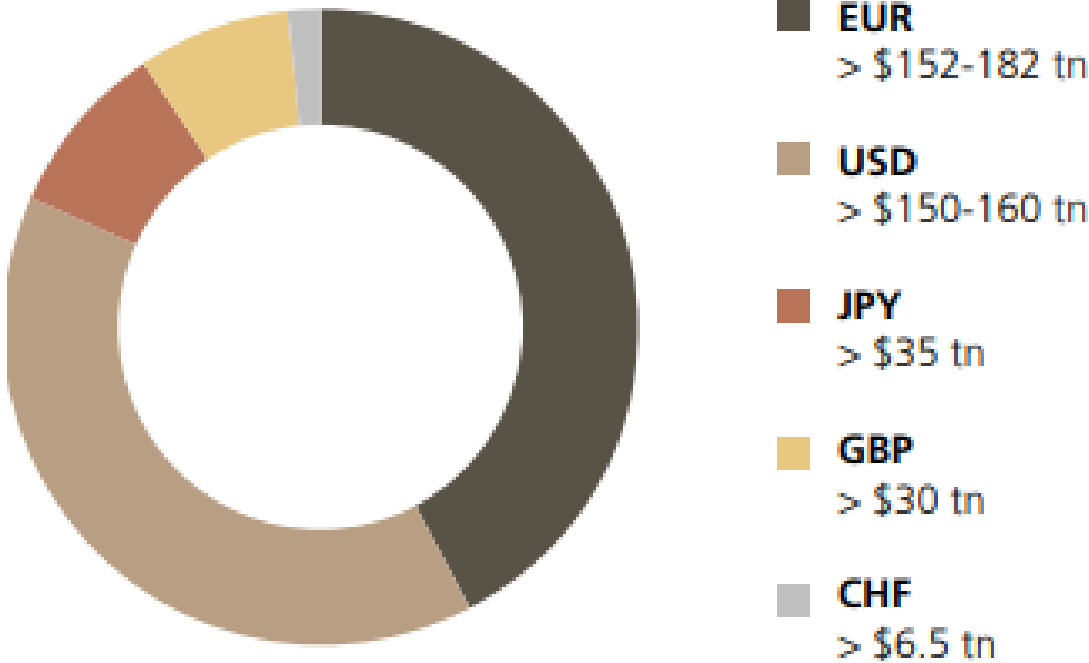
Ref: UBS.

Exposure to LIBOR By Product

	USD-LIBOR >$150–160 tn	GBP-LIBOR >$30 tn	EURIBOR >$150-180 tn	EURO-LIBOR >$2 tn	CHF-LIBOR >$6.5 tn	JPY-LIBOR >$30 tn	TIBOR >$5 tn
Syndicated loans	●●●	●●○	●●○	●●○	●●○	●●○	●●○
Business loans	●●●	●●○	●●●	●●○	●●○	●●○	●●○
Retail loans	●○○	●○○	●●○	●○○	●●○	●○○	●○○
Floating rate notes	●●●	●●○	●●●	●●○	●●○	●●○	●○○
Securitizations	●●●	●●○	●●○	●○○	●○○	●○○	●○○
OTC derivatives	●●●	●●●	●●●	●○○	●●●	●●●	●●○
Exchange-traded derivatives	●●●	●●●	●●●	●○○	●●○	●●○	●●○
Deposits	●○○	●○○	●○○	●○○	●○○	●○○	●○○

●○○ Low (< $100bn)
●●○ Medium ($100bn< x< $1tn)
●●● High (>$1 tn)

The investment banks have exposure to syndicated LIBOR loans, even if they do not perform traditional lending.

Ref: UBS.

Let's Distinguish Two Different LIBOR Uses

LIBOR coupons

Example:

Floating-rate note paying 3M USD LIBOR Actual/360

Adjustable-rate mortgage paying 1Y USD LIBOR + Spread with annual resets, monthly

LIBOR embedded options

Example:

Loan interest payments based on a formula like MAX(1%, 3M USD LIBOR) have a 1% LIBOR floor.

MIN(5%, 1M USD LIBOR) is a 5% cap.

Distinguishing Features of LIBOR

- Expert judgment:
  Good: Data from bank panel is used to forecast a
  rate, so floating-rate payer knows payment in advance of pay date.
  Bad: Can be manipulated (to be discussed). Not based on any actual transactions.

