Transition from LIBOR to SOFR
Definition: An average interest rate that a bank would be charged by other banks for unsecured funding over a specified term

Current USD LIBOR Submitting Panel: 16 Banks submit daily (trim the 4 highest/lowest submissions)
- 4 U.K. Banks
- 4 European Banks
- 3 Japanese Banks
- 3 U.S. Banks
- 1 Swiss Bank
- 1 Canadian Bank

<table>
<thead>
<tr>
<th>Over-the-Counter Derivatives</th>
<th>Volume (Trillions USD)</th>
<th>% Maturing by end of 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate swaps</td>
<td>81</td>
<td>66%</td>
</tr>
<tr>
<td>Forward rate agreements</td>
<td>34</td>
<td>100%</td>
</tr>
<tr>
<td>Interest rate options</td>
<td>12</td>
<td>65%</td>
</tr>
<tr>
<td>Cross currency swaps</td>
<td>18</td>
<td>88%</td>
</tr>
<tr>
<td>Exchange Traded Derivatives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest rate options</td>
<td>34</td>
<td>99%</td>
</tr>
<tr>
<td>Interest rate future</td>
<td>11</td>
<td>99%</td>
</tr>
<tr>
<td>Business Loans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syndicated loans</td>
<td>1.5</td>
<td>83%</td>
</tr>
<tr>
<td>Nonsyndicated business loans</td>
<td>0.8</td>
<td>86%</td>
</tr>
<tr>
<td>Nonsyndicated CRE/Commercial mortgages</td>
<td>1.1</td>
<td>83%</td>
</tr>
<tr>
<td>Consumer Loans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail mortgages</td>
<td>1.2</td>
<td>57%</td>
</tr>
<tr>
<td>Other Consumer loans</td>
<td>0.1</td>
<td>-</td>
</tr>
<tr>
<td>Bonds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floating/Variable rate notes</td>
<td>1.8</td>
<td>84%</td>
</tr>
<tr>
<td>Securitizations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortgage-backed securities (incl. CMOs)</td>
<td>1</td>
<td>57%</td>
</tr>
<tr>
<td>Collateralized loan obligations</td>
<td>0.4</td>
<td>26%</td>
</tr>
<tr>
<td>Asset-backed securities</td>
<td>0.2</td>
<td>55%</td>
</tr>
<tr>
<td>Collateralized debt obligations</td>
<td>0.2</td>
<td>48%</td>
</tr>
<tr>
<td>Total USD LIBOR Exposure</td>
<td>199</td>
<td>82%</td>
</tr>
</tbody>
</table>

Transition away from LIBOR

2012 - Present: Bank settle/ fined multiple billion for LIBOR manipulation
Individuals arrested convicted for LIBOR manipulation

Apr: U.S. Fed learns of problems with LIBOR
May: U.K. Regulators made aware of problems
Dec: Trade group responsible for LIBOR changes setting process

2008

Apr: Fed begins publishing SOFR

2012

Dec: Fed Reserve convened AARC (Alternative Reference Rate Committee), tasked to find new rate

May: U.K. Regulators made aware of problems

2014

June: ARRC selects SOFR as LIBOR replacement

2017

Apr: Fed begins publishing SOFR

July: FCA chief Andrew Bailey, announces FCA will not force banks to make LIBOR submissions beyond 2021

2018

July: FNMA issues first SOFR FRN

Apr: AARC endorses waterfall and fallback language on cash products

2019

May: CME launched SOFR Futures

End 2021: Create/publish term SOFR

End 2021: Potential end to SOFR: FCA No longer compels Banks to Submit

2020

2nd half: LCH to move PAI discounting to SOFR

2021

END 2021:
Potential end to SOFR: FCA No longer compels Banks to Submit
What is SOFR

SOFR: Secured Overnight Financing Rate

What is it: Broad measure of the cost of borrowing cash overnight collateralized by Treasury securities

What is included:
- Tri-party Repo collected from BNYM
- General Collateral Repo transactions obtained from DTCC (excluding specials)
- General Collateral Repo transactions cleared through FICC (excluding specials)