- Credit sensitive:
  Good: As an interbank rate, LIBOR prices in the credit risk between lending institutions, whose funding cost may be similar to the typical borrower.
  Bad: Can blow up if liquidity dries up.

- Unsecured:
  Good: Most loans are unsecured.
  Bad: Collateral has now become part of valuation.

The [R]Evolution of Discounting

- Consider a series of cash flows based on a floating-rate index, like a swap leg

- To price, need to
  - Calculate coupons (requires forward rates; "forecasting")
  - Get present value of payments (discounting)

- Discounting curve: applied to cashflows from an instrument

  $r[t]$ is the annual discounting rate => $1/(1 + r[1])$ discounts a one-year cashflow, $1/(1 + r[2])$ etc.

- Forecasting curve: used to compute coupons in a floating-rate instrument

  $s[t]$ is the forecasting rate, x is a spread, then the coupons are $s[1] + x$, $s[2] + x$ …

Discounting after the Financial Crisis

- Prior to the financial crisis, most US deals used USD LIBOR used for discount AND forecast

- Since the crisis, USD LIBOR still for forecast, but the overnight Effective Federal Funds Rate (EFFR*) for discounting, reflecting the requirement of a Credit Support Annex (CSA) to minimize counterparty risk

400 BP Spread!
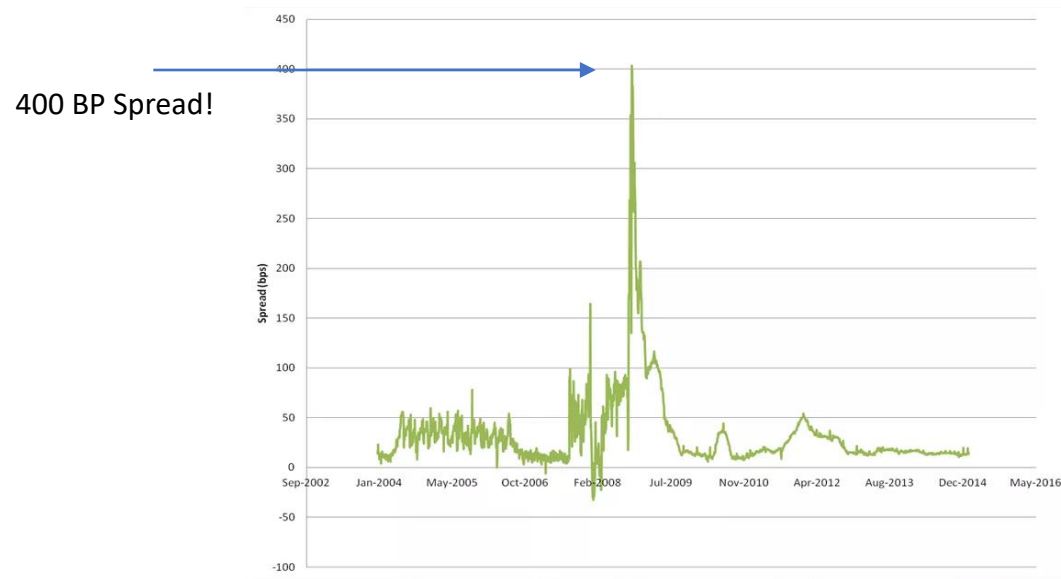
Historical LIBOR – EFFR Spread

*We use this notation, instead of the less precise "OIS," standing for Overnight Index Swaps.

Some Numbers

"Following the 2008 financial crisis, the failure of some banks signaled that ==interbank lending rates were not indeed risk-free==, as previously thought. Many derivative investments demonstrated significant counterparty risk because transactions were not subject to collateral or margin calls.

"Such counterparty risk famously led to the bankruptcy of investment banking giant <u>Lehman Brothers</u>. As the counterparty to 930,000 derivative transactions, representing approximately 5% of global derivative activity, the bank was unable to crawl out from under its crushing $619 billion debt, and ultimately shuttered its doors for good.

"Standard CSA agreements limit losses by mandating ==daily collateral calls== in order to prevent counterparties from closing out. Amid this backdrop, the natural choice for the risk-free discount rate is typically some type of <u>overnight rate</u>."

Summary so Far

- LIBOR is used widely as an interest rate
- It is used exclusively for forecasting now, and not for discounting
- It has pros and cons, including being manipulatable

- But why would someone want to manipulate it?   What would be gained?
- And how can we determine the impact of the manipulation?

3. The LIBOR Scandal

Includes: A lingering aspect of the Financial Crisis (No, the one in 2008-2009.)

LIBOR Understated by Some Panel Banks

- In 2008, reporting by the *Wall Street Journal* stated that some panel banks were submitting artificially low values of LIBOR

- The *Journal* concluded that the banks wanted to report lower-than-actual values of borrowing costs during the financial crisis

- A 2010 UCLA/Dartmouth study confirmed the understatement, but suggested the motivation was making profits on portfolios linked to LIBOR.

LIBOR Itself was Having Difficulties

In November 2008, the Governor of the Bank of England, Mervyn King*, told the UK Parliament that since the start of the financial crisis, "hardly anybody is willing to lend to any bank around the world for three months unsecured; they want to lend secured."

As a result, he said that Libor had become "in many ways the rate at which banks do not lend to each other, ...it is not a rate at which anyone is actually borrowing."

- Because of its issues, the UK Financial Conduct Authority is ending LIBOR as of December 31, 2021.

- The central banks of the five countries have begun developing alternatives to LIBOR.

- LIBOR is still in wide use today for forecasting, as discussed, but must be transitioned.

- I prefer to think of this as weaning a baby from the milk of the mother.

* Spoke at Gabelli on March 16th.

4. Development of Alternative Rates

Includes: overnight vs. tenor, securitized vs. not, compounding

Central Banks Introduce Alternative Rates

- All five of the LIBOR panel countries have proposed new rates

- Each is an actual market-based borrowing rate

- Each is an overnight rate

- Each is substantially less risky than LIBOR, i.e. not credit sensitive, with two of five rates secured

Currency	AR name	AR abbreviation	Issuer
CHF	Swiss Average Rate Overnight	SARON*	SIX Group (Swiss banking consortium)
EUR	Euro Short-term Rate	ESTR	European Central Bank
GBP	Sterling Over Night Index Average	SONIA	Bank of England
JPY	Tokyo Overnight Average Rate	TONAR or TONA	Bank of Japan
USD	Secured Overnight Finance Rate	SOFR*	Federal Reserve Bank of New York

* Secured rate.

SOFR Methodology (others are similar; see Appendix C)

- The Secured Overnight Financing Rate (SOFR) is a broad measure of the cost of borrowing cash overnight collateralized by Treasury securities. The SOFR includes all trades in the Broad General Collateral Rate plus bilateral Treasury repurchase agreement (repo) transactions cleared through the Delivery-versus-Payment (DVP) service offered by the Fixed Income Clearing Corporation (FICC), which is filtered to remove a portion of transactions considered "specials."

- The SOFR is calculated as a volume-weighted median of transaction-level tri-party repo data collected from the Bank of New York Mellon as well as GCF Repo transaction data and data on bilateral Treasury repo transactions cleared through FICC's DVP service, which are obtained from DTCC Solutions LLC, an affiliate of the Depository Trust & Clearing Corporation. Each business day, the New York Fed publishes the SOFR on the New York Fed website at approximately 8:00 a.m. ET.

Converting Overnight Rates to Tenor Rates

- To replace legacy LIBOR instruments or construct new ones, we need tenor rates.
- Different methodologies have been considered for tenor rates:
  - Arithmetic averaging vs. compounding
  - Backward looking vs. forward Looking ("term rates")
  - Compound in advance vs. compound in arrears
- The New York Fed (FRBNY) has chosen backward looking – compounding in arrears
- The Swiss SIX consortium is now publishing SARON tenor rates
- The Bank of England has recently proposed tenor methodologies

How SOFR Compounding Works

The FRBNY publishes 30 day, 90 day, 180 day term rates ("averages") compounded in arrears per

$$SOFR\ Average = \left[\prod_{i=1}^{d_b}\left(1 + \frac{SOFR_i \times n_i}{360}\right) - 1\right] \times \frac{360}{d_c}$$

Where:

- $SOFR_i$ = SOFR applicable on business day i

- n_i = number of calendar days for which $SOFR_i$ applies (often 1 day, or 3 days for typical weekend)

- d_c = the number of calendar days in the calculation period (that is, 30-, 90-, or 180- calendar days)

- d_b = the number of business days in the calculation period

- i denotes a series of ordinal numbers representing each business day in the calculation period

Other Maturities of SOFR

For other maturities, one can use specified start dates in the FRBNY's SOFR Index since inception (also published), which is derived similarly:

$$SOFR\ Index = \begin{cases} 1.00000000, & i = April\ 2, 2018 \\ \displaystyle\prod_{April\ 2, 2018}^{i} \left(1 + \frac{SOFR_i \times n_i}{360}\right), & i > April\ 2, 2018 \end{cases}$$

Where:

- $SOFR_i$ = SOFR applicable on business day i
- n_i = number of calendar days for which $SOFR_i$ applies
- i represents a series of ordinal numbers representing each business day in the calculation period

The SOFR Index will be published as a number rounded to the eighth decimal place.