How is it calculated: Volume-weighted median

Published: 8:00am EST by New York Fed

Source: Bloomberg, New York Federal Reserve
## Comparison of LIBOR to SOFR

<table>
<thead>
<tr>
<th>SOFR</th>
<th>LIBOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk free rate</td>
<td>Bank lending rate (credit risk)</td>
</tr>
<tr>
<td>O/N Rate (backward-looking)</td>
<td>Lending rage (forward-looking)</td>
</tr>
<tr>
<td>Secured (collateralized by Treasuries)</td>
<td>Unsecured</td>
</tr>
<tr>
<td>Calculated by NY Federal Reserve</td>
<td>Calculated by ICE Benchmark Administration</td>
</tr>
<tr>
<td>Transaction Based</td>
<td>Waterfall for calculation (often expert judgement)</td>
</tr>
<tr>
<td>~$1 Trillion in daily transactions</td>
<td>~$1 Billion in daily transactions</td>
</tr>
<tr>
<td>No term structure</td>
<td>Term Structure</td>
</tr>
</tbody>
</table>
Current SOFR Market: Cash Market

Total issuance through August has been ~$225bn
- US agencies have been ~80%

The majority of issuance is 2-year and less
- Demand has primarily been from U.S. money market funds

What the market needs: Increased issuance from non-financial corporates

Source: Bloomberg
Current SOFR Market: Derivatives

SOFR Futures Open Interest (OI) and Volumes have increased
- They still significantly lag both Eurodollar and Fed Fund Futures
  - 12% -> First year SOFR futures OI vs. ED
  - 7.7% -> First year SOFR futures OI vs. Fed Funds
- 6.3% -> First year SOFR futures daily volume vs. ED
- 3.8% -> First year SOFR futures daily volume vs. Fed Funds

Source: Bloomberg
Problems with SOFR Market: No consistence across issuers

SOFR is a backward-looking overnight rate compared to LIBOR which is a forward-looking term-rate

- This has led to no consistence amongst issuers

Lockout: A specified period of time before the coupon payment to which interest rates are held constant to determine interest payment

Lookback (reset): Coupon payment is determined by the observed values beginning and ending “X” days prior to interest accrual period

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Federal Home Loan Bank</th>
<th>Bank of America</th>
<th>Credit Suisse</th>
<th>European Investment Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue</td>
<td>FHLB 8/21/20 (3130AGXB6)</td>
<td>BAC 6/21/21 (06050TMM1)</td>
<td>CS 7/20/20 (22549LTM7)</td>
<td>EIB 6/10/22 (29878TDE1)</td>
</tr>
<tr>
<td>Coupon Calculation</td>
<td>Simple Average</td>
<td>Daily Compounding</td>
<td>Simple Average</td>
<td>Daily Compounding</td>
</tr>
<tr>
<td>Payment Date</td>
<td>On Interest period end date</td>
<td>2 business days following the interest period end date</td>
<td>On Interest Period End Date</td>
<td>On Interest Period End Date</td>
</tr>
<tr>
<td>Lookback</td>
<td>1</td>
<td>none</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Lockout</td>
<td>2</td>
<td>none</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Problem with SOFR Market: Calculation methods matter, especially in a low interest rate world

**Lockout:** Returns are different depending on timing of lockout period
- Best case for investor: Lockout period begins on last day of month
  - Takes advantage of elevated SOFR for ME / QE / YE spikes
- Worse case for investor: Lockout period is over last day of month
  - Do not receive elevated SOFR for ME / QE / YE spikes

**Compound vs Simple Average:** Can have meaningful differences because compound method discounts outlier rates
- Rising rate environment: simple average is typically better for investors
- Decreasing rate environment: simple average is typically worse for investors

**Difference in Return b/w 4-day and no lockout for 1yr Maturity**

**Rolling 3-month of Average SOFR less Compounded SOFR**

Source: BMO
Problem with SOFR Market: Volatility around month-ends

SOFR is volatile around month-end dates due to constrained dealer balance sheets

Possible Solution: Standing Fed Repo Facility -> this was mentioned in Fed Minutes from June’s meeting

Source: Bloomberg
New SOFR issuance on horizon: Treasury

Treasury has tasked TBAC at the last two refunding announcements to explore floating rate issuance with SOFR as the benchmark.