Issues

- When legacy financial products with maturities beyond 2021 switch to ARs, what spread should be added to an AR to make the transition as well matched as possible to what LIBOR would be, e.g.

  Est. 3M LIBOR (> 12/31/2021) = 3M AR + Spread

- For SOFR, the spreads (called "fallbacks") are estimated at 5-20 BPs.

- The lack of credit sensitivity has been challenged by smaller banks (Assets ~ $50 – 200 Billion) who have different funding and may use Ameribor

5. Legacy LIBOR Products

Includes: Fallbacks

Using Fallbacks on Legacy Products

- At this writing, fallbacks have not been standardized for any of the new ARs.

- Consensus seems to be building (from ISDA, FRBNY, and the Bank of England) for a median computed from historical rates, perhaps 3-5 years

- For USD, SOFR has been published since April, 2018. But EFFR is similar, is much longer dated, and can be used as a proxy.

- A nontrivial matter is the observation period, given compounding in arrears.

Observation Period

- Recall that LIBOR is forward looking, but compounding in arrears is backward looking.

- The computation of a compounded AR cannot continue until the payment date, as noted earlier, or the payer won't know what to pay until that day.

- Instead, the compounding must be for a time interval such that the payer is notified honoring governmental laws – i.e., Federal, state and city laws in the US.

- As an extreme example, notice of the first reset in an ARM must be at least 210 days prior, and subsequent resets are at least 60 days prior.

6. New LIBOR-like Products

Includes: Exchange-traded and OTC instruments

Versatility

- Tenor versions of the ARs as usable as LIBOR.

- They can be used as discussed as a coupon or an embedded option.

- Issuance to date has been small (Billions vs. Trillions of LIBOR)

- Notably, the US Treasury has not yet issued any floating-rate notes linked to SOFR

Current Issuance

- The Federal Home Loan Banks have issued a number of SOFR instruments

- Fannie and Freddie have stipulated that USD LIBOR cannot be used in ARMs after 12/31/2020, a full year before the end of LIBOR

- Exchange-traded SOFR futures, including those analogous to standard three-month LIBOR Eurodollar futures are liquid

- Unfortunately, SOFR swaps are illiquid and different from LIBOR swaps.

- Thus, constructing a SOFR swap curve to long maturities (30 – 50 years) is not possible

SOFR Swaps – Looking Inside

Three SOFR swap instruments trading in small volumes are shown below.

1. This SOFR vs LIBOR basis swap will help in curve construction during the transition off LIBOR.

SOFR vs USD-LIBOR Basis Swap	
Currency	USD
Floating Index	USD-LIBOR-BBA vs USD-SOFR-COMPOUND
Compounding	Daily Compounding of the SOFR Leg
Floating Index Tenor	LIBOR = 1, 3 & 6 Month
Max Maturity	30 Years
Payment Lag	SOFR: 2D LIBOR: 0D or 2D

SOFR Swaps – Looking Inside, cont.

2. This SOFR vs EFFR basis swap will help in offset risk when discounting changes (see next section). It is used in SOFR curve construction also.

SOFR vs Fed Funds Basis Swap	
Currency	USD
Floating Index	USD-Federal Funds H.15-OIS - COMPOUND vs USD-SOFR-COMPOUND
Compounding	Daily Compounding of the SOFR and EFFR Legs
Floating Index Tenor	1 Day
Max Maturity	30 Years
Payment Offset	SOFR: 2D EFFR: 2D

SOFR Swaps – Looking Inside, cont.

3. And, finally, this is the SOFR float vs. fixed swap analogous to a vanilla LIBOR swap, with ==one exception==

OTC Cleared SOFR	
Forecasting and Discounting Curves	USD-SOFR Curve
Price Alignment Rate	USD-SOFR
Settlement Convention	T +1
Reset Calendar	US Gov Securities
Payment Calendar	USNY
Spreads Above and Below Index	Supported on all SOFR, LIBOR and EFFR Indices

7. Discounting with ARs

Includes: Dates, planned compensatory structures

Clearing Services and Exchange Discounting

- Well before the end of LIBOR, exchanges and central clearers will switch to discounting with ARs

- Sterling (GBP) is already discounted with SONIA, also CHF with SARON

- ESTR (AR for EUR LIBOR) discounting begins in June

- SOFR discounting begins in October

- It's expected that OTC instruments will also change

Impact Analysis of Discounting Change

Follow ISDA and Fed's conceptualization

- Compensation is needed for the switch

- Cash compensation – reflects the P&L difference when switching, exchange cash

- Risk compensation – reflects the basis risk, receive a basis swap (e.g., SOFR vs EFFR)

8. Building a SOFR Curve

Includes: the best that can be done now

Instruments

	Instrument
CASH	SOFR
Future	1m SOFR future (convexity correction per Mercurio 2018)
Future	3m SOFR future (convexity correction per Mercurio 2018)
Swap	EFFR versus SOFR Basis Swap
Swap	USD LIBOR versus SOFR Basis Swap

- As of today, without SOFR float/fixed swaps, we use the instruments above.

- The one-month SOFR future is an arithmetic (sometimes called "simple") average rather than the FRBNY's compounded tenors

- The three-month is very similar to the FRBNY

- Basis swaps were already described

9. Roadmap

Includes: activities and dates

Key Dates

Date	Affected Index	Action	Agent	Notes
March, 2020	TONA	Publication of "reference rates"	Bank of Japan	not to be used for actual transactions
June, 2020	ESTR	Change from EONIA to ESTR Discounting	European Central Bank	By preannouncement, constant shift at all maturities
July, 2020	SONIA	Publication of compounded SOFR	Bank of England	
September, 2020	SONIA	Cease issuance of cash products linked to GBP LIBOR	Bank of England	
October, 2020	SOFR	Change from EFFR to SOFR discounting	CME, LCH	
December, 2020	USD LIBOR	Fannie/Freddie cease issuing new USD LIBOR ARMs	Federal Housing Finance Agency	
June, 2021	SOFR	Cessation of swaps using EFFR for discounting/PAI	CCPs	
June, 2021	TONA	Publication of overnight rates	Bank of Japan	
December, 2021	SOFR	Publication of forward-looking term rates	FRBNY	
December, 2021	All LIBORs	Cease publication	Bank of England	Pro forma LIBOR may be published after cessation

References

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"ICE LIBOR":
https://www.theice.com/iba/libor

"Beyond LIBOR":
https://www.ubs.com/global/en/libor.html

Wikipedia: "Libor," "Libor scandal"

CME swap term sheets

SOFR futures convexity correction: Mercurio (2018) https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3225872

SONIA road map (March 2020): https://www.bankofengland.co.uk/-/media/boe/files/markets/benchmarks/rfr/path-for-discontinuation-of-new-sterling-libor-linked-lending-end-q3-2020.pdf?la=en&hash=E5B0DFBF3D410DF4FE9771F8B00141462104F16E

Comprehensive LIBOR discussion (March 2019, but still relevant:
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"Calculating term rates for AMERIBOR from AMERIBOR futures," J. Coleman, R. J. O'Brien.

Appendix A

The LIBOR transition from the perspective of child development

Growing Pains

Dimension	Child	Financial Institution	Examples
Infancy	Nursing	LIBOR	USD LIBOR, EUR LIBOR
Weaning	Baby Food	Alternative Rates (ARs; "Risk Free Rates") for new deals	Secured Overnight Financing Rate (SOFR), Euro Short-Term Rate (ESTR)
Toddler	Hand Food	Implement fallbacks for legacy deals	Median of five-year SOFR-LIBOR difference distrib.
Pre-School	Fork	Discounting/PAI changes	Migration from Effective Federal Funds Rate (EFFR; "OIS") to SOFR
Kindergarten	Fork and Knife	AR swap curve from liquid instruments	SOFR curve from SOFR futures and SOFR fixed/float swaps

Appendix B

Glossary of LIBOR terminology

LIBOR Transition Glossary

Abbreviation	Term	Meaning
AR	Alternative Rate	Overnight rates issued by central banks as alternatives to LIBOR
ARM	Adjustable-Rate Mortgage	
EFFR	Effective Federal Funds Rate	
ESTR	Euro Short-Term Rate	EUR AR; details in text
FRBNY	Federal Reserve Bank of New York	
ICE	Intercontinental Exchange	Futures and swaps exchange
ISDA	International Swaps and Derivatives Association	
LIBOR	London Interbank Offered Rate	See talk text
NYSE	New York Stock Exchange	
PAI	Price Alignment Interest	Calls out separate discounting and forecasting
SOFR	Secured Overnight Financing Rate	USD AR; details in text