Based on this, Treasury is likely to issue a 1-year SOFR Floating Rate Note:
- Interest: Daily Compounding
- Lockout: 2-days
- Lookback: 1-days

Consideration for Treasury:
- Demand: Does it cannibalize existing issuance?
- Cost: Is it more expensive to issue vis-à-vis current T-bill benchmarked Floating Rate Notes?

Source: Bloomberg

From TBAC presentation, July 31, 2019
LIBOR: What happens to existing and new debt maturing after 2021 (Derivatives)

ISDA announced on July 30th its expected fallback language with some unknowns.

Create a static spread using mean/median difference between LIBOR and compounded SOFR over “X” lookback period.

Transition Period of “X” time where the SOFR plus spread is equal to a linear interpolation between (1) spread observed in SOFR/LIBOR basis market and (2) static spread calculated from lookback period.

Source: MBO, ISDA
LIBOR: What happens to existing and new debt maturing after 2021 (Derivatives)

VALUATION

There will be winners and losers no matter what the final approach is

Using Mean vs. Median is worth 1-3bps
- Mean includes outliers and the distribution is asymmetric

Lookback period is worth 1-5bps

Source: Bloomberg
LIBOR: What happens to existing and new debt maturing after 2021 (Cash Securities)

**Existing Debt**
Review fallback language on all securities
- For many Floaters if LIBOR ceases to exist, the bond converts to a fixed rate security (last LIBOR setting is used for the coupon of the bond for the rest of the term)
- For other Floaters that convert to a new benchmark, perform sensitivity analysis to understand the cost/value of this conversion

**New Debt**
ARRC has provided both Fallback Triggers and Waterfall replacement benchmarks for different floating rate instruments
- Ensure that all new issuance that is bought follows this methodology

**Fallback Triggers**
- Public statement by administrator that it has ceased to provide LIBOR
- Public statement by regulatory supervisor that administrator will cease to provide LIBOR
- Public statement by regulatory supervisor that the benchmark is no longer representative

**Waterfall of fallback rates for LIBOR FRNs (non-securitized, non-syndicated loans)**
- Term SOFR recommended by relevant government body + Spread
- Compound SOFR + Spread
- Replacement rate recommended by relevant government body + Spread (address if SOFR has been discontinued)
- Replacement rate in ISDA definition + Spread (address if SOFR has been discontinued and government body has not selected rate)
- Replacement rate determined by issuer or its designee
Appendix

Chart
Performance results for certain charts and graphs may be limited by date ranges specified on those charts and graphs; different time periods may produce different results. Charts are provided for illustrative purposes and are not indicative of the past or future performance of any PIMCO product.

Investment strategy
There is no guarantee that these investment strategies will work under all market conditions or are suitable for all investors and each investor should evaluate their ability to invest long-term, especially during periods of downturn in the market. No representation is being made that any account, product, or strategy will or is likely to achieve profits, losses, or results similar to those shown.

Index
It is not possible to invest directly in an unmanaged index.

Outlook
Statements concerning financial market trends or portfolio strategies are based on current market conditions, which will fluctuate. Outlook and strategies are subject to change without notice.

This material contains the current opinions of the manager and such opinions are subject to change without notice. This material has been distributed for informational purposes only and should not be considered as investment advice or a recommendation of any particular security, strategy or investment product. Statements concerning financial market trends are based on current market conditions, which will fluctuate. Information contained herein has been obtained from sources believed to be reliable, but not guaranteed.

PIMCO provides services only to qualified institutions and investors. This is not an offer to any person in any jurisdiction where unlawful or unauthorized. | Pacific Investment Management Company LLC. 650 Newport Center Drive, Newport Beach, CA 92660 is regulated by the United States Securities and Exchange Commission. | PIMCO Latin America Av. Brigadeiro Faria Lima 3477, Torre A, 5° andar São Paulo, Brazil 04538-133| No part of this material may be reproduced in any form, or referred to in any other publication, without express written permission. PIMCO is a trademark of Allianz Asset Management of America L.F. in the United States and throughout the world. ©2019, PIMCO.

CMR2019-0903413077