Appendix C

Alternative Rate Methodologies (other than SOFR; see main text for that)

Euro Short-Term Rate (€STR) – EUR LIBOR, EURIBOR alternative recommended by Euro WG

Calculation and administration	■ Calculated for each business day as a volume-weighted trimmed mean rounded to the third decimal ■ Calculations will be based entirely on actual individual transactions in euro that are reported by banks in accordance with the ECB's money market statistical reporting (MMSR) ■ Based upon transactions between 52 banks, with volumes of ~30B EUR per day 　■ Excludes Money Market Fund (MMF) activity 　■ Includes deposits but excludes CP/CD transaction (therefore "some" MMF activity will be captured) ■ The rate will be available by 09:00 CET on each TARGET2 business day, based on actual individual transactions from the previous day
Characteristics	■ Reflects wholesale euro unsecured overnight borrowing costs of euro area banks – not as broad as SOFR in the transactions it captures ■ Meets requirements laid out in the EU Benchmarks Regulation (BMR), effective January 2018 and established in response to the LIBOR and EURIBOR scandals 　– EU Benchmarks Regulation Group created to bring stability, accuracy and integrity back to benchmarks 　– "Article 28(2) of the European Benchmarks Regulation requires users to plan for cessation of any benchmark and reflect such plan in their contracts."[1]

Swiss Average Rate Overnight (SARON) – CHF LIBOR alternative recommended by the National WG on CHF Reference Rates

Calculation and administration

- Overnight interest rate average referencing the Swiss Franc interbank repo market, launched by the Swiss National Bank (SNB) in cooperation with SIX Swiss Exchange
- Based on concluded transactions and trade quotes posted on the SIX Repo trading platform, provided they lie within the parameters of the quote filter (parameterized in a way that limits the possibilities for manipulation)
- Continually calculated in real time and published every ten minutes, with fixings conducted three times a day (at 12 pm, 4 pm and 6 pm) to serve as a reference reading for derivative financial products and the valuation of financial assets
- Has become the standard for interbank deposits, remuneration of collateral and discounting
- Under the surveillance of SIX Swiss Exchange and regulated under the Swiss Financial Market Act (FMIA)
  - Index Commission for the Swiss Reference Rates serves as an advisory and oversight panel
  - Compliant with the IOSCO[1] Principles for Financial Benchmarks

Characteristics

- Considerably lower volatility compared to reference rates based on the unsecured money market
- Risk-neutral benchmark particularly suitable for secured loans due to the negligible counterparty and liquidity risks
- Calculated on concluded transactions and binding quotes on a regulated trading platform
- Use of quote filter limits the possibilities for manipulation to an absolute minimum
- Historical data does not require a license and is publicly available; current data can be obtained via all standard data vendors or directly from SIX Swiss Exchange

Tokyo Overnight Average Rate (TONAR) – JPY LIBOR, TIBOR, Euroyen TIBOR alternative recommended by Study Group on RFRs

Calculation and administration	• Transaction-based benchmark for the uncollateralized overnight call rate using information provided by money market brokers, calculated and published by the Bank of Japan (BOJ)
	
	• Methodology:
	   – The volume-weighted average call rate is the average call rate weighted by the volume of the transactions corresponding to each rate
	   – The rate is calculated by dividing the sum of the product of each transaction volume and the corresponding rate by the sum of the overall transaction volumes, based on data submitted by information providers (Ueda Yagi Tanshi Co., Ltd.; Central Tanshi Co., Ltd.; The Tokyo Tanshi Co., Ltd)
	   – The maximum (minimum) rate is the highest (lowest) rate of the maximum (minimum) rates submitted by the information providers
	
	• A provisional result is published on the evening (at 17:15 JST, except on the last business day of the month when it is 18:15 JST) of the period start; the final result is published in the morning (10:00 JST) of the end date

Characteristics	• Unsecured overnight rate with considerable transaction volume and a diversity of trading participants
	
	• Currently used:
	   – As a reference rate for OIS
	   – In calculating interest payments on JPY cash collateral in a Credit Support Annex (CSA) for derivatives transactions
	   – By the Japan Securities Clearing Corporation (the central clearing organization for JPY IRS) calculation of interest payments on variation margin

Reformed Sterling Overnight Index Average (SONIA) – GBP LIBOR alternative recommended by Sterling WG

Calculation and administration

- Widely used interest rate benchmark and the reference rate for sterling Overnight Indexed Swaps (OIS)
- Defined as the measure of the rate at which interest is paid on sterling short-term wholesale funds in circumstances where credit, liquidity and other risks are minimal
- Measured as the trimmed mean of interest rates paid on eligible sterling denominated deposit transactions (unsecured transactions of one business day maturity greater than or equal to 25MM GBP reported to the Bank's Sterling Money Market daily data collections)
- Published daily at 9 am ET based on the prior day's trading activity
- Extensive oversight, including governance arrangements in line with international regulatory best practice for benchmark administration:

The Bank as Administrator of SONIA
Deputy governor of Markets and Banking is responsible under Senior Manager's Regime

Fed Transactions (ON RRP)	Second line of defence	Third line of defence
Day-to-day activities undertaken across Markets and Statistics, with appropriate segregation of duties	A central Bank-wide risk function and a compliance division provide independent forward-looking assessment and challenge of risks across operations and business areas	Internal and External Auditors independently and objectively evaluate internal controls, risk management and governance processes

Characteristics

- Viable even with lower transactional volumes should there be any material structural changes
- Conceptually straightforward and relatively stable underlying market
- Overnight, unsecured and nearly risk-free reference rate that has a high correlation with the Bank rate
- Already used as a reference rate for sterling OIS, enables faster progress towards adoption

Appendix D

AMERIBOR

AMERIBOR is timely

2/26/20: "In a letter addressed last week to regulators, 10 banks spoke out in favor of an alternative reference rate called the American Interbank Offered Rate (Ameribor), saying that the Federal Reserve's preferred Secured Overnight Financing Rate causes <mark>an asset-liability mismatch</mark> in their part of the banking sector."

"The banks argued that SOFR is a good alternative for large investment banks that hold many secured government Treasury notes. But <mark>mid-sized regionals mostly hold unsecured assets</mark>, and linking bonds and loans to the secured transactions that SOFR tracks as a benchmark is not reflective of their business."

Profiling the AMERIBOR banks

Bank Name	US Rank (assets)	HQ location	Assets ($ Bn)	Market cap ($ Bn)
Arvest Bank	90	Bentonville, AR	19	N/A (private)
Associated Banc	60	Green Bay	33	4
Brookline Bancorp	238	Boston	5	1
Flagstar Bancorp	87	Troy, MI	19	2
First Merchants	126	Muncie	12	1.7
Cullen/Frost Bankers	N/A	San Antonio	N/A	3.6
Old National Bancorp	85	Evansville, IN	20	3
PacWest Bancorp	72	Los Angeles	26	5
ServisFirst Bancshares	154	Birmingham, AL	9	1.5
Signature Bank	43	New York	50	5.6
JP Morgan*	1	New York	2,737	327
Regions Financial*	30	Birmingham, AL	129	20

*To use LIBOR.

Definition of AMERIBOR

Based on overnight, unsecured loans on the American Financial Exchange (AFX), hosted by CBOE.

"…calculated as the transaction volume weighted average interest rate of the daily transactions in the AMERIBOR® overnight unsecured loan market on the AFX. AMERIBOR® is an interest rate expressed on an Actual/360 Day Count and Following Business Day convention that is rounded to the fifth decimal place. AMERIBOR® is calculated after the close of trading on the AFX and is published nightly by CBOE under ticker symbol AMBOR. AMERIBOR® is compliant with IOSCO benchmark standards."

Exchange traded AMERIBOR instruments

- 3 Month futures
- 7 Day futures

Data on 3/11/2020:

| Symbol	Expiration	Last	Change	High	Low	Settlement	Volume
AMB3Z19	03/18/2020	9847.50	0.00	9847.50	9847.50	9847.1250	50
AMB3H20	06/17/2020	9971.00	5.75	9971.00	9971.00	9960.7500	25
AMB3M20	09/16/2020	9963.50	0.00	0.00	0.00	9975.2490	0
AMB3U20	12/16/2020	9977.00	0.00	0.00	0.00	9973.7500	0
AMB3Z20	03/17/2021	0.00	0.00	0.00	0.00	9973.5000	0

(DELAYED 10 MINUT[...]

Symbol	Expiration	Last	Change	High	Low	Settlement	Volume
AMW2H20	03/12/2020	9889.00	0.00	0.00	0.00	9889.0000	0
AMW3H20	03/19/2020	9908.00	12.00	9908.00	9908.00	9893.5000	25
AMW4H20	03/26/2020	9963.25	10.75	9963.25	9963.25	9951.5000	10
AMW1J20	04/02/2020	9953.25	0.00	0.00	0.00	9951.5000	0
AMW2J20	04/09/2020	0.00	0.00	0.00	0.00	9951.5000	0
AMW3J20	04/16/2020	0.00	0.00	0.00	0.00	9951.5000	0

Compare to SOFR futures

Globex	Product Name	Exchange	Subgroup	Volume	Open Interest
SR1	One-Month SOFR Futures	CME	Stirs	18,089	347,108
SR3	Three-Month SOFR Futures	CME	Stirs	12,664	235,312

Trade Date: 10 Mar 2020 | FINAL

← 500 – 1,000 times more liquid

CME SOFR Futures
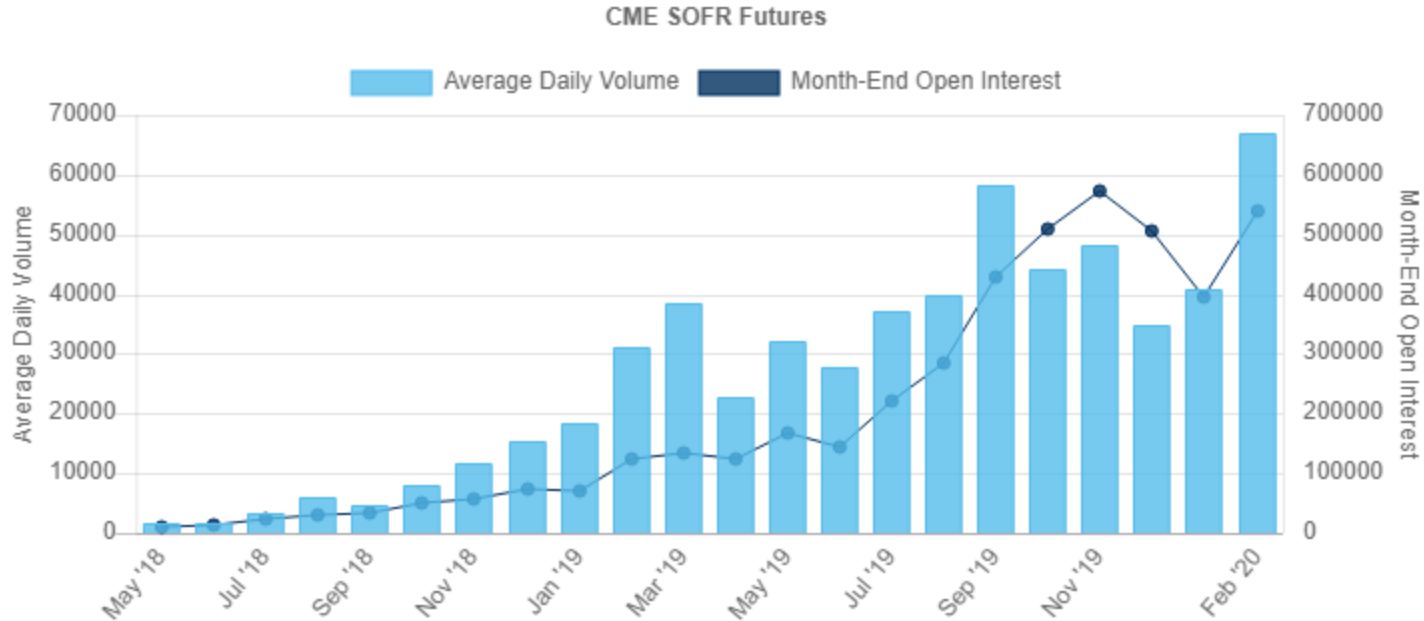
AMERIBOR Term Rates

- AFX has not addressed the issues of compounding (backward looking) or term rates (forward looking)

- One author has suggested using the futures directly to get 7D and 3M term rates

- Banks wishing to adopt AMERIBOR would need an alternate means to calculate other tenors

- 1M futures will begin trading on the CBOE on March 29th, 2020